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

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Introduction

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 to function within the changing schools of today (ISTE, 2000; NCATE, 2001). In this new climate, teacher preparation institutions must consider new ways of doing business, and technology offers capabilities that may help to address these challenges.

Computer-based technologies have already transformed many aspects of work and daily life, and these changes are impacting education as well. 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. The focus on technology in the PT3 program stems from its potential to positively impact education, not just as a “bolt-on” to what already exists, but as a vehicle for making transformative changes in teacher preparation (Ertmer, 2003).

In part, the PT3 program was created in response to the fact that the use of technology in colleges of education has been sorely lacking in the past. Several national reports over the past decade have bemoaned the poor state of teacher preparation with respect to technology use (Moursand & Bielfeldt, 1999; Office of Technology Assessment, 1995; Panel on Educational Technology, 1997; Smerdon et al., 2000). Problems cited 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.

To address these problems, colleges of education have begun to change their practices to embrace effective use of technology. Recommended practices include: (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 (Moursand & Bielfeldt, 1999). After more than five years of reform planning by its faculty and administration, the School of Education at Purdue University recently completed 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, in effect from June 2000 through May 2004, provided substantial support for the implementation of these reforms. The grant project, its major initiatives, and some of its outcomes are described in this paper.

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 anchored by a required, introductory level, educational technology course that focuses on helping students build basic technology knowledge and skills within the context of planning, implementing, and evaluating instruction (Newby, Stepich, Lehman, & Russell, 2000). In addition, instruction in the application of technology in specific disciplines and with a variety of learners is integrated throughout block and methods courses. Technology also 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 cohesive field experiences for our students than were available in the past. The diversity strand is supported by 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. The portfolio strand is supported by a new requirement that all teacher education students develop a professional portfolio in electronic format.

Purdue's P3T3 project addressed each of these strands and so played a significant role in implementation of the new teacher preparation programs. The overall goals of the P3T3 project were 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 sought to meet its goals via three complementary components: (a) a faculty development and mentoring program designed to assist the faculty in learning new technologies and effectively modeling their use in teacher education courses; (b) the development of a dynamic electronic portfolio system that provided pre-service teachers with the means to digitally represent their teaching performances; and (c) technology-enabled (virtual) distance field experiences for pre-service teachers in diverse setting. Ultimately, it was our hope that pre-service teachers would 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. Together, these components addressed many of the challenges that confront Purdue and many other colleges of education.

Faculty Development

The faculty development component of the P3T3 project focused on helping faculty to acquire and refine technology knowledge and skills that they could use and model for the prospective teachers in their classes. The professional development component of the P3T3 project involved a two-day "start-up" workshop, technology skills development workshops, mini-grants, 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, participated in the project over its four years.

The two-day start-up workshops, offered during summers and others breaks in the academic calendar, initiated participating faculty members and others into the project. Designed for about 10-20 participants each, a total of nine start-up workshops were conducted for a total of 113 participants. In part, the start-up workshops were designed to model problem-based or inquiry learning processes as described by Torp and Sage (1998). Technology was used as a tool in this inquiry process and, additionally, was the subject of the 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 specific 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 inquiry-oriented approaches to technology integration. 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 that they might employ in their own classes.

Following the inquiry activity, we demonstrated a variety of available technologies 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 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.

Following each start-up workshop, and at various other times through the academic year, we offered hands-on, skills development workshops for participating faculty members. Topics included: WebCT (the “standard” web-based course support system at Purdue), web page development (e.g., FrontPage, Dreamweaver), working with graphics, concept mapping with Inspiration software, 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. In total, there were almost 900 enrollments in these workshops, and participants' overall evaluation ratings of the workshops were: Great - 66%, Good - 25%, OK - 3%, Fair - 0%, Poor - 0%, No Rating - 6%.

During the project's second year, we introduced Techie Talk, a less formal and briefer faculty development session. Techie Talks were 30-60 minute presentations or mini-workshops conducted during a weekday lunch hour during the academic year; faculty and staff could just drop in. We typically offered 6-12 Techie Talks each semester. Some Techie Talk sessions focused on specific technology skills (e.g., tips for using email or MS Word), while others showcased 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 making connections among faculty and between faculty and the P3T3 staff in a format that was more abbreviated than a full workshop.

