

Connections in Teacher Education: Lessons from Electronic Portfolios, Videoconferencing, and Distance Field Experiences

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Abstract

Teacher preparation programs today, given the emphasis on candidate performance, must find ways to provide pre-service teachers with needed experiences to grow professionally while simultaneously helping them to reflect on and document those experiences to obtain licensure. New approaches and tools may be needed to meet these demands. At Purdue University, P3T3: Purdue Program for Preparing Tomorrow's Teachers to use Technology, a PT3 implementation project, is supporting recently restructured teacher preparation programs that emphasize technology, diversity, field experience, and portfolio assessment. The P3T3 project provides this support through three interrelated implementation activities: faculty development and support, the development and implementation of an electronic portfolio system for pre-service teachers, and the use of video conferencing to enable distance field experiences in diverse parts of Indiana. The common theme across these initiatives is connections in teacher education. Faculty development enables the faculty to make connections within their own practice by using technology. The electronic portfolio system allows pre-service teachers to make connections between their own work and the standards that guide professional growth and licensure. Distance field experiences create connections between pre-service teachers and K-12 students and teachers in diverse parts of the state. This paper describes how technology enables the development of these key connections in teacher education and presents some of the evaluation results obtained by the P3T3 project to date.

Introduction

Over the past two decades, a number of national reports have emphasized the need to improve teacher preparation (Carnegie Forum, 1986; Holmes Group, 1986; Moursand & Bielfeldt, 1999; National Commission on Teaching and America's Future, 1996). Today, teacher education programs are faced with a variety of challenges. They must prepare future teachers to meet national and state standards with regard to both content and pedagogy in an era when there is increased emphasis on performance. Further, they must also help pre-service teachers learn to use technology and develop their understanding of diversity and multiculturalism (NCATE, 2001) to function within the schools in today's society. Meeting these challenges is forcing teacher preparation programs to consider new ways of doing business. Technology offers new capabilities that can enable colleges of education to better meet these challenges.

It is clear that the emergence of modern, computer-based technologies has transformed many aspects of work and daily life. Technology knowledge and skills are increasingly viewed as essential to success in the 21st century. Glenn (1997) noted that computers have advanced from simple machines with limited functions and capabilities to powerful machines with sophisticated applications and high-speed networking capabilities, and this increase in capability is impacting education like the rest of society. As a result, computers and the Internet have become the focus of major educational initiatives and reform efforts, such as the U.S. Department of Education's PT3 program, Preparing Tomorrow's Teachers to use Technology, which aims to impact teaching and learning by improving the preparation of teachers to use technology effectively in the classroom. This focus on technology stems from its potential to positively impact education.

However, technology use in colleges of education has historically been suspect. Several national reports have decried the poor state of teacher preparation with respect to technology use (e.g., Moursand & Bielfeldt, 1999; Office of Technology Assessment, 1995; Panel on Educational Technology, 1997; Smerdon et al., 2000). These reports indicate that technology is not central to teacher preparation in most colleges of education. Problems include limited use of technology in teacher education courses, an emphasis on teaching about technology rather than teaching with technology, lack of faculty modeling, insufficient funding and faculty professional development opportunities, and lack of emphasis on technology in students' field experiences. While the U. S. K-12 schools have many computers and widespread Internet access, only about one-third of teachers feel well prepared to use these technologies (Smerdon et al., 2000).

To meet the challenges in teacher education today, colleges of education must change their practices to embrace effective use of technology. Moursand and Bielfeldt (1999) recommended addressing the issue of teacher preparation to use technology through: (a) institutional planning for integration of educational technology into teaching and learning, (b) technology integration across the teacher preparation curriculum rather than limited to stand-alone courses, (c) increased opportunities for student teachers to use technology during field experiences, and (d) faculty development to bring about appropriate modeling of technology uses in their courses. After more than five years of reform planning by its faculty and administration, the School of Education at Purdue University recently completed the final stages of implementation of completely restructured elementary and secondary teacher education programs that make significant strides toward addressing these recommendations. A PT3 implementation grant, P3T3: Purdue Program for Preparing Tomorrow's Teachers to use Technology, is providing support for the implementation of these reforms.

Background

Purdue University's new teacher education programs were launched with students entering teacher preparation programs in the fall of 1999, and the final new courses were put into place in spring of 2002. The new elementary and secondary education programs feature a cohesive set of courses, arrayed in a series of blocks, with practical experiences accompanying each block. The programs are anchored by four thematic strands – technology, field experience, diversity, and portfolio assessment.

The technology strand is composed of three interwoven threads. First, like many other teacher education institutions, Purdue has a required, introductory level, educational technology course that students take at the beginning of their teacher education program. Unlike many technology-only courses, it focuses on helping students build basic technology knowledge and skills within the context of planning, implementing, and evaluating instruction (Newby, Stepich, Lehman, & Russell, 2000). Second, instruction in the application of technology in specific disciplines and with a variety of learners is integrated throughout block and methods courses, building on the foundations laid in the beginning course. Third, technology provides a supporting infrastructure for communication, engagement, and reflection on practice.

The field experiences strand is supported by Theory Into Practice (TIP) components that accompany each block of courses in the new program. The TIPs provide more and more cohesive field experiences for our students than were available in the past. The diversity strand is supported through appropriate course work and by exposing pre-service teachers to various forms of diversity (e.g., socioeconomic, rural/urban, religious, cultural, intellectual, special needs/gifted populations) during field experiences. Because Purdue is not located near a major urban center with concomitant cultural and ethnic diversity, technology is helping to provide exposure to diversity by providing linkages to diverse urban settings at a distance. Finally, the portfolio strand is being implemented through a new requirement that all teacher education students will develop a professional portfolio to: (a) be used for self-reflection on learning and practice, (b) document professional growth, and (c) provide the foundation for performance-based licensure. To support this initiative, Purdue's PT3 project has created a web-based electronic portfolio system that supports students' creation and maintenance of their portfolios.

Purdue's P3T3 project fortuitously was funded at just the right moment to play a significant supporting role in the implementation of the new teacher preparation programs. The overall goals of the P3T3 project are to: (a) prepare pre-service teachers to demonstrate fundamental technology competencies, using technology as a tool for teaching/learning, personal productivity, communication, and reflection on their teaching; and (b) prepare teacher education faculty in Education, as well as selected colleagues in Science and Liberal Arts, to teach pre-service teachers in technology-rich environments, modeling approaches that future teachers should use themselves when they teach K-12 students.

The project is meeting its goals via three complementary components: (a) a faculty development and mentoring program designed to assist the faculty in learning new teaching/learning technologies and effectively modeling their use in teacher education courses; (b) the development of a dynamic electronic portfolio system that provides pre-service teachers with the tools to select multiple ways of viewing their evolving teaching practice, reflect on that practice, and use digital representations to meet performance-based assessments; and (c) technology-enabled (virtual) distance field experiences for pre-service teachers in diverse setting. Ultimately, we hope that pre-service teachers will learn about technology, see it modeled by their instructors, reflect on their own learning about teaching using digital

technologies, and, in the end, use these technologies for teaching and learning with their K-12 students.

