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Learning to Teach with Technology: From Integration to Actualization

BELINDA GIMBERT AND CARLA ZEMBAL-SAUL
The Pennsylvania State University

BACKGROUND AND PURPOSE

In their review of literature on information technology and teacher education, Willis and Mehlinger (1996) asserted, "Most preservice teachers know very little about effective use of technology in education and leaders believe there is a pressing need to substantially increase the amount and quality of instruction teachers receive about technology" (p. 978). This is not surprising given that the United States Office of Technology Assessment (U.S. Congress, 1995) report found that technology was not a central component of teacher preparation programs in most colleges of education. A summary of the key findings states, "Most technology instruction in colleges of education is teaching about technology as a separate subject, not teaching with technology across the curriculum. Seldom are students asked to create lessons using technologies or practice teaching with technological tools" (p. 165). Clearly there is a need to integrate technology into teacher preparation.

Attention to technology integration into university coursework alone, however, may be insufficient for assisting prospective teachers in learning how to effectively infuse technology into their classroom teaching practices. A common problem reported in the literature is the decontextualization of elements of teacher education (Zeichner, 1992). A number of reports on teacher education (Goodlad, 1990; Holmes Group, 1986, 1990; Levine, 1992) have identified professional development schools (PDSs) as having the potential to transform teaching and learning. The focus on creating a culture of collaboration and professional learning aimed at supporting students' meaningful learning and development is fundamental to the appeal and promise of PDSs (Darling-Hammond, 1994; Rosaen & Hoekwater, 1990). In light of the potential to provide unique opportunities to integrate university coursework and field experiences (Darling-Hammond, 1994; Levine & Trachtman, 1997), PDSs offer a compelling context in which learning to teach with technology may be possible. More specifically, school-university partnerships foster contexts in which school-wide and classroom-based environments offer prospective teachers meaningful opportunities to develop abilities and understandings to effectively use instructional technology. Technology infusion in such settings stands to be a powerful approach to fostering change with respect to instructional technology in teacher preparation. The purpose of this article is to highlight examples of technology infusion in the context of a particular PDS, the school-university partnership between The Pennsylvania State University and the State College Area School District (PSU-SCASD PDS Program).

PROGRAM CONTEXT

As a result of a six-year effort, four professional development schools were collaboratively developed to achieve three central goals (for an indepth description of the partnership, see Dana, Silva, & Colangelo, 1998). The primary goal of the PSU-SCASD PDS Program is to enhance the education of all children. Second, there is an emphasis on providing high quality field experiences for prospective elementary teachers. The final goal is to engage in furthering the professional growth of school-based and university-based teachers and teacher educators.

Penn State elementary education majors in their final year of preparation are selected to complete the yearlong internship program through an extensive application and interview process in which mentor teachers play a major role. Interns agree to begin the experience during the second week in August with an intensive two-week, campus-based preparation experience, termed "Jump Start." Interns then join their mentors for orientation, classroom preparation for the school year, and district meetings. At this point, interns abandon the university calendar to teach alongside their mentors.

Through specialized coursework and seminars taught onsite at one of the four PDSs and by teaching alongside their mentor teachers each day of the school year, interns earn 30 credits, the equivalent of Penn State's Elementary Education Discipline Inquiry Block Courses (i.e., three credits each in math methods, science methods, social studies methods, classroom management, and clinical experience) and Student Teaching. Through the auspices of a Lucent Technologies Foundation grant, teams of classroom teachers and Penn State teacher educators structure the experience to ensure that course objectives are met and technology needs are supported within the rich context of spending a full school year in the field. Mentors and Penn State faculty rely on the Penn State Elementary and Kindergarten Education Conceptual Framework to shape and guide the internship experience.

A FRAMEWORK FOR LEARNING TO TEACH WITH TECHNOLOGY

One goal of the PSU-SCASD PDS Program is to support interns in developing abilities and understandings associated with effective use of technology to enhance student learning. The Science Education Group at Penn State has developed a model/framework for learning to teaching with technology (Figure 1) that has proven to be helpful in designing learning experiences for prospective teachers (Dana & Zembal-Saul, 2001; Friedrichsen, Dana, Zembal-Saul, Munford, & Tsur, in press; Sillman, Zembal-Saul, Friedrichsen, & Dana, 2001). The technology tools that are addressed fall into three main categories: (a) online collaborative tools to support web-based discussions and other web-based activities (e.g., *Course Info*™ by Blackboard.com); (b) discipline-specific tools (e.g., simulations and modeling in science); and (c) general productivity tools (e.g., *Power Point*™ web authoring applications, *iMovie*™. The Learning to Teach with Technology Model is based on conceptual change learning principles (Posner, Strike, Hewson, & Gertzog, 1982) and is designed to raise the status of prospective teachers' conceptions of supporting children's learning using technology.