At the end of the second year, we also launched a mini-grant initiative. Each faculty member who participated in a start-up workshop received several hundred dollars of supply and expense funding to support their technology integration efforts. While helpful, we found that some faculty members were not able to do as much as they wanted with these funds and others had little use for the support. So, we took unused support dollars and created a pool of funds for a mini-grant competition. Faculty members submitted proposals for technology integration initiatives that were competitively awarded during two rounds of mini-grant funding. This led to a number of exciting faculty-developed initiatives. For example, Professor Brenda Capobianco, a science teacher educator, obtained two mini-grants to support the integration of technology in her elementary science methods course. With the mini-grant funds, she was able to purchase a set of electronic laboratory probes and accompanying software, which she introduced to support inquiry-oriented laboratory activities in her course. She transformed a course that had been largely devoid of technology into one in which technology was infused in support of a key course theme of inquiry-oriented science teaching and learning (Capobianco & Lehman, 2004).

Finally, to assist the faculty in carrying out their plans and developing their own expertise, we offered a 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. We viewed this support as critically important to the successful implementation of the faculty’s technology integration initiatives.

What was the impact of the faculty development initiative? Based on the results of faculty and student surveys conducted at the beginning of the project in 2000 and again at the end of the project on 2004, there was a substantial increase in the use of and comfort with technology. Faculty reported increased use of spreadsheets, presentation software, video conferencing, and hand-held technology. Students reported increased use of word processors, spreadsheets, web browsers, email, presentation software, digital cameras, and hand-held technologies. Whereas only 43% of students agreed that faculty used technology in classes at the beginning of the project in 2000, 99% of students agreed that the faculty used technology in classes by the end of the project in 2004. According to faculty self-reports, all of the responding faculty members reported that they integrated technology into their teaching, and 85% reported having changed their curriculum to add or increase the integration of technology. These data suggest that faculty members successfully integrated technology into teacher education classes. The most widely reported uses of technology were for: email communication with students (98% of responding faculty members), Internet information retrieval by students (85%), in-class presentations (73%), online course resources (69%), technology-based assessment and evaluation (63%), and WebCT course support (54%).

Clearly, many of the technologies used by the faculty involved the Internet and World Wide Web. Given that the Internet has become pervasive in K-12 schools (Kleiner & Lewis, 2003), university teacher educators must model its use to help prospective teachers see effective ways to integrate it in their own classrooms. Many P3T3 faculty development initiatives focused on Internet technologies (e.g., web page design, WebCT, IP-based video conferencing). For the faculty members in our project, the attraction of the Internet, in part, was its ability to make information instantly accessible to others. As one of the participating faculty members commented n an interview, “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.” Another faculty member also cited the communication capabilities of WebCT by noting: "[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."

Faculty members saw the Internet as a tool for better connecting with their students. They used the Internet to communicate with students via email and through posting of course information online. They often created in-class assignments focused on information retrieval from the Web, an activity that mirrored their own professional use of the Internet as tool for keeping up-to-date on research and their discipline. They also used online course discussions in WebCT as a way of extending classroom dialogue. These uses of technology create opportunities for what Dede (1996) has called distributed learning in which the technology facilitates communication and collaboration. While the technology was not viewed by most faculty members as a replacement for conventional approaches, the faculty in the P3T3 project at Purdue embraced those uses of the technology that complemented their classroom interactions 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. Portfolios are purposeful collections of student work that demonstrate effort, progress, and/or achievement. 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. Portfolios provide a vehicle for pre-service teachers to demonstrate their understanding of teaching and learning and so connect their own learning to the standards that guide teacher certification.

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 focused on the latter by creating our own customized, large-scale, electronic portfolio system. The system was designed to allow our pre-service teachers to collect and archive relevant example of their work, submit selected work for faculty assessment, and receive feedback from the faculty about it. The system was designed to support a direct connection between ongoing assessment and reflective practice.

The Purdue Electronic Portfolio (PEP) system was housed on a server with about two terabytes of storage space, enough to give each one of our approximately 2000 pre-service teachers the storage equivalent of a CD-ROM. Candidates' artifacts were stored in a Microsoft SQL Server database, a popular choice for large-scale, web-accessible databases. Candidates interacted with the system through a web-based interface driven by Microsoft Active Server Pages (ASP) technology. Because it was web-based, candidates could access the e-portfolio system from any place with an Internet connection.