The remainder of this paper provides an overview of the three implementation components of the P3T3 project: faculty development, the dynamic electronic portfolio system, and technology-enabled field experiences. Together, these three components address many of the challenges that confront colleges of education. Technology, in a broad sense, is an enabler. In this paper, we examine how technology enables the creation of connections within teacher education. For faculty, technology provides a means to better connect with students. For pre-service teachers, technology provides a tool that allows them to archive their work, reflect on it, and connect it to the standards that today define teacher education. Finally, technology provides a way for Purdue's School of Education, which is located in a rural and mostly homogeneous community, to connect with more diverse K-12 student populations to give our pre-service teachers experience with students unlike themselves.

Faculty Development

The faculty development component of the P3T3 project focuses on helping faculty to acquire and refine technology knowledge and skills that they can use and model for the prospective teachers in their classes. Two main emphases in the effort are: (a) modeling a problem-based and learner-centered approach to technology integration, and (b) using the Internet as a teaching and learning resource.

Research in technology-rich classrooms has shown that teachers tend to shift toward more learner-centered practices in these environments (Sandholtz & Ringstaff, 1996). Adopting a problem-based perspective to teaching technology (Hill, 1999) offers an approach that aligns with the learner-centered characteristics of technology-rich classrooms. To promote this view of technology integration, the P3T3 project involves faculty participants in problem-based workshop experiences to model ways that they might use technology themselves. A range of technologies is employed, but use of the Internet is a frequent emphasis.

The Internet arguably is one of the most significant educational developments in the past half-century. According to data from the National Center for Education Statistics, in the fall of 2001, 99% of U.S. public schools and 87% of instructional rooms were connected to the Internet (Kleiner & Farris, 2002). Given that the Internet is becoming pervasive in K-12 schools, university teacher educators should model its use to help prospective teachers see effective ways to integrate the Internet in their own classrooms. Many of the faculty development initiatives of the P3T3 project focus on Internet technologies (e.g., web page development, WebCT, IP-based video conferencing).

The professional development component of the P3T3 project involved a two-day "start-up" workshop, technology skills development workshops, and a year-long support/mentoring program for participating faculty members. Approximately 95% of the faculty in the School of Education, along with selected teaching assistants and colleagues in the Schools of Science and Liberal Arts, have participated in the project.

The two-day start-up workshop provided the initiation into the project for participating faculty members and other teaching staff. Original plans called for start-up workshops to be offered during the summers when most faculty members would have free time. Because of a late start during the first year of the project, two start-up workshops were conducted during break times in the 2000-01 academic year. Subsequent workshops were offered in the summers of 2001 and 2002 as planned. One final start-up workshop was offered during October 2002,

during Purdue's fall break, to accommodate new hires and others who had been unable to attend at other times.

Start-up workshops were designed for about 15 to 20 participants. Believing in the value of heterogeneous grouping, we sought to mix Education faculty members, graduate teaching assistants, faculty members from Liberal Arts and/or Science, Education undergraduates, and technology-using teachers from our K-12 partner schools. Although no single workshop had representatives of all of these groups at once, members of all of the constituent groups have participated at one time or another.

In part, the start-up workshops were designed to model problem-based learning processes as described by Torp and Sage (1998). In this process, individuals are confronted with an ill-defined problem, define the parameters of the problem, conduct an investigation, and communicate the results. While problem-based learning need not involve technology, we emphasized the use of technology as a tool in the process and, additionally, as the content of the start-up workshop investigation itself. For our workshops, participants working in small groups addressed the question, "What technologies are available at Purdue University to support teaching and learning, how can they be used, and what do faculty and students need to know about them?" Teams developed their own investigations, gathered information, and prepared multimedia reports about their investigations to present to the other groups. Technology was used during this process to acquire background information (e.g., Internet), produce artifacts (e.g., digital camera photos), and prepare a presentation (e.g., Powerpoint). Through this process, faculty members were exposed to constructivist approaches to technology integration in the service of content learning. They were able to participate in the process, reflect on the roles of teachers and learners, and see applications of specific technologies in the classroom. We sought to give the participants a relatively rich example of technology integration that they could draw upon when conceptualizing possibilities for technology integration in their own classes.

Following the problem-based learning activity, we demonstrated a variety of available technologies to participants to raise awareness. Faculty members need to see models of what is possible in order to stimulate ideas for how they might integrate technology into their own classrooms (Ertmer, 1999). We examined examples of technology integration in K-12 classrooms, and we asked the faculty to reflect on potential uses of technology in their own teaching. Finally, we asked each participant to develop and share concrete plans for integrating technology into at least one course that he or she would teach during the coming academic year. This engendered a sense of commitment and gave the faculty member a clear goal to focus his or her efforts. This planning activity was the culmination of the start-up workshop.

In the three years of our implementation project, 67 regular members of the Education faculty (about 95% of the current total) plus five adjunct faculty members, three visiting faculty members, 15 graduate teaching assistants, and two School of Education staff members participated in start-up workshops. In addition, nine faculty members in Liberal Arts and three in Science (two jointly appointed in Education) also participated. Further, two faculty members from the Education Department of a regional campus and two from the School of Consumer and Family Sciences, which were not originally partners in the project, also participated. One faculty member from another university sat in on a start-up workshop.

Following each start-up workshop, a number of hands-on, skills development workshops were offered for participating faculty members and others. We also repeated these workshops at various times throughout the academic year to accommodate varying schedules and to permit others to participate. Workshop topics have included: WebCT (the "standard" web-based course

environment at Purdue), web page development (e.g., FrontPage, Dreamweaver), working with graphics, concept mapping with Inspiration software, managing one's university computer account, digital video capture and editing, IP-based video conferencing, and others. These workshops were designed to help the faculty develop the technology knowledge and skills they might need to better integrate the use of technology in their own teaching.

A typical workshop involved two hours of hands-on work; complex topics, such as WebCT, were presented in a series of workshops covering components. Some workshops were led by members of the P3T3 staff, and some were presented by representatives of Purdue's ITaP (Information Technology at Purdue) training group (which was part of the campus-wide Multimedia Instructional Development Center when the project first began), a local partner in the project. Partner Apple Computer has also conducted workshops. To date, there have been over 800 enrollments in these workshops. Participants' overall evaluation ratings of these workshops have been: Great - 66%, Good - 25%, OK - 3%, Fair - 0%, Poor - 0%, no rating - 6%.