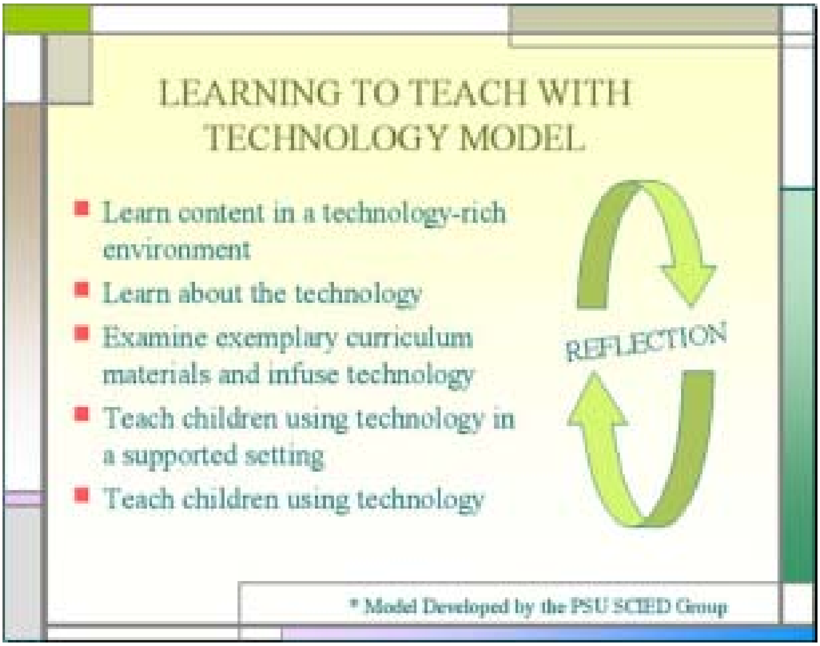

Figure 1. Learning to teach with technology model

In the first phase of the model, prospective teachers learn subject matter in a technology-rich environment. Given that many prospective elementary teachers report never having learned in this way, the purpose of this phase is to have them experience as learners what it is like to use technology to develop meaningful understanding of content. For example, as part of science methods, we might have interns use light intensity probes to collect data and develop explanations about the properties of light as part of a model science lesson. Once prospective teachers have experienced learning with technology, the second phase engages them in learning about the technology. Continuing with the prior example, interns would learn how to interact with the real-time graphing software used in the light investigation, as well as set-up and troubleshoot the light intensity probes. In the third phase of the model, prospective teachers examine exemplary curriculum materials and work collaboratively to infuse appropriate applications of technology. In the case of interns, these existing materials may include district curriculum. Emphasis is placed on the “value added” with technology, as opposed to incorporating technology for technology’s sake.

The final phases of the Learning to Teach with Technology model include opportunities to teach children using technology, and are heavily supported by university faculty and mentor teachers. In phase four, the emphasis is on providing prospective teachers with safe and scaffolded experiences working with children. This typically involves co-planning and co-teaching a small group of children with another intern or mentor teacher. The goal here is to minimize the complexities and distractions associated with classroom contexts and focus prospective teachers on children’s thinking. Finally, in the fifth phase, prospective teachers plan and teach a technology-enhanced lesson to the children in their internship classroom. It is important to note that throughout this model there are opportunities for prospective teachers to engage in substantive reflection and develop considerations for teaching with technology. Interns post their lesson plans, written reflections, and other program projects to web-based portfolios that they author (Zembal-Saul, 2001; Zembal-Saul & Dana, 2001).

CASES OF TECHNOLOGY INTEGRATION IN PDS CLASSROOMS

In the next section, five cases are presented as examples of technology integration in the elementary PDS classrooms. These cases represent various phases of the Learning to Teach with Technology Model, particularly the fourth and fifth levels. In addition, a variety of applications of technology are illustrated, including multimedia authoring software, simulations, web-based resources, and graphing software.

Grade 1—Mystery Dinosaurs: Demonstrating the Discovery Process using *Kid Pix™*

This case represents the most advanced stages of technology integration. That is, interns sought out opportunities to support and demonstrate student learning on their own, outside the requirements of program assignments. In designing a culmination activity for a first grade science unit, Prehistoric Life, a team of two interns and their mentor teachers worked together to develop a plan for technology integration. They generated ways to construct a presentation task as the final activity. More specifically, they agreed that children would work in small groups to author slide shows using *Kid Pix*™ Rather than focusing merely on what was learned, they decided also to include an emphasis on the process children used to determine the identity of their mystery dinosaurs. University faculty in the PDS community provided support, which ranged from converting digital images to the proper format for use in *Kid Pix*™ to working with small groups of children to develop their slide shows.