Pre-service teachers could log in to the PEP system, manage their account information, upload files, and create artifacts. They could upload most digital files — word processing documents, photos, scanned images, Powerpoint presentations, even videos. Any individual item of evidence was stored in a file. In our parlance, an artifact was an individual file or collection of files that the student assembled in the PEP system to address one or more professional standards. Thus, an artifact could 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 used a template to create an artifact; the completed artifact was a secure web page with links to associated files. Each artifact included common elements — the student's name and photo, course information, relevant standards — as well as whatever components the student wished to include. Students could 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 could add and format their own components to personalize artifacts; these components could be accessed by the student or instructor through live links on the resulting web page. Artifacts, finally, could be assembled to make portfolios. See Figure 1.

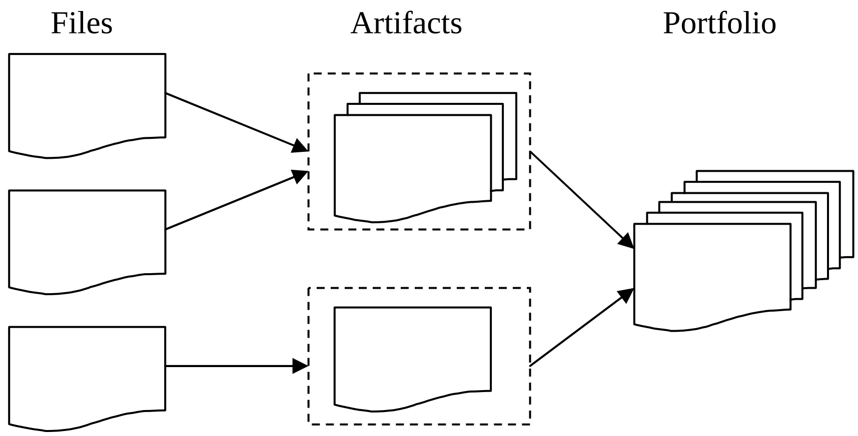

Figure 1. Organization of the Purdue Electronic Portfolio System

After creating an artifact, the pre-service teacher released it to an instructor for evaluation. Until released, an individual artifact remained private and could only be accessed by the pre-service teacher who created it. The system also allowed students to make their artifacts public, allowing other individuals within the PEP system to view it. (No artifact was completely public, because access to the PEP system required a login ID and password.)

Faculty members could log into the system to assess students' work. The instructor could 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 proceeded through the teacher education program, another layer of assessment corresponds to review of the overall portfolio. In Purdue's assessment system, this overall review occurred 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.

In general, students have found the PEP system to be relatively easy to use. However, conceptual barriers have been more substantial. Teacher education students at Purdue had 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 was unfamiliar. Further, most students were not comfortable with the idea of assessing their own proficiencies with respect to established state and national standards. Faculty guidance in addressing these issues will be critically important as we move forward.

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 were determined by the faculty. But, a tension existed between the desire of the faculty on the one hand to ensure that students created an integrated and reflective portfolio that cut 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 agreed upon gate review procedures that placed 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, is was manageable.

While students, for the most part, readily adapted to the PEP system, the faculty was less comfortable with it. Nonetheless, PEP 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, 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.

Students have come 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. 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 such as Purdue, have difficulty placing students in field settings that provide for needed experiences with, for example, diverse student populations. Distance education technologies offer capabilities that can provide needed experiences for pre-service teachers when appropriate field sites are not in close proximity. Using distance education technologies, specifically video conferencing and the Internet, future teachers can observe and also interact with K-12 classrooms from afar. This concept is certainly not new. As long ago as the 1960s, closed circuit television was used to enable teacher education students to observe school classrooms (e.g., Abel, 1960). In the 1980s, Iowa State University's Teachers on Television program established that the observation skills of preservice elementary teachers could be improved through remote observation of public school classrooms using microwave-based video connections (Hoy & Merkley, 1989). However, closed circuit and microwave television technologies were expensive and difficult to set up and maintain. Today's video conferencing technologies offer a much more flexible and cost-effective option for observation of and interaction with school-aged learners at remote school sites.

To date, most literature about video conferencing has dealt with traditional distance education in which course content originating at one location is delivered to students at other locations. More recent literature has discussed other educational applications of video conferencing. For example, some schools have experimented with virtual field trips, typically short term experiences where K–12 or college students connect to a distant site by means of video conferencing to learn more about the site or participate in a planned activity (LeBlanc, 2002; Pachnowski, 2002). In Indiana, for example, a number of K–12 school sites are connected to 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. Using the Vision Athena network, K-12 classes are able to connect to the Indianapolis Zoo or the Indianapolis Children's Museum to learn about exhibits and interact with educational personnel at these sites. As part of our P3T3 project, we explored another application of video conferencing as a tool to link teacher education classes with diverse K–12 students and classrooms for observation and interaction. Although a few such projects have been reported (Edens, 2001; Howland & Wedman, 2003; Phillion, Johnson, & Lehman, 2004), this is an application of the technology that remains relatively little explored.