During the project's second year, we introduced Techie Talk, a more informal faculty development session. Techie Talks were presentations or mini-workshops that last 30-60 minutes and were conducted over the lunch hour during the academic year to allow the faculty and others to drop in. Some Techie Talk sessions focused on specific technology skills (e.g., tips for using email or MS Word), while others focused on faculty success stories related to technology integration (e.g., WebCT for course support, using IP-based video conferencing to connect with K-12 schools). They offered a means of providing information and skills development in a format that was more abbreviated than a full workshop, and they provided a vehicle through which the technology integration successes of faculty members could be showcased.

Finally, to assist the faculty in carrying out their plans and developing their own expertise, we offered an academic year-long support and mentoring program. Brand (1998) noted that despite increased access to computers and related technology, educators often experience difficulty in integrating technology into classroom teaching practice. Training and mentoring provide two major incentives in aiding faculty to successfully integrate technology in teaching (Dusick, 1998, Groves & Zemel, 2000). The P3T3 staff reviewed participants' personal plans for technology integration, and, based on the specifics of each plan, a graduate assistant with appropriate skills was matched to an individual faculty member to serve as a liaison with the project. The graduate assistant contacted the faculty member and offered support throughout the year, either working directly with the faculty member or, when necessary, referring the faculty member to another person with appropriate expertise. Support was provided through one-on-one tutoring and assistance at the faculty member's request. In addition, the P3T3 staff offered a drop-in help session one afternoon each week throughout the academic year for faculty members who were working on technology integration projects and needed immediate assistance. Each faculty member also received some supply and expense funding to support integration activities or purchase materials. With this support, faculty members and graduate teaching assistants have successfully implemented many technology initiatives.

Faculty Development Evaluations

To investigate the impact of faculty development initiatives, both quantitative and qualitative evaluation data were collected. Quantitative data included faculty reports of technology integration in courses, self-assessments of technology proficiency, student assessments of faculty proficiency, and faculty ratings of usefulness of P3T3 project faculty development initiatives. These data were gathered by surveys administered to all Education faculty members in the fall of 2002 and spring of 2003 as well as surveys administered to a sample of students in the spring of 2003. All surveys were administered online, and frequencies of responses were tabulated.

Qualitative data were collected via mini-case studies of selected faculty members who integrated the use of a course website and/or WebCT in their teaching. Semi-structured interviews of the faculty members were conducted by graduate students working with the P3T3 project to gather the faculty members' perceptions with respect to three questions: 1) How did they integrate technology? 2) What were their perceptions of the technology they integrated? and 3) Were they able to implement the technology effectively? Six technology-using faculty members were interviewed: three who used web editing software to develop a course website and three who used WebCT. Interviews were recorded and transcribed. Completed faculty projects (e.g., developed websites) were also examined as a source of information.

On a survey conducted in the fall of 2002, completed by 44 faculty members, 90% of the responding faculty members reported that they integrated technology into their teaching, and 86% reported having changed their curriculum within the past year to add or increase the integration of technology. This suggests that faculty members were following through with project activities to integrate technology into their classes. The most widely reported uses of technology were for: communication with students (86% of responding faculty members), information retrieval (84%), in-class presentations (74%), student projects (65%), and online class discussions (51%).

In the spring of 2003, both faculty and students were surveyed regarding their perceptions of proficiency with technology. Faculty were asked to rate themselves and typical students. Students were asked to rate themselves and typical faculty members. Selected results, based on 37 faculty and 229 student responses, are shown in Table 1. Faculty tended to rate themselves as more proficient than students across categories. Students rated themselves as more proficient than faculty in general knowledge of hardware and software and use of the Internet, but they agreed that faculty were more proficient in the use of email, presentation software, knowledge of instructional technology integration issues, and overall. Members of each group tended to see themselves as somewhat more proficient than the other group saw them. However, it is notable that significant percentages of both groups were judged fully proficient by the other group.

Whereas only 43% of students in the first year of the project (2001) agreed that faculty members used technology in class, on the 2003 student survey 97% of students agreed that faculty members used technology in class. This dramatic increase suggests that the project has been successful in encouraging faculty members to integrate technology into their teaching and so model its use for students. The faculty themselves rate the P3T3 project highly: 86% agreed that the two-day workshop was useful, 81% agreed that the technology skills workshops were useful, and 78% found the one-on-one assistance and mentoring useful.

Table 1

Faculty and Students' Assessments of Level of Proficiency with Technology

Level of Technology Proficiency	General Competency with Computer Hardware and Software		Use of the Internet		Use of Electronic Mail		Use of the Computer for Presentations		Knowledge of Instructional Technology Integration Issues		Overall Technology Competency	
	Faculty	Students	Faculty	Students	Faculty	Students	Faculty	Students	Faculty	Students	Faculty	Students
Intermediate (Faculty Ratings)	24%	62%	27%	43%	8%	35%	38%	43%	32%	51%	46%	59%
Proficient (Faculty Ratings)	73%	24%	59%	32%	89%	51%	38%	24%	43%	5%	49%	22%
Intermediate (Student Ratings)	46%	39%	41%	27%	25%	32%	31%	28%	42%	50%	47%	53%
Proficient (Student Ratings)	46%	57%	45%	54%	68%	62%	59%	54%	44%	26%	47%	40%

To gather addition perspectives from participating faculty members, selected users of Internet technologies in the classroom were interviewed. Three faculty members, referred to as Professors A, E, and F, were interviewed about their website design experiences. Professors A and F had no knowledge of website development prior to participation in the P3T3 project, while Professor E did have some prior experience and worked with a graduate student on the development of a course site. Each met with success in learning the process of website development and management. While the developed sites varied in level of sophistication, all of the faculty members felt that what they created met or exceeded their expectations.

The professors in this study each attended a faculty workshop and began their individual website projects because they felt it was an opportunity to enhance their skills with a personal mentor while developing something useful. The attraction of the Web in education was the ability to make information instantly accessible to others. Professor F commented, "There are several people I work with that use web pages... Web pages look like the information source... I don't have the technical skills to do it, but after I went to the Dreamweaver workshop, I know what I can do."

Professor A, a former K-12 school administrator, also worked with a P3T3 mentor after attending a faculty workshop. His comment echoed the one above about the value of the web as an instructional and informational tool. He stated, "I use the web a lot in my work area...this university is a highly technology involved university. Both of these are motivations for me to create a website for myself." Professor E also recognized the value of the web as a communication tool for her students, her associates at other universities, and the outside world. She had already worked with a graduate assistant to create her own website, but had encountered frustrations trying to work with a particular web editing package on her office Macintosh computer. She was excited about the opportunity to convert her designs from the PC platform to Dreamweaver, a cross-platform web editing package.

Three other faculty members, who used WebCT to set up an online support environment for a course, were also interviewed. These course instructors found WebCT to be a convenient support tool for teaching for similar reasons. Professor G frequently visited area schools to follow up on his students who were engaged in practicum experiences. Using WebCT, he was able to more easily keep track of what his students were doing. He required the students to use WebCT to post assignments, and he then could review these materials and provide feedback without having to visit the school site just to review the students' materials. As a result, he was able to cut down on the number of on-site visits to the school. Professor G commented, "It saves me time, because in the past, I have had to make many trips to the school, and now, I make only a few."

