Field-Based Technology Education: Teaching Teachers

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Abstract - This paper will outline the current status of technology integration in schools from the perspective of researchers and policy makers. The focus of the paper will then turn to how teacher education programs in the U.S. have been preparing future teachers to use technology. In order to illustrate the complex issues that must be addressed when preparing teachers to use technology, this paper will report on and summarize the past seven years of an intensive field-based course given at American University in Washington, DC. This course has provided students with an opportunity to experience technology within a real-life school setting while providing local teachers with knowledge and practical skills on integrating technology into their classrooms.

Index Terms - Educational policy, national standards, teacher education, technology integration.

INTRODUCTION

Frustration, confusion, barriers, challenges - all of these words seem to describe the process that teachers go through when integrating technology into teaching and learning. The challenge facing the country right now is to change those words that describe this process into excitement, illumination, gateways and hope. Why has putting computers in classrooms not led to their overwhelming use? Why have teachers not embraced technology as the proponents for school reform through technology assumed they would? Teachers are in the trenches of integrating technology into education. They have to deal with networks and hardware that do not always work; software that may not fit into the lesson that they are trying to teach; the anxiety of working with students who usually know more than they do; pressure from parents who want their kids to be doing more with technology; and pressure from school administrators who want to prove that their school is on the cutting edge. If technology is going to be successfully integrated into schools, teachers can no longer be peripheral to the process.

TECHNOLOGY INTEGRATION IN SCHOOLS: WHERE ARE WE NOW?

As we push forward into the 21st century, the United States is at a turning point in technology integration in schools. Now that more than 99 percent of all public schools have computers and are wired to the Internet, the focus of research is to evaluate how the billions of dollars spent on hardware, networking, software and professional development have paid off for the students, teachers and, indeed, the larger society [1]. According to the U.S. Department of Education, only 20% of the 2.5 million public school teachers feel comfortable using technology in the classroom [2].

Changes in 2002 to the Elementary and Secondary Education Act, known as No Child Left Behind Act (NCLB) ended the trend in spending by the federal government for educational technology equipment. The NCLB Act eliminated most of the individual programs that had begun during the Clinton administrations and consolidated them into two areas, both of which are allocated through state block grants. Clinton’s Technology Literacy Challenge Fund and the Technology Innovation Challenge Grants were combined to form the new NCLB sponsored program Enhancing Education through Technology which focuses on teacher education. Previous programs such as Community Technology Centers, 21st Century Community Learning Centers and the Preparing Tomorrow's Teachers to Use Technology Program remained in 2002, but with reduced funding [3]. The second NCLB sponsored program, Improving Teacher Quality State Grants, is not specifically for educational technology, but grant proposals with an educational technology focus will be considered under this area [4].

The NCLB act significantly reduces the amount of money in the federal budget specifically dedicated to educational technology – from $870 million FY2001 to $700 million in FY2002. Although the Community Technology Centers and the Preparing Tomorrow's Teachers to Use Technology Program were salvaged by the Senate for FY2002, these programs are recommended for elimination in FY2003. The Bush administration defended the program cuts by making the case that students were not performing better as a result of the previously funded programs and that funding needed to provide to teachers for technology training within the context of Title 2 professional development

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support [5].  Considering, this reorganization of federal technology funds, education reformers will be monitoring the success of this NCLB technology programs over the next few years.

Christopher Dede, the Timothy E. Wirth Professor in Learning Technologies at Harvard University, is also skeptical of what wiring classrooms have actually accomplished. In his article, *Rethinking How to Invest in Technology*, Dede [6] writes that “unless other simultaneous innovations occur in pedagogy, curriculum, assessment, and school organization, the time and effort expended on instructional technology produce few improvements in educational outcomes” (p. 185). At the North Central Regional Educational Laboratory’s National Educational Technology Conference in June 2002, Dede explains in his keynote speech that when schools start to implement these innovations, technology will be an integral part of this “next generation” of educational practices [7]. Technology will only help to increase student achievement when more complex, interactive and virtual media is used combined with face-to-face teaching in collaborative learning environments. Schools must strive for this “next generation” before they will see the return on their technological investment.

The promise of technology has been questioned now that school systems are faced with the reality of having to integrate these machines into day-to-day classroom activities. The nation’s schools have powerful tools at their fingertips but to use them effectively takes leadership, planning, time, skilled teachers, technical support, innovation and, of course, money. The focus is now shifting from hardware and wires to curriculum integration and pedagogical practices. With this shift in focus, teachers are moving into the spotlight of the technology educational reform movement.