The project required extensive planning, and the interns were well prepared and organized in terms of doing this. They began by introducing children to the technology prior to engaging in the main task, allowing them to become desensitized to all of the "bells and whistles" of the software. The next phase of planning was low-tech – a paper and pencil task. Each child in the group was responsible for designing one to two slides. This included selecting the digital photos they planned to use, identifying background colors and designs, writing captions, and scripting the narration associated with each slide.

To access enough computers to allow 46 children to work in groups to construct their slide shows, five computers were relocated into one of the first grade classrooms for a day. One mentor and intern pair facilitated a lesson with half of the group, while the other group worked on their slide shows. The two groups swapped activities mid-day. In the slide show production group, teams of children, each facilitated by an adult, worked over a three-hour period to construct their projects. Completed slide shows incorporated multiple forms of media, including text, images, and sound (Figure 2).

On the final day of the unit, parents were invited to attend the slide show presentations. Teachers, university faculty, parents, and other audience members were very impressed with the children's explanations of how they had determined the identities of their mystery dinosaurs, as well as how they had designed their slide shows. Shared comments from the adults expressed surprise that first graders were capable of using technology to demonstrate their learning.

Figure 2. Students' present their slideshows about dinosaurs

Grade 2—Exploring Seasons: Simulating an Ecosystem with *Sammy's Science House*™

In this case, the software program, *Sammy's Science House*™was integrated into a second grade unit aimed at helping children understand weather conditions and ecosystem changes associated with the four seasons. The objectives of the unit focused on how students identified and described the four seasons, and explained the effects of each season on people, plants, and animals. The intern who planned and implemented this series of lessons did so in fulfillment of a methods course requirement. Given that the emphasis was on working with small groups of children with the support of the mentor teacher, this case represents the fourth phase of the previously described model.

The intern rearranged the classroom to accommodate two computer work stations. Small groups of four to five children each were introduced to the software through a brief demonstration and instructed to go to Acorn Pond, a simulated ecosystem. In this area the children progressed through the four seasons at Acorn Pond. As they did so, they recorded their observations, drawing and annotating seasonal weather conditions. Next, students documented their explanations for changes that were occurring with the plants and animals at Acorn Pond, as well as changes to the pond itself. Temperatures at Acorn Pond during each season also were recorded. Children then discussed their drawings and described them to parents and university faculty who volunteered in the class. Some of the questions explored included the following: What happened to the tree, the animals, and the pond during each season? What issues were encountered by various animals and plants in each season, and how did they respond? Assessment of students' work was based on their drawings of the Acorn Pond ecosystem and explanations associated with seasonal changes.

Assessment data indicated that students developed appropriate understandings of seasonal changes through this activity. In addition, children were enthusiastic about using the computers. They reported enjoying the interactivity provided by the program, and the freedom to work in small groups to make decisions about how and in what order to investigate various aspects of the ecosystem.

Grade 3—Where do insects go in winter? Using the Web to Support a Science Investigation

Like the first grade example, this case also represents the highest level of implementation associated with the Learning to Teach with Technology Model. That is, the intern in this case integrated technology into her instruction on her own after having experienced all phases of the model through program assignments and activities. The investigation was motivated by a number of students in the intern's class who demonstrated an interest in the outdoors. Considering the constraints of the curriculum and the interests of these students, the intern led a group of children into the woods near the school for a science investigation. She chose to use a guided approach to inquiry and framed the investigation with the question: Where do insects go in winter? To support the investigation, the intern searched for books on insects in the school library and browsed the Web for sites associated with insect galls and over-wintering. In doing so, she realized how important it is for a teacher to have a good understanding of content before trying to teach it to children.

The intern followed-up her trek into the woods with students with a class discussion that focused on what they had observed on their field trip. In particular, she asked children why they had not found any insects in the woods. Children's ideas about this included that it was too cold and that insects were buried deeper in the ground than they had explored. At this point, the intern introduced a plant gall that her mentor teacher had brought in. She let students look at it with microscopes and make conjectures as to what it could be. Some children thought it might be a cocoon that hardened on a seedpod.