WebCT also allowed the faculty members to better organize course materials for students. One faculty member commented: "[It allows us] to extend the instruction beyond the classroom. We've been able to put up articles that students can look at and read... outside the regular class. That's been really helpful, really useful." All three interviewed WebCT users cited the ability of WebCT to conveniently make all course materials available in one place.

While a variety of technologies are available to faculty members to integrate into their courses, those applications centered on the Internet have emerged as among the most popular with the faculty in our project. Faculty members see the Internet as a tool for better connecting with their students. They use the Internet to communicate with students via email and through posting of course information online. They often create in-class assignments focused on information retrieval from the Web, an activity that mirrors their own professional uses of the Internet as tool for keeping up-to-date on research and their discipline. They also use online course discussions, usually in WebCT, as a way of extending the dialogue that occurs within the classroom, so that students are engaged with the course material even when they are not in class. These uses of technology create opportunities for what Dede (1996) calls distributed learning in which the technology facilitates communication and collaboration rather than inhibits it. While the technology has its shortcomings and is not viewed by most faculty members as a replacement for conventional approaches, it seems clear that the faculty in the P3T3 project at Purdue have embraced those uses of the technology that complement what they do by facilitating the building of connections with their students.

Dynamic Electronic Portfolio System

Portfolios are another tool for the building of connections in teacher education. Portfolio assessment is becoming an important way to address competency-based standards. Portfolios are purposeful collections of student work that demonstrate effort, progress, and/or achievement (Barrett, 1999; Russell & Butcher, 1999). They provide an opportunity for pre-service teachers to demonstrate and organize their understanding of teaching and learning. With portfolios, pre-service teachers can build rich collections of materials to document their teaching knowledge, dispositions, and performance. According to Danielson and Abrutyn (1997), portfolio developers engage in four processes: (a) collection - the gathering of relevant materials, (b) selection - identification of those materials that best demonstrate knowledge and capabilities, (c) reflection - thinking about one's own practices, and (d) projection - looking forward to consider what steps need to be taken to improve. Through this process, teacher candidates grow and develop, and the resulting portfolio provides a richer picture of their understanding than can be achieved through more traditional, objective measures.

There is growing interest in the use of electronic multimedia portfolios for documenting

growth and development of pre-service teachers (Barrett, 2001; Read & Cafolla, 1999). Electronic portfolios, or e-portfolios, have advantages over their paper counterparts including the ability to represent materials in multiple ways, ability to link to standards, reduced storage demands, accessibility, and students' development of technology skills in the process of creating the portfolio. E-portfolios can be created using tools ranging from off-the-shelf generic computer applications to a customized application built specifically for that purpose (Barrett, 2001). In the P3T3 project, we have focused on the latter.

The P3T3 project has created, and is continuing to refine, a customized, large-scale, electronic portfolio system as one part of an overall dynamic assessment system. The system is dynamic in that: (a) it encourages ongoing collection and archiving of relevant performances by the teacher candidate, (b) the teacher candidate can choose a variety of media forms to represent the complexities of teaching, and (c) the teacher candidate can choose, by reflecting on the individual performances, which of her or his archived materials best represents a given performance standard. In short, the dynamic aspect of the model lies in both its capability to store a range of media that are easily accessible and the way it provides the teacher candidate with a scaffold for systematically thinking about and reflecting on his or her work. Teacher candidates can juxtapose a variety of representations of their work, each highlighting or complementing aspects of ongoing practice and their learning about the practice. The system supports a direct connection between ongoing assessment and reflective practice.

The Purdue Electronic Portfolio (PEP) system resides on a robust server with about two terabytes of storage space, enough to give each one of our 2000 or so pre-service teachers the storage equivalent of a CD-ROM. Candidates' artifacts are stored in a Microsoft SQL Server database, a popular choice for large-scale, web-accessible databases. Candidates interact with the system through a web-based interface that is driven by Microsoft Active Server Pages (ASP) technology. Because it is web-based, candidates can access the e-portfolio system from any place that has an Internet connection. This provides for great flexibility of access.

Pre-service teachers log in to the PEP system using their standard campus login names and passwords. Once in the system, they can manage their own account information, upload files, perform various other tasks, and create artifacts. Candidates can upload digital representations of just about anything — word processing documents, photos, scanned images, Powerpoint presentations, even videos. Any individual item of evidence is stored in a file. In our parlance, an artifact is an individual file or collection of files that the student assembles in the e-portfolio system to address one or more professional standards. Thus, an artifact may be a single thing (e.g., a written lesson plan) or a set of related things (e.g., a written lesson plan, a grading rubric for use with it, a photo or video of the candidate conducting the lesson in a K-12 classroom). Students use a template to create an artifact; the completed artifact is a web page with links to associated files. Each artifact includes common elements — the student's name and photo, course information, relevant standards — as well as whatever components the student wishes to include. Students may classify artifacts according to three broad themes developed by the Purdue faculty (attention to learners, understanding curriculum in context, and commitment to professional growth) and according to the ten INTASC principles that undergird many teacher preparation standards. Students add and can format their own components to personalize artifacts; these components can be accessed by the student or instructor through live links on the resulting web page. Artifacts, finally, can be assembled to make portfolios. See Figure 1.

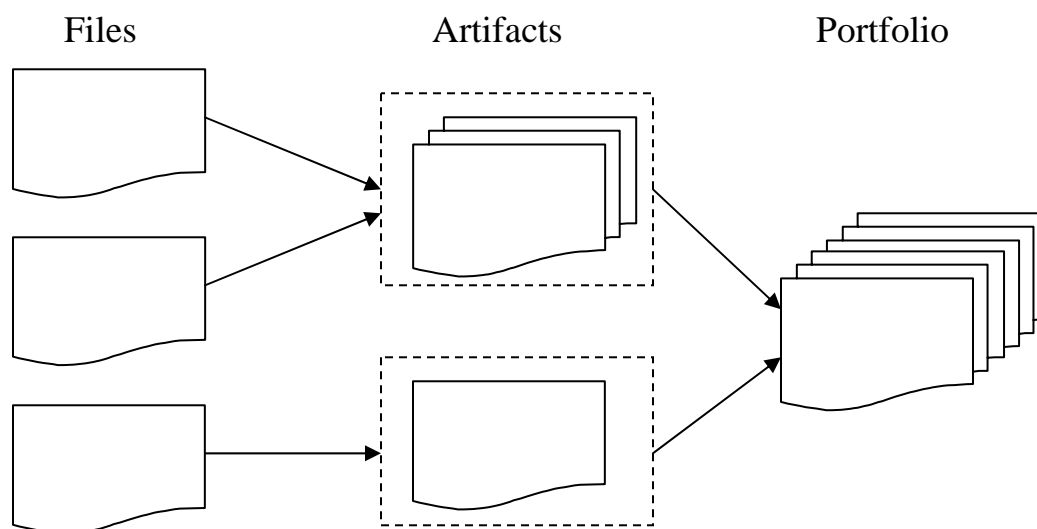


Figure 1. Organization of the Purdue Electronic Portfolio System

After creating an artifact, the pre-service teacher must release it to an instructor for evaluation. Until it is released, an individual artifact remains private and can only be accessed by the pre-service teacher who created it. The system also allows students to make their artifacts public, which means that other individuals within the PEP system can view it. (Artifacts are never truly public, because access to the PEP system requires a login ID and password.)