The P3T3 project implemented an initiative to use video conferencing technology to support distance or virtual field experience for pre-service teachers and develop various models for enhancing teacher preparation through linkages between the university and participating K-12 schools. Four Indiana school districts were partners in the project: School City of East Chicago, Crawfordsville Community Schools, Lafayette School Corporation, and Lawrence Township Schools of Indianapolis. While all four partner districts offered some types of diversity, two in particular – East Chicago, an urban community in northwest Indiana, and Lawrence Township, in the Indianapolis metropolitan area – had student populations that were more ethnically and socio-economically diverse than those in most of the schools near the Purdue campus.

At the outset of the P3T3 project, we expected to use the Vision Athena network for the video conferencing. While we did use 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 points with reasonably fast (128 Kbps or better) Internet access. Special distance education rooms or video studios are not needed. Room-to-room video conferencing was supported by Viewstation units, which start at about $2,500. The Viewstation has 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. With a hand-held controller, users can control the remote end camera to focus in on particular students or activities in the distant classroom. For person-to-person or small-group-to-small-group connectivity, we used Polycom ViaVideo desktop video conferencing units, which operate in conjunction with a Windows PC. While its camera is of lesser quality and lacks the panning and zooming capability of the larger Viewstation units, the ViaVideo is inexpensive (about $400) and supports application sharing during video conferencing. Using ViaVideos, pre-service teachers could tutor individuals or small groups of K-12 students.

The most extensive pilot project involving the use of video conferencing was conducted with beginning teacher education candidates in Block I, in which teacher candidates take two classes: (a) Exploring Teaching as a Career and (b) Multiculturalism and Education. The two foundational courses share a theory into practice (TIP) early field experience, in which the pre-service teachers ordinarily travel to nearby schools to observe classrooms for a couple of hours each week to observe teachers, teaching, schools, and student diversity. Because Purdue is not located near a major urban center, opportunities for the pre-service teachers to encounter diversity are limited. In addition, the pre-service teachers sometimes 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 communities and the schools that serve them are rapidly changing and diversifying (Glazer, 1997). This pilot project was designed to help our teacher candidates experience the ethnic, linguistic, and socio-economic diversity they need to be prepared for the future.

In this pilot project, beginning pre-service teachers enrolled in one or two sections of the TIP did virtual rather than actual field experiences through the use of video conferencing and the Internet. Each semester for eight 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 equipment. The class of teacher education students connected with the bilingual elementary classroom about once a week throughout the semester for between one and two hours each session. During that time pre-service teachers observed the classroom, interacted with the children and teacher, and prepared and presented a variety of enrichment activities.

Prior to beginning the 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 to overcome the impersonal nature of video conferencing communication. After the site visit, the virtual field experiences began and continued weekly through the semester. Initially, pre-service teachers spent time observing the classroom and getting oriented to classroom activities. Unlike the typical TIP experiences in the class, in which individual students visited different classrooms during the week and discussed their observations during the next class, the video conferencing allowed all of the students in the class, as well as the instructor, to observe of the same classroom setting. This created a shared context for discussions about the classroom and the actions of the teacher. As the semester progressed, the pre-service teachers became increasingly involved in actually interacting with the students in the distant 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. These enrichment/reinforcement activities were worked out in advance in consultation with the classroom teacher to supplement her existing curriculum. Over the life of this pilot project, pre-service teachers taught lessons on fractions, story books, historical figures, and the 9/11 World Trade Center disaster. In one semester, Purdue pre-service teachers were invited to prepare activities related to Japan, a year-long theme in the elementary classroom. The pre-service teachers, in groups of three, prepared lessons related to Japan's geography, school life, food, daily activities, wildlife and art/drama/literature. A variety of enrichment lessons were created, adding to the teacher's curriculum while giving the pre-service teachers a chance to learn about and work with diverse elementary students. A video program describing this pilot project was produced by Soundprint Media and WHRO-TV, the PBS affiliate in Norfolk, Virginia, for the *Teaching Now!* (formerly *PT3 Now!*) video series and can be viewed online at: http://teachingnow.org/watchTV.php?id=30.