**TEACHERS: AN INTEGRAL PART OF THE TECHNOLOGY TEAM**

Recent research shows that teachers play a key role in ensuring that technology is used effectively in the classroom. *The Sustainability Challenge* report offers 10 critical next steps that must be taken by policy makers and school systems to ensure that the money spent in the past decade to develop the technology infrastructure of our nation’s schools does not go to waste. The first action item on this top-ten list is “accelerate teacher professional development” [8]. In Chapter four of the same report, the authors point to the Year 2000 Research Report on the Effectiveness of Technology in Schools as evidence that professional development for teachers is vital. This research report, which “examined over 300 studies of technology uses, found teacher training to be the most significant factor influencing the effective use of edtech to improve student achievement” (p. 35).

Unfortunately, research also shows that teachers have been slow to use the technology that is available to them and make it a part of their everyday classroom activities. In a national survey on information technology in teacher education released by The Milken Exchange and the International Society for Technology in Education (ISTE) in 1999, researchers found that although the technology infrastructure has increased in schools and universities, few teachers are integrating technology directly into their teacher methods [9]. A national survey released in 2000 by the National Center for Educational Statistics (NCES) revealed that 53 percent of public school teachers indicated that they used computers or the Internet for instruction during class time. Computers were most often used for such activities as word processing/spreadsheets, Internet research, practice drills and solving problems and analyzing data [10].

However, in a regional study of Silicon Valley schools, which is outlined in Larry Cuban’s *Oversold and Underused* [11], it is reported that “less than 10 percent of teachers who used computers in their classrooms were serious users (defined as using computers in class at least once a week) and between 20 and 30 percent were occasional to rare users (once a month)” (p. 188).

Despite this somewhat bleak picture of how teachers are using technology, most schools are attempting to prepare teachers to use technology through professional development opportunities. Teachers are also seeking learning opportunities for themselves in order to build their technical skills and their ability to use the technology within the curriculum. The NCES study indicated that 93 percent of teachers are prepared to use technology because of independent learning. Professional development activities (88 percent) and colleagues (87 percent) were cited as also being very helpful in preparing teachers [12].

Beyond these professional development activities for in-service teachers, teachers also receive technology preparation as pre-service teachers. More than half of the teachers in the NCES study cited college and graduate work as helping to prepare them to use technology (51 percent). Moreover, college and graduate work was frequently cited as a preparation method among teachers who were just starting their careers. Eight-four percent of teachers with three or fewer years of teaching experience reported that college and graduate work prepared them to use these technologies [13].

Teacher education programs play an increasingly important role in preparing teachers to use technology. In 1997 when NCATE released its report embracing technology, the organization challenged teacher education programs to do more than introduce pre-service teachers to technology in a computer literacy course. NCATE called for teacher educators to use technology in their own classrooms and for their own research as a way of modeling best practices for their students. Today, a commitment to technology is clearly seen throughout all six of NCATE’s standards for accreditation. The organization’s vision for the professional teacher for the 21st century asks that accredited programs “prepare candidates who can integrate technology into instruction to enhance student learning” [14, p. 3]. In an interview with Arthur Wise, president of the National Council for Accreditation of Teacher Education (NCATE) conducted by the George Lucas Educational Foundation, Wise explains that teachers must be able to integrate
technology effectively into instruction; that university professors model effective uses of technology in their instruction; and that colleges and universities must have an adequate infrastructure to support the technology needs of its teachers and students [15].

NCATE also recommended in its 1997 report that teacher education programs take into account the National Educational Technology Standards for Teachers or NETS•T. These standards, developed by the International Society for Technology in Education, define the fundamental concepts, knowledge, skills, and attitudes for applying technology in educational settings. Teacher education programs are encouraged to follow these standards, which are broken down into six categories and have 23 related performance indicators, to ensure that the teacher being educated will be able to help their students meet the National Educational Technology Standards for Students - NETS•S [16].

In 2003, NCATE reports that 36 states have adopted their standards and NCATE has influenced the teacher preparation programs of 48 states, Washington, DC and Puerto Rico [17]. In addition, 43 states have adopted the NETS or aligned their technology standards to mirror NETS [18]. With these standards providing a solid foundation for teacher education programs, how and how well are teachers being prepared to use technology?