Faculty members can log into the system to assess students' work. Since most artifacts are created as part of courses, the system links individual students' artifacts to the courses in which they are created. The instructor can retrieve all of the students' artifacts for a particular course during a particular semester for assessment. In order to track students' progress and growth as they proceed through the teacher education program, another layer of assessment corresponds to review of the overall portfolio. In Purdue's assessment system, this overall review occurs at four points in the student's academic career. At each of these checkpoints, or gates, students must demonstrate appropriate progress on the portfolio to proceed in the teacher education program.

Formative Evaluation of the PEP System

Pilot testing of the PEP system was conducted in the 2001-02 academic year with a total of about 800 students in Block I and Block II, the first two semesters, of the teacher preparation programs. Full implementation of the project went into effect in Fall 2002. At the present time, there are about 1200 users in the system, and one gate assessment has been completed.

As part of the formative evaluation, online student surveys were linked into the system during the pilot testing phase of the project in 2001-02. These surveys were designed to capture students' initial perceptions of the system. One survey was completed after students first used the system, and another was completed after completion of the first artifact. Additional information was obtained from faculty and students during the implementation process. Since the pilot testing began, a number of developmental and technical issues have been identified.

Table 2
Student Perceptions of Ease of Use of the PEP System

Survey item	% Responding Strongly Agree or Agree
<i>Initial Use Survey</i>	
I was able to easily locate the e-Portfolio website	95%
The log-in process was easy.	86%
Uploading my picture into the e-Portfolio was easy	73%
The online help was useful.	41%
The overall process went smoothly.	68%
<i>Post-Artifact Creation Survey</i>	
I was able to successfully complete my artifacts.	86%
I understood what I needed to do to complete an artifact	81%
The amount of time I spent creating my artifacts was not excessive.	76%
The online help was useful.	40%
The overall process went smoothly	74%

In general, students have found the PEP system to be relatively easy to use. Percentages of students who strongly agreed or agreed with items on the initial use survey (n=112) and the post-artifact creation survey (n=58) are shown in Table 2. Generally, most students agreed that the system was easy to use. The lowest approval ratings were for the online help, figures that are skewed to some extent because a large proportion of students responded that they did not use the online help at all. Nonetheless, these results led us to try to make improvements to the online help to more effectively guide who were having difficulties.

It is too soon to make any definitive statements about the impact of the creation of the portfolios on our teacher candidates. However, it is clear from observations of the initial users of the system that good work is being assembled. Figure 2 shows a partial example of a teacher education student's artifact from EDCI 205, the first course in the new program. The figure depicts snippets of text that would be accessible in full through the graphical links on the artifact web page. In this case, the teacher education student created one link to a document containing a personal educational history and a second link to a document describing a mentor teacher. A third link, not shown, connected to a statement about this candidate's philosophy of education. The individual tied these three documents together as a representation of a personal past, present, and future of teaching.

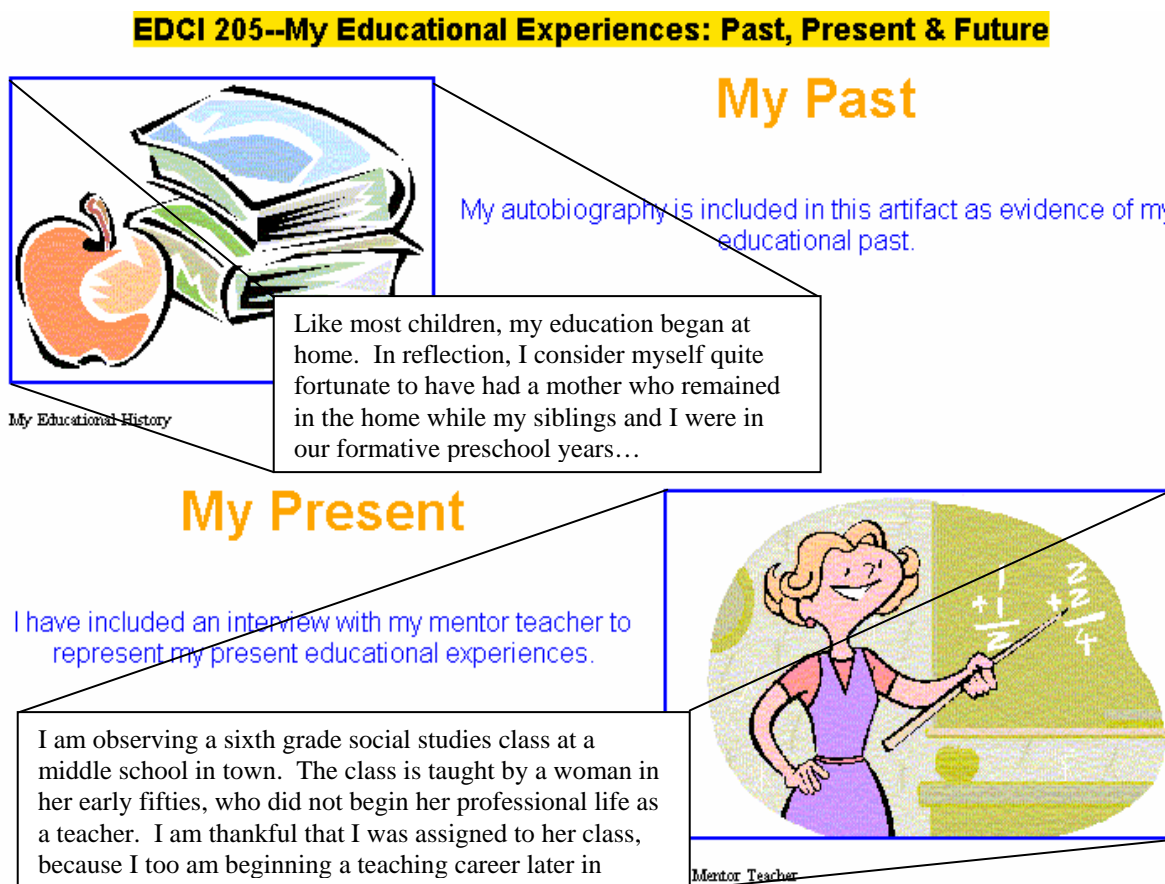


Figure 2. A Depiction of an Example E-portfolio Artifact

While students are developing good materials and archiving them in the e-portfolio system, both developmental and user issues have arisen. From a technical standpoint, students have had relatively little difficulty with the system. However, conceptual barriers have been more substantial. Teacher education students at Purdue have not been required to produce portfolios previously, except in individual courses. As a result, the idea of creating a longitudinal portfolio throughout their programs of study is unfamiliar. Further, most students are not yet comfortable with the idea of assessing their own proficiencies with respect to established state and national standards. Most students do not yet have a clear notion of how to show their own development over time, and they sometimes want to claim that a single artifact shows evidence of meeting all possible standards. Faculty guidance in addressing these issues will be critically important as we move forward with the new system.