The intern proceeded by dividing the group in half. Three children sat with her at the computer, while the others recording their ideas and questions in their science journals. Books on insects were available for the students to browse as they worked. The focus during this part of the lesson was to show students a variety of sources of information about insects. The intern shared a series of web sites with the children at the computer that included pictures of galls, information about various insects, and pictures of insects in their habitats (Figure 3). The students analyzed the detailed images of the galls. They identified galls that they had seen in their yards and on the school grounds.

The intern concluded that finding ways to infuse technology with scientific inquiry is an important aspect of supporting children's learning. In particular, guided research using web-based resources provides information that children can use to enhance their knowledge and generate further questions for investigation.

Figure 3. Students visited websites to learn about insects

Grade 4—How healthy is the food we eat? Representing Nutritional Information using *Graph Club*™

In his efforts to address the Pennsylvania Science and Technology Standards, an intern designed instruction aimed at having students explore foods on the basis of protein content by constructing graphs using graphing software. This case represents phase five of the model in which prospective teachers use what they have learned about teaching with technology to independently design and teach a technology-integrated lesson.

Students were introduced to *Graph Club*™and given time to explore the software and engage in tutorials. Next, students were placed in small groups, with each individual having a designated task. More specifically, two students were responsible for interacting with the computer and software, one for guiding the progress of the group as outlined by the intern, and one for assessing the group's ongoing progress. These roles were exchanged periodically throughout the project. Students then began investigating the labels of foods that were being compared. This information was used to build graphs. The intern provided focus questions to guide students in their comparison of different foods and assessed students' ideas as they generated their graphs. After students had constructed their initial graphs, the intern's questions shifted to emphasize making predictions. That is, students were asked to use their developing understanding to predict the composition and nutritional value of new food samples. Students generated insightful questions that fueled additional inquiries, such as, "Why do two brands of apple sauce contain such different amounts of sodium?"

Grade 5—Demonstrating Understandings of Convection Currents: Students as Web Page Authors

In this case, an intern took on a very ambitious task—helping her students develop personal web pages. To prepare for this project, she secured permission from the parents for students to be able to post selected class projects on their sites. The intern then planned and implemented a series of lessons in which students were introduced to the authoring software, *HomePage 3.0*™ in the school computer lab. These lessons included opportunities to learn about (a) manipulating text and background colors; (b) linking pages and images; (c) inserting and manipulating images/graphics and backgrounds; and (d) managing web sites (i.e., organizing pages, verifying links, consolidating). Once initial student web pages were constructed, they were linked to the class web site.

The intern developed a schedule that provided each student in the class with approximately 20 minutes three times per week to work on their web pages at one of several computer stations located in the classroom. One of the first curriculum-based tasks was for students to illustrate and explain a demonstration of convection currents that was presented as part of the geology unit. The intern reflected that students were enthusiastic about and engaged in the authoring task. Moreover, the web-based artifacts constructed by students served as valuable assessment data for teachers and parents.

CONCLUSIONS AND IMPLICATIONS

These cases illustrate that as attempts to infuse technology into teacher preparation shift from teaching about technology to teaching with technology (Dana & Zembal-Saul, 2001; Willis & Mehlinger, 1996), professional development schools can serve as powerful contexts for facilitating teacher learning. In each of these cases, prospective elementary teachers were supported by their mentor teachers and university faculty in planning and implementing technology-integrated instruction. Moreover, the fact that a number of interns continued to teach with technology long after it was required by program activities and assignments serves as compelling evidence that the prospective teachers indeed valued teaching in this way. This work also suggested that a model or framework informed by learning theory can assist teacher educators in designing appropriate and meaningful learning experiences for prospective teachers (Dana & Zembal-Saul, 2001; Friedrichsen, Dana, Zembal-Saul, Munford, & Tsur, in press; Sillman, Zembal-Saul, Friedrichsen, & Dana, 2001).

As we craft ways to facilitate the development of prospective teachers' abilities and understandings associated with integrating technology into classroom practices, teacher educators are faced with "better problems" (Dana, Silva, Gimbert, Nolan, Zembal-Saul, Tzur, Sanders, & Mule 2001). How do our philosophies of teaching and learning with technology influence the way prospective teachers understand using technology? How do we keep up with the changing technology? How can we further develop our own understanding and abilities associated with using technology? In what ways can we create and sustain classroom learning environments that facilitate prospective teachers' developing understandings of teaching with technology? How can we support and enhance practicing teachers in their efforts to model the effective use of technology in classrooms? Negotiating these dilemmas leads us to engage in reflection and collaboration with our colleagues in schools and the university, activities that are at the heart of work in professional development schools.

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Contact Information:

Belinda Gimbert and Carla Zembal-Saul
The Pennsylvania State University
University Park, PA 16802 USA
bgg111@psu.edu
czem@psu.edu