TEACHER EDUCATION PROGRAMS: PREPARING TEACHERS TO USE TECHNOLOGY

There are several methods for how teacher education programs prepare pre-service teachers to use technology. One common way is by providing one or two computer literacy courses that introduce students to some of the technology available for use in the classroom [19]. However, these courses often do not give students enough practice to feel confident with the technology or enough instruction on how to integrate it into their classes [20]. These types of stand-alone courses give students the impression that they too can simply “add-on” technology when they are teaching and not use it throughout their lessons.

Another approach to technology preparation for pre-service teachers is to infuse technology into each course in the teacher education program. This approach is more desirable because students will have more opportunities to practice a variety of technologies in a more realistic context then in a stand-alone course. Furthermore, pre-service teachers will see, first-hand, how to integrate technology into the classroom as their instructors will be modeling those methods for them [21]. However, faculty members in schools of education are often not prepared themselves to teach using technology. Unless faculty members have received appropriate instruction on integrating technology into a course, then an infusion approach will not be successful [22].

Teacher education programs also provide students with technology instruction through field-based experiences. Pre-service teachers are paired with in-service teachers who are already using technology in their classrooms. These experiences are often most meaningful to pre-service teachers because they are able to see first-hand realistic examples of how technology is used in the classroom [23]. In addition students are able to see some of the other potential technical challenges and issues surrounding technology. The Sustainability Challenge report explains that “teachers develop technology skills most effectively through lessons that enable them to integrate technology into a piece of their own curriculum - a piece of work in which they feel invested” [24, p. 36]. Field-based experiences give pre-service teachers opportunities to develop their own authentic lessons using technology and test them in a classroom. At the same time in-service teachers have the opportunity to develop new lessons with an active partner for support and assistance.

The best teacher education programs, however, combine two or three of the methods of technology instruction to educate their pre-service teachers. The International Society for Technology in Education honors teacher education programs that set the mark for exemplary approaches to technology integration with the Distinguished Achievement Award. The University of Texas won the award in 2002 for its UTeach program, which was established to recruit and prepare the “next generation of math and science teachers for the state of Texas” [25].

The UTeach program integrates technology based tools throughout its course work and provides students with field-based experiences. Students are expected to use online assessment tools, e-mail, discussion boards, spreadsheets, statistical software and learn to create a web page and a class CD. Through print and video based portfolio assessment, students demonstrate technology competencies. As part of the assessment, students are observed teaching technology based lessons. In addition, students are paired with an Austin school teacher who mentors them about teaching, in general, and provides training in technology. Together, the pre-service and in-service teachers design technology based lessons that are used in the mentor’s classroom. The technology training for the mentor teachers is supported through a Preparing Tomorrow’s Teachers to Use Technology grant (PT3) [26].

The Technology-Based Teacher Education Program at Lehigh University is a BA/MEd program that offers a technology literacy course combined with a technology-rich field-based experience. The first seminar course in elementary and secondary education that students are required to take reserves the last hour for “Tech Talk.” Students discuss and practice using technologies such as e-mail, word processing, databases and digital cameras. Students must demonstrate competency in these tools before the end of the course [27].

For the field-based component of this program, Lehigh has a relationship with the Moravian Academy, a K-12 independent school. Through this partnership pre-service teachers are able to work in a technology-rich environment.
with teachers who have experience with using technology in education. The in-service teachers benefit from being able to collaborate with the pre-service teachers on new technology-based projects that will add to their curriculum. The pre-service teachers are required to keep a web-based journal of their experiences, specifically how they are using technology. In-service teachers provide feedback to the pre-service teachers on the final project – a technology infused lesson - at the end of the semester. The pre-service teachers must also present their final projects to the entire class as a way of sharing ideas and innovations [28].

The Learning and Integrating New Knowledge and Skills (LINKS) program at the Texas Women’s University (TWC) is another positive example of how technology can be integrated into a teacher education program. The implementation of the LINKS program completely redesigned the teacher education program at TWU to ensure that it meets NCATE’s standards for technology proficiencies. The program is also a PT3 grant [29].

PT3 programs like LINKS provide some of the best examples, nationwide, of how teacher education programs can prepare teachers to use technology throughout teaching and learning. "I've seen more changes in colleges of teacher education since the initiation of this program than I've ever seen before," said Lajeane Thomas, director of ISTE's National Educational Technology Standards project. "It's important that we continue the wonderful progress that has been made" [30, para. 14]. PT3 grantee universities create strong partnerships among pre-service teachers, faculty and teachers in public schools. All groups benefit from learning from one another. In addition, the PT3 grantees are also required to do extensive evaluation of their projects. These evaluation efforts will allow PT3 administrators to review what is working and recommend best practices for all teacher education programs.