Of the developmental issues that have been encountered, among the most significant has been determining how students should pass through the multiple assessment gates that correspond to the key assessment points of Purdue's reformed teacher education programs, and who should monitor this process. The gate review mechanisms, assessment rubrics, and procedures are being determined by the faculty through Elementary and Secondary Education Committees with additional input from the Block Council, an ad hoc committee that was formed to coordinate implementation of the Blocks, and the Assessment Council, which now oversees the Unit Assessment System. A tension exists between the desire of the faculty on the one hand

to ensure that students create an integrated and reflective portfolio that cuts across courses and the desire on the other hand to minimize the extra effort involved in assessing the work of hundreds of teacher candidates. After much discussion, the faculty has agreed upon gate review procedures that place the responsibility for particular gate reviews within the context of key courses within the program. While this may limit some of the connections between courses and concepts that we seek in our teacher preparation programs, the practical realities of managing a large teacher preparation program are acknowledged.

Our experiences with the electronic portfolio system to date have yielded some useful lessons. While students, for the most part, have readily adapted to the use of the system, the faculty is less comfortable with it. Although the faculty is becoming more adept with the technology, some faculty members have struggled to come to grips with the changes demanded of them. Nonetheless, the PEP has acted as a catalyst for change. The demands of implementing this new system have forced the faculty to address the creation of appropriate artifact-producing assignments across the curriculum, procedures for gate review, and rubrics to be applied to all teacher education students. The ensuing discussions have been good. Faculty members are talking with one another about the business of teacher education, and, as a result, Purdue's programs have improved. In addition, many faculty members have sought to improve their own technology skills to keep pace with students who are creating multimedia electronic portfolios.

It is becoming increasingly clear that the integration of portfolio requirements into established courses is necessary to ensure the success of this endeavor. Established courses provide an important degree of stability. They provide a built-in structure and a form of accountability that is familiar both to the faculty and the students. As part of courses, portfolio artifacts are viewed by the students as regular assignments rather than something that must be added on top of existing work. This is a good thing in that students are comfortable with the notion of course assignments, but it can be a negative as well. In the fall of 2002, several students failed to complete portfolio assignments required for gate review simply because they viewed the work as being of relatively minor importance when deadlines for other assignments were pressing. This has led both to programmatic changes (e.g., successfully completing portfolio artifacts is now linked to successfully passing courses) and an increased emphasis on the importance of the portfolio in students' programs of study. Students are slowly coming to recognize that the portfolio is something of great personal and professional importance that will follow them throughout their college careers and probably beyond. However, they still have difficulty with the notion that they are responsible for understanding what is expected of them, as defined in state and national standards, and how they must show in their own work that they meet these expectations. The idea of creating these connections does not come naturally to most students; it is something we as teacher educators must help them to do.

Coordination across the curriculum is particularly important if we are to help teacher candidates to create a portfolio that makes sense for an entire teacher education program. Some colleges of education have chosen to address portfolio requirements within the confines of a single capstone course. While that approach can work, the portfolio thus created is not truly a part of the entire teacher education program. At Purdue, we have chosen to make it a part of our entire teacher education program. To do that, faculty members must work with one another and with students to craft assignments that bridge individual courses to create a synergistic whole. This is a challenge, but it is one that we gladly accept, because it is through these connections that we build a stronger teacher education program.

Technology-Enabled Field Experiences

Field experiences have been identified as a key means to better prepare teachers for the diversity and complexity of today's classrooms (Goodlad, 1990). While field experiences are generally recognized as critically important, many colleges of education, particularly those in rural areas, have difficulty placing students in field settings that provide for needed experiences with, for example, diverse student populations and technology. Distance education technologies offer capabilities that can be used to provide needed experiences for pre-service teachers when appropriate field sites are not in close proximity. The P3T3 project has implemented an initiative to use technology to support distance or virtual field experience for pre-service teachers that address key components of our teacher preparation programs. This pilot initiative was designed to explore various models for enhancing teacher preparation through linkages between the university and participating K-12 schools.

Using video conferencing technologies, future teachers can observe and interact with K-12 classrooms from afar. This concept is not new; closed circuit television was used for observation of classrooms in teacher education programs as far back as the 1960s (e.g., Abel, 1960), and, in the 1980s, Iowa State University's Teachers on Television program showed that the observation skills of pre-service elementary teachers could be improved through training using microwave-based video connections to public school classrooms (Hoy & Merkley, 1989). However, these older video technologies were expensive and difficult to set up and maintain. Today's video conferencing technologies offer a flexible and cost-effective option for observation of and interaction with school-aged learners at remote school sites.

At the outset of the P3T3 project, we expected to use an intrastate fiber optic video network called Vision Athena (<http://www.visionathena.org>), managed by the Center for Interactive Learning and Collaboration, a partner in the P3T3 project. While we have used that network on a limited basis, IP-based video conferencing equipment from Polycom (<http://www.polycom.com>) emerged during the project as a better way to meet most of our needs. This technology supports good quality video and audio over the Internet, is relatively affordable, and is very flexible because a standard H.323 Internet video conferencing connection can be established between any two locations with access to a reasonably fast (128 Kbps or better) connection. Special distance education rooms or video studios are not needed.

We currently use two types of Polycom video conferencing equipment. Room-to-room video conferencing is supported by Viewstation SP (point-to-point) or FX (multipoint) units. These compact units have an integrated camera with panning and zooming capability that can be attached to any available video monitor and plugged into an Ethernet jack for Internet connectivity. Educational prices start at about \$2,500 for the Viewstation SP. For person-to-person or small-group-to-small-group connectivity, we use the Polycom ViaVideo computer-based desktop video conferencing unit, which operates in conjunction with a Windows PC. While the ViaVideo camera is of lesser quality and lacks the panning and zooming capability of the larger Viewstation units, the inexpensive (about \$400) ViaVideo unit adds the exciting capability for application sharing during video conferencing. Two pilot projects involving these IP-based video conferencing technologies are briefly described here.

