Making Connections in Teacher Education: Using IP-Based Video Conferencing to
Link Pre-Service Teachers with K-12 Classrooms

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Abstract

Teacher education programs often struggle with issues such as diversity and technology integration in field placements for future teachers. Distance education technologies offer capabilities that can be used to address these issues. Video conferencing allows pre-service teachers to observe and interact with K-12 classrooms at a distance, which can provide for virtual field experiences of diverse classroom settings and involving innovative uses of technology. New IP-based video conferencing systems, which support good quality video and audio over the Internet, offer greater flexibility at lower cost than older video conferencing technologies. Pilot projects as part of P3T3: Purdue Program for Preparing Tomorrow's Teachers to use Technology, a PT3 implementation project, have developed models of how to link pre-service teachers and classes with K-12 teachers and students using IP-based video conferencing. Advantages of this approach include: development of pre-service teachers' observational skills, linkages with diverse classroom settings, and opportunities for university students to practice developing and delivering instruction via this technology. Limitations include issues with school Internet firewalls, classroom audio and sometimes video problems, and lack of in-person contact. The technology offers promise for certain kinds of field experiences in teacher education.

Introduction

Teacher preparation programs are faced with a variety of challenges. 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 preparation programs 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. Teacher preparation programs must also help pre-service teachers learn to use technology and develop their understanding of diversity and multiculturalism (NCATE, 2001). Meeting these challenges may require new approaches.

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. Purdue University has initiated an innovative project in the use of technology-enabled field experiences, part of a Preparing Tomorrow's Teachers to use Technology (PT3) implementation grant, to address key components of its teacher preparation program including understanding of classrooms and diversity, technology integration, and development of appropriate instruction for K-12 learners.

While distance education has traditionally been viewed primarily in terms of content delivery, i.e. a teacher at one site presents course materials to students at other sites, today's distance education technologies offer opportunities for other types of interactions between colleges of education and K-12 schools. For example, using distance education 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). 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 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. This paper reports on a project, part of P3T3: Purdue Program for Preparing Tomorrow's Teachers to use Technology, which is exploring the use of video conferencing distance education technologies for enhancing teacher education by providing opportunities for pre-service teachers and classes to link with K-12 students, teachers, and classrooms.

Background

After five years of reform planning by its faculty and administration, the School of Education at Purdue University recently completed implementation of the final phase of completely restructured elementary and secondary teacher education programs. The new programs, which were launched with students entering teacher

preparation programs in the fall of 1999, feature a cohesive set of block courses and practical experiences that are anchored by four strands – technology, portfolio assessment, diversity, and field experience.

In Purdue's new teacher preparation programs, the technology strand is manifest in a required educational technology course followed by integration of technology experiences throughout other courses. To address the portfolio strand, each pre-service teacher develops a portfolio to document professional growth, for self-reflection on learning, and to provide the foundation for performance-based licensure. A large-scale, web-based, electronic portfolio system has been developed as another aspect of the P3T3 project. 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, special needs/gifted populations) during field experiences. The field experiences strand is supported by a Theory Into Practice (TIP) component that accompanies each block of courses in the new program. The TIPs provide our pre-service teachers with more and richer field experiences than were available in the past. The P3T3 project is helping to support implementation of the new programs and ensure that technology is integrated throughout the teacher preparation programs as originally intended.

The overall goals of the P3T3 project are to (1) 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 (2) prepare teacher education faculty to teach pre-service teachers in technology-rich environments, modeling approaches that future teachers should use themselves. The project is meeting its goals via three complementary components: (a) faculty development and integration of technology in teacher preparation courses, (b) development of a electronic portfolio system to support production of portfolios by all pre-service teachers, and (c) creation of rich and diverse field experiences enabled by the use of technology. This paper focuses on the latter, specifically the use of distance education technologies to create virtual field experiences for prospective teachers.