Although the current political administration is not recommending the continuation of the PT3 program, teacher education programs can apply for grants focusing on technology integration under the Improving Teacher Quality State Grants program. However, even though most states view technology integration as a priority and will include it in requests for these state grants, without the PT3 structure, a centralizing component of technology education is lost. The collection of best practices in technology in education may not be as diligent as under the PT3 program. Proponents of the PT3 program also fear that states will not encourage the partnership between teacher education programs and public schools, thus limiting the sharing of ideas between these institutions [31].

In the past two decades, teacher education programs have not only included technology instruction in their traditional education programs as previously described, but they have also added on entire departments dedicated to educational technology as we know it today. These departments usually offer a variety of programs of study including instructional design geared for students who want to work in corporate or government sectors; distance learning or e-learning for corporate, formal and non-formal educational settings; and programs that focus on educational technology in K-12 education. These K-12 education programs prepare students to be technology coordinators in schools and to take leadership roles in the integration of technology in school systems. The professionals that emerge from these programs are critical to the future of technology in schools because they are conducting the research and critically examining the issues that face the nation about how to move forward most effectively.

**SCHOOL-BASED TECHNOLOGY MENTORING**

American University’s School of Education began preparing its pre-service teachers to use technology in 1996 using a model to provide university students with practical experiences and more technical skills in the area of technology and its role in educational settings. Two courses are available to students to fulfill this goal. The first course, Uses of Technology in Education, a redesign of a traditional survey of technology course, became a required course for all undergraduate education students. The course introduces students to several important technologies including web design, authoring tools like Hyper Studio and PowerPoint and educational software. Students learn to use these technologies during class time and then produce products - which could be used in an educational setting. Students are also required to participate in discussions about issues surrounding educational technology through an online discussion board. The final project is to write a grant proposal for a computer lab in a school. This project helps students to understand the costs and considerations that go into planning for technology in schools.

The second course is an intensive field-based seminar, called Advanced Technology in Education, covering specific topics related to using advanced technology in public schools. The vision of the course is for students to experience technology hands-on and to give them an idea of the reality of schools on a building level. Through this course, students pursuing careers in educational technology and students in the MA and Ph.D. program in Education, as well as traditional teacher education students, gain hands-on experience working with public and private educational institutions in the areas of multimedia applications, networks, applications of educational technology tools and the technical training of teachers and other personnel. Since 1996, students have worked with six public schools and one private school within Washington, DC.

In 1996, the first year this course was offered, NetDays were popular. Volunteers from the community were partnering with schools and corporations to network the schools. However, NetDays only provided a network for the school. They did not provide technical support or professional development in technology, which was a real need, especially after the implementation of a network. It was then logical to offer this course in a school setting so that the teachers and the school received an actual service
and AU students were able to apply what they were learning through real-life experiences.

The course was designed to be flexible and broad, which is important when working within a school. Although other universities were teaching skills like advanced database design, or how to refurbish computers, it was theorized that students could get the same type of experiences if they focused on networking instead of these traditional technologies while providing a more useful service to the school.

The first few years the course was offered, the students’ primary function was to learn about, install, and then teach the teachers how to use the network. Networks, at the time (1996-2001) the course was offered were perhaps the most important technology that a school could have. Students who took this course installed networks for three schools and repaired a network for another school. At each school, students generally worked on networking printers and file sharing. In the instances where the school did not need network support, students have provided other services such as building a website for the school.

Each year, the students in the course worked one-on-one with teachers. Students are paired with teachers and work with them one-on-one to create goals for the semester of what those teachers would like to learn related to technology. These students provide guidance and resources for the teachers. Projects in the first few years focused typically on teaching the teachers how to use technology and to find that “hook” that would get them to use it. One example is a student showing a teacher how to use email. This teacher, now a principal, was hesitant about technology use but found that email was the one thing that made sense. She now uses e-mails all the time and has embraced technology at her school. When a teacher had more technology experience, the AU student and the teacher would create a project together to implement in the classroom.

The university students also assess the technology of school and provide technical support as needed. Students are thus provided with the opportunity to learn and apply advanced technologies. Technical projects might include running a network through the school, repairing a network or building a web page. The students are also required to document and analyze these experiences.

During class time, students discuss theories and issues surrounding educational technology and work out problems that may arise with their partner teachers. To complete the course, they are also required to write a substantial research paper which focuses in on specific problem with in the educational technology field. An additional complexity for this course, and for many technical type courses, is that the schools that we have worked with have typically been Apple-based, whereas most of the students that have these skills tend to be Windows-based. This turned out to be an advantage in the long run – the teachers get to see how the students are willing to jump in and figure the Macs out, even though they might not know too much more. It’s the willingness and attitude more than anything that is shared.