Pilot Project 1: Class to Class Interactions

The first pilot project was conducted with beginning teacher education students. In the first block of the teacher preparation programs at Purdue University, teacher candidates take two classes: Exploring Teaching as a Career and Multiculturalism in Education. The classes provide a

foundation for future education courses by helping the pre-service teachers to understand the nature of teaching and schooling in a diverse world. The two courses share a theory into practice (TIP) component, an early field experience, in which students typically travel to nearby schools to observe classrooms for a couple of hours each week. The goal of this initial TIP experience is to help students become familiar with the work of teachers, observe teaching, reflect on student diversity and its expression in the school setting, and begin to interact with learners.

Because Purdue not located near a major urban center, opportunities for pre-service teachers to encounter diversity during field experiences are limited. In addition, pre-service teachers often feel there is little need to understand diverse populations of students because they expect to teach in predominantly white and rural areas after graduation (Yao, 1999). However, the demographics of much of Indiana, like other locales in the United States, are rapidly changing and diversifying (Glazer, 1997). To help our teacher candidates experience the ethnic, linguistic, and socio-economic diversity they need to be prepared for the future, we launched this pilot project.

In this pilot project, beginning pre-service teachers enrolled in a section of the first block's TIP experienced diverse classrooms for their field experiences through the use of video conferencing and the Internet. Over six semesters, Professor JoAnn Phillion and her students linked with a teacher and students in an elementary school in a diverse inner city school in East Chicago using Polycom Viewstation equipment. The two sites connected about once a week throughout the semester for between one and two hours. During that time pre-service teachers observed the classroom, interacted with the children and teacher, and prepared a variety of enrichment activities, in consultation with Professor Phillion and the classroom teacher, which they taught using the interactive capabilities of the technology.

At the beginning of each semester, the pre-service teachers first became acquainted with the technology. They learned how to connect to a remote site and operate the camera controls for both the Purdue site and the distant school site. They practiced using the equipment, and they developed mechanisms to facilitate communication. Prior to beginning the actual video conferencing field experiences, the university class visited the participating school at which time the pre-service teachers toured the school; met staff, teachers, and students; and interacted with the students in the class involved in the project. This visit allowed the pre-service teachers to gain first-hand knowledge of the school and the students, which we believe helped somewhat to overcome the impersonal nature of video conferencing communication.

After the site visit, the virtual field experiences began and continued weekly through the remainder of the semester. Initially, pre-service teachers spent time observing the classroom and getting oriented to classroom activities. During one semester, the first session was spent on introductions that took the form of riddles about "Who am I?" Some riddles were done in English and some in Spanish for the bilingual classroom.

A typical interactive session began with the classroom teacher teaching a lesson. Pre-service teachers then took turns, individually or in small groups, teaching enrichment or reinforcement mini-lessons to the students. Over the life of this pilot project, pre-service teachers have taught lessons on fractions, story books, historical figures, the life and culture of Japan, and communicated with the students in both English and Spanish. One session was devoted to the World Trade Center disaster; Purdue pre-service teachers and the 3rd grade students wrote memoirs about where they were on 9/11 as part of a process writing activity. The teacher provided links on her website that the pre-service teachers used to see how to discuss sensitive topics with young students. In a recent semester, the pre-service teachers developed

lessons about the geography, school life, food, daily activities, wildlife, and the arts in Japan to build on the teacher's thematic unit.

Pilot Project 2: Small Group Interaction via Personal Video Conferencing

Pilot project 2 was developed as a part of a course on the production of instructional materials open to both undergraduate and graduate students. Professor Tristan Johnson launched this pilot project to provide his university students with a genuine context and audience for the design, development, and implementation of instructional materials. In this pilot project, teams of university students created instructional materials, both web-based and for video conferencing delivery, for K-12 learners. Several different experiences were implemented over several semesters.

In the first semester of this pilot project, a small group of university students created a web-based virtual field trip for 2nd grade students at a partner school who were planning to visit a children's museum in the state. The virtual field trip was designed to prepare the students for the museum visit by having them obtain information online, assimilate the information, and communicate their understanding to peers, university students, and teachers. Video conferencing, via the Vision Athena network, was employed for both planning and implementation of a lesson built around the virtual field trip. The university instructor, team of student developers, and teacher met twice via video conferencing to collaboratively plan the virtual field trip and associated instructional activities. A third video conferencing session was employed by the university students to observe as the teacher implemented initial instructional activities with the 2nd graders in the classroom. As a culminating activity, the team of university students led the final classroom activity at a distance using video conferencing. The whole project spanned about ten weeks of class time.

The next semester, university students engaged in small group to small group interaction with a group of 5th grade students. During this semester, the team of university students developed a stock market investment project using themes outlined by the cooperating teacher. Four lessons were created, one web-based and three using video conferencing. A key strategy implemented during this second iteration of pilot project 2 was the use of application sharing during video conferencing with Polycom ViaVideo units connected to Windows PCs. This capability allowed the university students to share an application (Microsoft Excel) with the K-12 students so that they could co-construct a spreadsheet as part of the lesson.

The third semester of this pilot project continued the use of application sharing as one part of a comprehensive lesson developed for an urban 5th grade class at a partner elementary school in the Indianapolis area. This time, the team of university students directed by an advanced graduate student developed a lesson built around a popular engineering contest founded at the university called the Rube Goldberg Machine Contest. Rube Goldberg was cartoonist who drew cartoons of absurdly complex machines that took many complicated steps to perform a simple task. In the early 1980s, Purdue University began a contest that paid homage to the cartoonist by requiring teams of engineering students to construct elaborate machines that used many steps to perform a simple task such as sharpening a pencil or screwing in a light bulb.

The university team developed a website to provide background information for the 5th graders about Rube Goldberg, metric measurement, and simple machine concepts. Video conferencing sessions were used to introduce students to concepts that built toward the culminating activity of the lesson, a Rube Goldberg machine building contest for the 5th graders. Application sharing with the ViaVideo units was used during one of the video conferencing

sessions to help students understand simple machine concepts. During the lesson's final session, teams of 5th grade students, who had constructed their own Rube Goldberg machines, demonstrated them in front of the video conferencing unit to the university students who served as the judges at a distance. Thus, the university students were able to gain experience in the creation of authentic instruction from planning to design to development to implementation and finally evaluation. At the same time, the 5th grade students benefited from an engaging lesson that involved important mathematics and science concepts and interactions with a genuine audience of college students.

Evaluation of the Technology-Enabled Field Experiences

Evaluation of the technology-enabled field experiences took several forms. In the fall of 2002, surveys were administered online to the teacher education students (n=21) in pilot project 1 prior to the initiation of the video conferencing activity and again at the end of the semester. The participating faculty members also conducted their own formative evaluations, and they were interviewed about their perceptions of the strengths and limitations of this approach. Results are summarized below.