As one way to address the challenges of providing diverse and rich field experiences in a limited geographic location, Purdue's P3T3 initiative is making use of two-way video conferencing to link pre-service teachers and teacher education classes with diverse K-12 students, teachers, and classrooms. The purpose of this initiative is to explore various models for enhancing teacher preparation through these linkages between the university and participating K-12 schools.

Two video conferencing systems are used in the project. Some of our partner K-12 schools are linked to an intrastate fiber optic video network called Vision Athena (http://www.visionathena.org). The Vision Athena network is managed by the Center for Interactive Learning and Collaboration, a partner in the P3T3 project. While Purdue University does not have a direct connection to the Vision Athena network, we can connect with schools on the network through a video bridge. The other technology we are using is IP-based video conferencing equipment from Polycom (http://www.polycom.com), which supports good quality video and audio over the Internet. This technology is relatively affordable and very flexible, because a standard H.323 connection can be established between any two locations with access to a reasonably fast Internet connection (128 Kbps or better). Because of these advantages, it is emerging as the technology of choice in our project.

We use two types of Polycom video conferencing equipment in our project. Room-to-room video conferencing is supported by Viewstation SP (point-to-point) or FX (multipoint) units. These compact units have a camera with panning and zooming capability that can be attached to any available video monitor and plugged into an ethernet jack for Internet connectivity. Prices start at about $2500 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 described in this paper.

Class to Class Video Interactions for Beginning Pre-Service Teachers

In the first block of the teacher preparation programs at Purdue University, teacher education students take two classes: Exploring Teaching as a Career and Multicultural Education. The classes are designed to provide a foundation for future education courses by helping the pre-service teachers to begin to understand the nature of teaching and schooling. The two courses share a 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.

Unfortunately, because of Purdue's geographic location away from any major urban centers, opportunities for encountering diversity during field experiences are limited for pre-service teachers in our program. In addition, pre-service teachers often feel there is no need to understand diverse populations of students because they plan to teach in predominantly white and rural areas after graduation (Yao, 1999). The demographics of the areas they plan to teach in, however, are rapidly changing and diversifying (Glazer, 1997). As local placements reflecting ethnic, linguistic, and socio-economic diversity are difficult to find within driving distance, and as it is essential that students have these experiences, one of our pilot projects has endeavored to use technology to reach out to diverse classrooms in other parts of the state.

The pilot project described here was implemented in order to link learning about technology with learning about multiculturalism by placing beginning pre-service teachers in diverse classrooms for their field experiences through the use of video conferencing and the Internet. In this pilot project, elementary pre-service teachers enrolled in a section of the first block's TIP participated in their field experience via video conferencing with a partner school in a diverse area of Indiana. Using Polycom Viewstation equipment, a faculty member (one of the authors) and students at Purdue linked with a teacher and students in a grade three bilingual class in a diverse inner city school in East Chicago. The two sites connected 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 which they taught using the interactive capabilities of the Polycom technology and the Internet. Prior to each interaction the teacher posted information about her current curriculum and suggestions for activities on her website. The pre-service students prepared mini-lessons based on the teacher's guidelines in consultation with the faculty member who acted as a liaison for all parties.

At the beginning of each semester, the pre-service teachers became acquainted with the technology. They learned to connect to the remote site, operate the remote controls for the cameras both at the Purdue site and the school site, and develop mechanisms to facilitate communication. The pre-service teachers practiced with the equipment by splitting into two groups and video conferencing between two local classrooms. The university students received a checklist of procedures to follow prior to connecting and while connecting for reference.

Prior to beginning the actual video conferencing field experiences, the university class made a site visit to the participating school. During this trip, the pre-service teachers spent the day touring the school; meeting staff, teachers and students; and interacting with the students in the grade three class involved in the project. During the visit, the pre-service teachers used guiding questions in order to do a mini-ethnographic project aimed at uncovering their assumptions of the school and students. This visit allowed the pre-service teachers to gain first-hand knowledge of the school and the students, which we believe helped to overcome some of the impersonal nature of remote connection.