Very different things happened at each school. At one elementary school the first year (1997), students were a little more hands-on in terms of the teachers. They were more interested in studying the teachers from afar, rather than jump right in and work with them. Although they did a great job with the network (with the help of a computer science course), but they didn’t do too much for the teachers. The third year was the best example of this class being a service to the school, and this is because we had the ‘computer teacher’ from the school participating hands-on with the teacher education students. The group met at night at the school, and worked on getting the school’s computer lab up to speed. We spent at least two Saturdays at the school with the crew from NetDay getting them all networked. In this setting, students learned more about networking than any other.

Other settings were not as positive. For example, one year the course worked with a school where the course was invited by the PTA, but the principal and the support staff were not interested in the program. This principal was not accommodating and wanted the university to pay to use the school building after hours, wanted our students to clock in with her or not come in the building during school hours, that sort of thing. The classroom-based projects were good but the rest of the course objectives were never realized because the instructor and students couldn’t get on the same page as the school – we never had a sense of what they really wanted or needed.

In the most recent setting, networking became less of an issue. The focus of the course became very much on providing the classroom teachers and the school in general with a direction for the use of technology, from building an impressive and useful website to giving classroom teachers greater skill in the ways technology could be used to directly address learners’ needs and better matched to the curriculum.

One main challenge when examining a longitudinal study of this sort is to look at the overall impact on both the organizations and the individuals involved in the projects. Since there were a series of projects, over a variety of organizations, implemented by different groups, the overarching impact is difficult to measure. In order to find some common trends among the data it was necessary to look beyond traditional educational technology research into the broad and complex field of technology management. Technology management is a relatively new area of study, both in terms of research as well as academic programs. However, some main principles of technology management have been established, and those principles are well matched to analyzing the impact of this project on the organizations and individuals involved.

According to Chanaron and Jolly, the purpose of technology management is defined as the implementation and employment of technology to leverage all functions within an organization [32]. That is, technology should be viewed as a means by which organizations reach their
desired goals. To those of us who are educators, this main principle of technology guides our decision making from individual choices of software in classrooms to district and statewide networking. The field of technology management gives us some broad standards by which we can examine the use of technology within an organization, which includes: alignment with organizational mission and goals; optimization of technology resources; and oversight and ongoing assessment of technology planning. In order to benefit an organization, technology management must address each of these areas. Overall, we found we were able to address with alignment to organization goals in about 80% of the cases, optimization of resources in about 70% of cases, and oversight in about 35% of the cases.

CONCLUSIONS

Much of the current research that evaluates the technology explosion in schools over the past decade shows the nation has just begun the real work that must take place to see effective technology integration. In a report released in March 2003 by the Benton Foundation and the Education Development Center's Center for Children and Technology entitled The Sustainability Challenge: Taking EdTech to the Next Level, these groups contend that there are “indications that many schools are not using this new infrastructure to maximum advantage” [33, p. 14]. A June 2002 survey, also cited in The Sustainability Challenge released by the National School Boards Foundation, outlines research and guidelines on schools' use of the Internet. The survey findings show that “it is not enough to install computers and wire schools and classrooms for Internet access — although there is still plenty of work to do in this regard. Today, the focus needs to expand to how schools are using technology. Many teachers still are unprepared to integrate technology into their instruction” [34, para. 4].

Larry Cuban, professor of education at Stanford University and a leader in the educational technology field, argues in his book Oversold and Underused: Computers in the Classroom, that “overall, the quantities of money and time [that have been spent on technology] have yet to yield even modest returns or to approach what has been promised in academic achievement, creative classroom integration of technologies, and transformations in teaching and learning” [35 p. 189]. Cuban contends that equipping schools with computers and Internet access has not brought about the changes in education that the reformers expected. There is limited evidence proving that schools have produced computer literate graduates who are prepared for the workforce or that schools have transformed their teaching practices to be more inquiry-based and student-centered. And, the debate still rages over whether access to technology can increase student achievement. Cuban cautions reformers and educators to examine how technology is being used and to what end before continuing to invest.

Unlike the Lehigh program, the course discussed in this paper reaches out to some of the neediest schools in the country. The goal is to work with local school systems and new teachers in partnership to give both the schools and teachers the skills they need while advancing the understanding of future technology leaders.

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