Throughout pilot project 1, most of the pre-service teachers quickly adjusted to the video conferencing. They began to see the technology as a tool that could be used for teaching and their own and others' learning, personal productivity, and communication. Significantly, one benefit seemed to be the development of pre-service teachers' classroom observation skills. These beginning teacher education majors came into the course as unskilled observers, but through the guidance of a faculty member who observed alongside them via the video conferencing, they became better observers themselves. In addition, the shared observational experience led to opportunities for richer class discussions. Further, the pre-service teachers' understanding of diversity issues appeared to have grown as a result of the project.

When surveyed about the technology-enabled field experience at the end of 2002, the pre-service teachers in pilot project 1 mostly were positive. See Table 3. While few students had prior experience with the technology (even those who agreed that they were familiar with the technology had had only minimal exposure to it), most agreed that they learned to use the technology and that it was easy to use. They tended to be comfortable with the technology by the end of the class, and most agreed that it was a valuable addition to the class, increased their comfort with technology use, and increased their comfort with their ability to teach diverse learners. On open-ended items, they reported that they saw advantages in the ability to connect to a diverse classroom site and learn about technology and distance education. Limitations included the lack of person-to-person interactions and technical issues such as connectivity difficulties, audio and video problems, and the time delay in verbal exchanges caused by the distance.

Table 3

Pre-service teachers' responses to video conferencing survey items.

Survey item	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
<i>Before Video Conferencing</i>					
I am familiar with and have had some experience with video conferencing.	0%	33%	19%	19%	29%
I expect the video conferencing in this class to be easy to use.	0%	67%	13%	10%	0%
I hope to learn about the use of video conferencing in education from this class.	38%	57%	5%	0%	0%
I believe that the use of video conferencing will be a valuable addition to this class.	24%	52%	24%	0%	0%
<i>After Video Conferencing</i>					
By the end of the class, I felt comfortable with the video conferencing equipment that we used.	19%	52%	29%	0%	0%
The video conferencing in this class was easy to use.	19%	62%	19%	0%	0%
I learned how to use video conferencing in education from this class.	19%	71%	0%	5%	5%
I believe that the use of video conferencing was a valuable addition to this class.	33%	43%	14%	5%	5%
Because of the experience in this class, I feel more comfortable in my ability to use technology for teaching and learning.	29%	52%	5%	10%	5%
Because of the experience in this class, I feel more comfortable in my ability to understand and teach diverse learners.	38%	38%	10%	5%	10%

When working with any new medium of communication, there are inevitable difficulties and a period of acclimatization. The first step in each of these pilot projects was simply to get the technology working between the university and remote site. For IP-based video conferencing, a significant initial barrier is Internet firewalls. Most schools are protected by an Internet firewall which must be configured to allow selected outside connections. When trying to set up video access, we ran into difficulties. These problems were resolved, but not without spending time and obtaining the help of several technicians. Once established, the IP-based connections worked fairly well most of the time.

The university students generally felt that the remote field experience was instructionally valuable, increased their confidence, better prepared them for teaching in the future, and engendered a desire to continue using technology for teaching. Challenges included the difficulties of jointly planning an instructional unit with a cooperating teacher at a distance, the constraints of a typical school schedule, and students' occasional lack of comfort with the ambiguities of the process.

The technology is good, but students in both pilot projects noted limitations. Sometimes, technical problems or teacher absence caused the cancellation of a video conferencing session. In addition, IP-based video conferencing connections sometimes could become “choppy” as a result of limited bandwidth or network congestion. The video might freeze and/or the audio break up. Even when working perfectly, the picture on the screen, while not bad, might have been clearer. Effective observation often means noting subtle facial expressions and body gestures not easily discerned by viewing a video monitor. Pre-service teachers reported that had difficulty judging whether the K-12 students at a distance understood when a lesson was being presented. In the second pilot project, our use of ViaVideo units with small groups pushed the limit of what the small camera could convey. Further, audio is as important as the video. While the teacher’s voice came through clearly most of the time, the children’s voices were less clear. Furthermore, background room noise created interference. While we have found that having the teacher work with the students to speak more loudly and clearly helped, audio quality is generally a problem that we have not fully resolved.

Despite some shortcomings, in both of these pilot projects, pre-service teachers learned to see technology as a tool that enabled them to communicate across distance, and with students they may have had little experience of in the past. Exposure to the diverse classrooms in our partner schools sites seemed to open the students’ thinking to new possibilities. As a result, class discussions were rich and varied. In addition pre-service teachers learned to work together in groups and in partnership with a faculty member and classroom teacher. The main issue for the pre-service teachers was that they were not in a “real” classroom with “real” students. However, with structure, the future teachers seemed to benefit from the experience.

When we consider all factors, these virtual field experiences seem to be a worthwhile way to expose pre-service teachers to experiences they might not otherwise get. Our teacher education program has at its core emphases on early and continued field experiences, on developing technological skills, and on understanding diverse learners. Virtual field experiences seem to offer significant promise for expanding the options for linking teacher education students with K-12 teachers and students. While we do not advocate replacing traditional field experiences with virtual field experiences, these experiences do seem to offer significant potential for augmenting the experiences of prospective teachers in university preparation programs.

Conclusion

Teacher education is faced with a variety of challenges today. Technology, while certainly not without its drawbacks, does offer new capabilities that can enable teacher education institutions to do a better job of meeting those challenges. Technology makes possible the development of connections, and those connections make possible new ways of addressing traditional problems in teacher education.

New technologies, particularly those associated with the Internet, can enhance communication between teacher educators and future teachers. Using the web, via course websites or course portals such as WebCT and Blackboard, teacher educators can provide a central point of information for teacher education students. Further, they can use electronic mail and online discussion system to extend office hours and in-class discussions. These approaches break down the traditional boundaries between in-class and out-of-class time and experiences. As a result, there are opportunities for the development of richer dialogue and the growth of true communities of learners in teacher education programs.

Electronic portfolios offer opportunities for other kinds of connections. Future teachers today must demonstrate that they have acquired the knowledge, skills, and dispositions to be effective teaching professionals. Portfolios offer a means by which students can document in rich and varied ways their own growth, development, and ultimately competency. Electronic portfolios allow teacher education candidates to build a collection of their work using familiar, easily accessible, and easily editable digital tools. This work can be represented using multiple media with embedded links to "live" examples. Further, it can be connected to those state and national standards that must be satisfied to obtain teacher licensure. Thus, teacher candidates today can use technology not only to build a professional resume but also to show how that resume satisfies society's demands for what teachers must be able to know and do.

Finally, technology can be used to connect teacher education institutions with the K-12 schools. While field experiences have long been a part of most teacher preparation programs, they are often limited by available placement opportunities in the vicinity of the college or university. New video conferencing technologies offer a flexible and relatively inexpensive means by which teacher education institutions can connect with K-12 schools that are not in the geographical proximity of the institution. Such connections, while not a replacement for traditional field experience, offer opportunities for new experiences and for ways to introduce future teachers to students and settings that they would be unable to encounter otherwise.

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