Following the site visit, the virtual field experiences began and continued weekly through the remainder of the semester. (This pilot project has been repeated during five consecutive semesters.) 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. Students in the grade three class and pre-service teachers brought in baby pictures and made riddles about "Who am I?" Pre-service teachers prepared Powerpoint presentations of their riddles to share. 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, directly teaching mini-lessons to the students. These activities reinforced what the teacher was teaching in the class or enriched the curriculum. Over the life of this pilot project, pre-service teachers have had the opportunity to engage in a variety of activities, including teaching lessons on equal and unequal fractions using everyday objects, colorful graphs, and diagrams and charts; reading stories and providing follow up questions; researching information about Benjamin Franklin and presenting it to students in the form of a skit; and communicating with the students in both English and Spanish. One session was devoted to discussing the World Trade Center disaster. Purdue pre-service teachers and the grade three 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.

Informal observations of the project to date suggest that it has had benefits. In each semester, the pre-service teachers quickly adjusted to the technology and learned how to manipulate the equipment. They readily followed the guidelines of the classroom teacher and the faculty member; however, most groups were not adventurous in exploring the capabilities of the technology to work with the students in the classroom. Journal entries indicated that they began to see technology as a tool that could be used for teaching and their own and others' learning, personal productivity, and communication. Significantly, one benefit seems to be the development of pre-service teachers' classroom observation skills. These beginning teacher education majors come into the course as unskilled observers, but through the guidance of a faculty member who observes alongside them via the video

conferencing, they become better observers themselves. In addition, the shared observational experience leads to opportunities for richer class discussions.

The pre-service teachers understanding of diversity issues and how to teach children unlike themselves have apparently also grown as a result of the project. Diversity occurs is in every interaction, although often subtly and in ways students may not expect. Many pre-service teachers thought the classroom teacher would teach "differently" because she had diverse students. They also expected badly behaved students and indicated surprise at the well-maintained school and the well-behaved students. In interactions with the teacher and students and in interviews with the teacher, they learned that the teacher has high expectations, does not water down the curriculum, teaches in an integrated style, and builds on the students' prior experiences. They have also learned a great deal about teaching, including how to teach in a bilingual setting and how to teach at a distance.

On an end-of-semester survey during one semester, 15 pre-service teachers rated the overall video conferencing experience good, 4 were undecided, and 1 rated it poor. No one rated it either very good or very poor. The pre-service teachers 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.

The teacher in the participating classroom indicated some reservations about feeling as though she was on display and that the students "went a little wild" after the Purdue class signed off. On the positive side she felt her students benefited from contact with Purdue students, enjoyed the activities, and readily spent time preparing for the activities. She felt that involvement in the project has kept her own thinking fresh, and she is using her participation in this project as part of what she will compile for National Board certification. Her students have indicated a range of feelings, most of them positive. While some of the K-12 students have reported feeling nervous, they like the attention and feel like the Purdue students are friends. Overall, these preliminary results are encouraging.

Small Group Instruction via Personal Video Conferencing

A second pilot project involving remote field experiences was developed as a part of a course, Production of Instructional Materials, open to both undergraduate and graduate students. A faculty member (one of the authors) launched this pilot project in cooperation with the P3T3 project to provide the university students with a genuine context and audience for the design, development, and implementation of instructional materials. Teams of university students created instructional materials for a K-12 audience. By linking with a K-12 classroom, an authentic context was created for university students needing to develop instructional design skills, and the K-12 students benefited by receiving custom-designed instruction. In addition, an apprenticeship model was employed as part of the project whereby advanced graduate students mentored the teams of university students, acting as project managers, during the instructional design process.