In addition to the pilot project described above, a number of other experiments in the use of the video conferencing technology were conducted. For example, Professor Mark Balschweid used video conferencing to allow students in his agriculture teacher education class to unobtrusively observe a classroom to reflect on what goes on there. As with Professor Phillion's pilot project, the video conferencing permitted an entire class of pre-service teachers to observe a K-12 classroom setting together, thus creating a shared context for discussion about what they saw. Professor Tristan Johnson, a faculty member in educational technology, used video conferencing and the Internet as a vehicle for his instructional design class to create and deliver instructional materials to an audience of K-12 students. In one semester, the university students developed a website and video-based lessons about cartoonist Rube Goldberg, metric measurement, and simple machine concepts to capitalize on a well-known Rube Goldberg machine contest started by engineering students at Purdue. 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 (O'Connor, 2003; Phillion, Johnson, & Lehman, 2004). Most recently, Professor Gerald Krockover, a science educator, used video conferencing to supplement face-to-face supervision of student teachers. In each case, video conferencing supported extensions or enrichments of the traditional teacher education curriculum by enabling university classes to reach out and connect with K-12 classrooms at a distance.

As part of the project evaluation, students in Professor Phillion's pilot project were surveyed about their perceptions. Table 1 shows the results from end-of-semester Likert-type survey items from one year. While students had little prior experience with the technology, 69% agreed or strongly agreed that they were comfortable with the video conferencing equipment by the end of the semester, and 81% agreed or strongly agreed that it was easy to use. A large majority (81%) agreed or strongly agreed that they learned to use the video conferencing equipment from this class experience. About two-thirds (66%) agreed or strongly agreed that the technology was a valuable addition to the class. A majority (60%) agreed or strongly agreed that that they felt more comfortable using technology for teaching and learning as a result of the class experience, and, significantly, 83% agreed or strongly agreed that that they felt more comfortable teaching diverse learners as a result of the experience.

Table 1
Pre-service teachers' responses to end-of-semester video conferencing survey items (n=42).

Survey item	**Strongly Agree**	**Agree**	**Undecided**	**Disagree**	**Strongly Disagree**
By the end of the class, I felt comfortable with the video conferencing equipment that we used.	6 14%	23 55%	12 29%	1 2%	0 0%
The video conferencing in this class was easy to use.	8 19%	26 62%	8 19%	0 0%	0 0%
I learned how to use video conferencing in education from this class.	6 14%	28 67%	3 7%	4 10%	1 2%
I believe that the use of video conferencing was a valuable addition to this class.	11 26%	17 40%	6 14%	4 10%	4 10%
Because of the experience in this class, I feel more comfortable in my ability to use technology for teaching and learning.	9 12%	20 48%	9 21%	2 5%	2 5%
Because of the experience in this class, I feel more comfortable in my ability to understand and teach diverse learners.	13 31%	22 52%	4 10%	1 2%	2 5%

One benefit of the experience seemed to be the development of pre-service teachers' classroom observation skills. Consistent with the finding of Hoy and Merkley (1989), the 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 context led to opportunities for richer class discussions. 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. They also showed evidence of significant growth in their understanding of diverse students and how to teach them. One pre-service teacher commented, "I also think that being able to see a more diverse classroom than the ones close by was a big advantage for us because it gave us something to relate our multicultural studies to." Another remarked, "I've learned not to be afraid of teaching students in the more run down communities… they're not as scary as I had first imagined."

Of course, there were difficulties that must also be acknowledged. Most schools are protected by an Internet firewall which must be configured to allow selected outside connections. When trying to set up video conferencing connections, we ran into difficulties that required time and effort on the part of technical support staff to resolve. The IP-based video conferencing technology is good but sometimes technical problems or teacher absence caused the cancellation of a video conferencing session. In addition, the connections sometimes became "choppy" or broke up as a result of limited bandwidth or network congestion. Even when working perfectly, it was difficult for pre-service teachers to make observations by watching a video screen, and the children's voices were difficult to hear over the background noise of the classroom. Furthermore, the main issue for the pre-service teachers was that they were not in a "real" classroom with "real" students. Some students felt cheated that they did not get to go into an actual classroom each week. However, most of the future teachers seemed to benefit from the experience.

When we consider all factors, these virtual field experiences seemed 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 offered a way to expand 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 offers 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. Further, their work 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. Video conferencing technology offers a flexible tool with which teacher education institutions can connect with K-12 schools at a distance. 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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