Three different experiences were implemented during different semesters. In each case, the key project goals were to: (a) develop and implement web-based learning materials for K-12 learners, (b) develop and implement video conferencing distance learning activities with students at a remote site; and (c) through these activities, provide university students with the opportunity to enhance their skills in the design, development, and implementation of instructional materials. Video conferencing was used to a lesser extent than in the first pilot project, described above, but it played a key role in the project. Various forms of evaluation, including observations, student reflections, peer assessments, and instructor assessments were employed during the projects.

In the first semester of this pilot project, a small group of university students created a web-based virtual field trip for a class of second grade students at a rural partner school who were planning to visit a children's museum in the state. The virtual field trip was specifically designed as an online learning activity with both asynchronous and synchronous components. The main aims of the virtual field trip were to expose students to information prior to the actual field trip to the museum, help students get excited about going to the museum, increase student participation at the remote site by helping them obtain information about the predetermined trip, and set the educational tone and expectations prior to the museum visit. To accomplish these goals the virtual field trip was designed to help students obtain information online, assimilate the information, and communicate their understanding to peers, university students, and teachers.

Video conferencing was used for both planning and part of the implementation of the lesson built around the virtual field trip. The university instructor and team of student developers used video conferencing on two different occasions to connect to the participating classroom teacher to collaboratively plan the virtual field trip and associated instructional activities. Then, video conferencing was employed for the university students to observe as the teacher implemented initial instructional activities with the second graders in the classroom. As a culminating

activity, the team of university students used the video conferencing to remotely lead a final classroom activity involving the web-based instructional materials. Overall, the development and implementation activities spanned about ten weeks of class time, although only two hour-long video conferencing sessions were involved in the implementation phase of the project.

The next semester, university students engaged in small group to small group interaction with a group of fifth grade students. During this semester, the team of university students developed a stock market investment project based on specific programmatic themes outlined by the cooperating in-service teacher. Adapting the approaches of the first semester, four lessons were created, one web-based and three via live video conferencing. A key strategy implemented during this second iteration of the pilot project was the use of application sharing during video conferencing using Polycom ViaVideo units. This capability allowed the university students to share an application (Microsoft Excel) remotely and work with the K-12 students to co-construct a spreadsheet as part of the lesson. The purpose of the application sharing was to promote a higher level of interaction between university and K-12 students during the lesson.

The third semester of this pilot project continued the use of application sharing as one part of a comprehensive lesson developed for a fifth grade class at a partner elementary school in an urban center in the state. This time, the team of university students directed by an advanced graduate student developed a lesson involving both web-based instructional materials and synchronous video conferencing sessions built around a popular engineering contest founded at the university called the Rube Goldberg Machine Contest. Rube Goldberg was well-known cartoonist who drew cartoons of absurdly complex machines that took many complicated steps to perform a simple end result. In the early 1980s, students at Purdue University began the contest that paid homage to the cartoonist by requiring teams of engineering students to construct elaborate machines that required 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 fifth graders about Rube Goldberg, metric measurement, and simple machine concepts. Video conferencing sessions were used to introduce students to the lesson concepts building toward the culminating activity of the lesson, a Rube Goldberg machine building contest for the fifth graders. Application sharing with the ViaVideo unit was used during one of the video conferencing sessions to help students understand simple machine concepts. Sharing a photo of a simple machine, such as a pair of scissors, students were able to manipulate images in a Microsoft Word document to demonstrate that they understood concepts of force, the location of the fulcrum of a lever, and so forth.

During the final session of the lesson, teams of fifth grade students, who had constructed their own Rube Goldberg machines to raise a small American flag in multiple steps, demonstrated their machines in front of the video conferencing unit. The team of university students observed the activity at a distance and served as the judges of the contest. 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 fifth grade students benefited from an engaging lesson that involved important mathematics and science concepts and interactions with a genuine audience consisting of college students. It was in many senses a win-win activity.

These three iterations of this pilot project involved a number of important instructional attributes. The university students' learning was situated in real context that allowed them to develop important instructional design skills. The instructor and advanced graduate student modeled the instructional design process for the novice designers and coached them as needed. Under this guidance, the university students were able develop their own expertise, gradually assuming increasing responsibility for the instructional outcomes. The video conferencing played a key role in the process, both as a vehicle for planning with the cooperating teacher and as a delivery system for the lesson that resulted. It also stretched the university students by requiring them to plan and implement a lesson using what for most of them was an unfamiliar instructional environment.

A formative evaluation that included interviews and surveys from the university students indicated that on the whole the experience was beneficial. They felt that the remote field experience was instructionally valuable, showed a real-life application, increased their technology confidence, generated satisfaction, 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 semester schedule, and students' lack of comfort with this approach and the ambiguities that resulted. There were occasional problems with the technology such as difficulties in establishing good connections and the limitations of ViaVideo unit as a video conferencing tool with small groups when it was designed mainly to be a person-to-person video conferencing tool. Overall, the remote field experience was judged a reasonable success, and both university students and the K-12 students enjoyed their involvement in the experience.

Strengths and Limitations of the Distance Learning Technology

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 on both ends. For IP-based video conferencing, a significant initial barrier is school Internet firewalls. Because of information security concerns, most schools are protected by an Internet firewall. While keeping people out of the internal network, a firewall can be configured to allow selected outside connections. When trying to set up this access, we ran into difficulties in both of these projects. These problems were resolved, but not without a fair amount of time and the help of several technicians. Once established, the IP-based connections worked fairly well most of the time.

Once the equipment was working, the participants had to spend time learning to use the system to communicate. This process was not difficult, but it was critical to the success of each project. The university students needed to practice using the system to help them get a feel for the communication abilities, and the K-12 teachers and students also needed to practice with the system to develop a level of comfort and fluency with the technology to facilitate routine communication. We found that it helped to develop conventions to facilitate communication, such as having name signs and using signals to denote when students at the remote site were supposed to do something.

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 classrooms in East Chicago and our other partner sites seemed to open their minds 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 was that the pre-service teachers were not in a "real" classroom with "real" students. Some students, at least initially, felt a loss at this mode of interaction. Sustained interaction for a lengthy period, such as the two hours originally planned for the video conferencing with the diverse classroom in East Chicago, proved to be difficult for the pre-service teachers. So, that experience was restructured into shorter time blocks involving an initial discussion, observations, and then debriefing. In the other pilot project, students were somewhat uncomfortable with the open-ended nature of the process and the difficulty of communicating with a teacher at a remote site. Structure is needed to help pre-service education students benefit from this experience, but it is important to remain flexible and willing to adapt.

The technology is good, but students in the pilot projects have noted limitations. IP-based video conferencing connections are susceptible to problems as a result of limited bandwidth or network congestion. Sometimes the Internet-based video conferencing connection is "choppy." When Internet packets are "dropped" as a result of network traffic, this can result in the video freezing and the audio breaking up. Even when working perfectly, the picture on the screen, while not bad, could be clearer. Effective observation often means noting subtle facial expressions and body gestures not easily discerned by viewing a video monitor. The ViaVideo unit, which is really designed for personal video conferencing, can be used with small groups, but the results are not optimal; without panning and zooming capability, the video is limited.

Audio is as important as or more important than the video. While the teacher's voice comes through clearly most of the time, the children's voices are less clear. Furthermore, background room noise can create interference. While we have found that having the teacher work with the students to speak more loudly and clearly, audio quality is generally a problem that we have not fully resolved..

Considering all factors, as a part of a teacher education program, which has at its core emphases on early and continued field experiences, on developing technological skills, and on understanding diverse learners, these virtual field experiences seem to be a worthwhile way to expose pre-service teachers to experiences they might not otherwise get. Distance education technologies seem to offer significant promise for expanding the options for linking students in teacher preparation programs with K-12 teachers and students.

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