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Julie Thomas
Texas Tech University, julie.thomas@unl.edu

Sandi Cooper
Texas Tech University, sandra_cooper@baylor.edu

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Preparing Tomorrow's Teachers to Teach with Technology: Getting Past *Go* in Science and Mathematics

Julie Thomas
Texas Tech University

Sandi Cooper
Texas Tech University

Abstract

We are teacher educators (in elementary science and mathematics) who are enthusiastic about technology as a teaching tool – though it is as new to us as it is to our university colleagues. We recently led a United States Department of Education Preparing Tomorrow's Teachers to Use Technology (PT3) grant project entitled TechLinks. In an effort to encourage peer faculty members to connect methods instruction with current technology initiatives (namely the International Society for Technology Education [ISTE], 2000, and the National Council on Accreditation of Teacher Education [NCATE], 1997), TechLinks provided faculty fellowships – $1,000 for equipment and materials and a technology assistant who provided just-in-time learning for up to six interested faculty members each year. This development money helped to generate a community of teacher educators who not only began to appreciate the power of teaching with technology but recognized new-found confidence in technology knowledge and skills. As members of this group ourselves, we developed a number of ideas for integrating technology into science and mathematics methods courses. We created a number of course assignments that incorporated technology teaching applications – helping future teachers learn about good science and mathematics teaching methods and new technology tools simultaneously. This article is intended to share examples of successful technology applications with others and to propose the usefulness of the Flick and Bell (2000) guidelines.

Training in Technology

Teachers report that they are underprepared in using new technologies (Heinich, 1991) and teacher education programs are not adequately preparing graduates to use technology as a teaching tool (Congressional Office of Technology Assessment, 1995). Although many colleges of education do provide a technology course for preservice teachers (O'Bannon, Matthew, & Thomas, 1998), research suggests that preservice teachers need multiple experiences throughout their teacher education program to learn how technology tools can be used for instruction and learning (Falba et al., 1999; O'Bannon, et. al., 1998; Thomas, 1998). Most university faculty members realize the need to integrate technology into their teaching but lack training themselves (Thomas, 1998). Certainly, enhanced integration of technology in K-12 classroom instruction depends on teacher educators who successfully model the use of technology in teacher education courses. And, as Rogers (2000) suggested, faculty members need technical support and release time to make the changeover.

Technology in Context

In a recent article, Flick and Bell (2000) proposed a number of guidelines for preparing tomorrow's science teachers to use technology. Reform documents developed by the American Association for the Advancement of Science (1990) and the National Research Council (1996) framed their recommended applications. They proposed technology instruction that (a) is introduced in context, (b) addresses worthwhile pedagogy, (c) takes advantage of the unique features of technology, (d) makes scientific views more accessible, and (e) develops students' understanding of the relationship between technology and science. The following describes our teacher preparation efforts as they relate to the Flick and Bell guidelines.

Getting Past <u>Go</u> With Basic Software Applications and Meaningful Context

We learned to focus on practical applications that would provide meaningful context (Flick & Bell, 2000) and resources for future elementary teachers with limited content knowledge and related low levels of teaching confidence. Additionally, we learned to incorporate technology applications that require basic computer software (Microsoft Office) and Internet access – no special software or hardware. We expected our future-teacher-students would be able to apply these ideas in any school. The following sections describe some of our explorations with blending technology applications into science and mathematics methods course assignments. They include creating PowerPoint presentations, designing and using Webquests, developing useful Internet resources, applying authentic interactions, and managing virtual discussions.

Creating PowerPoint Presentations

We want our students to be comfortable with Microsoft PowerPoint as a teaching tool. We ask students to prepare a short slide show when they introduce a hands-on activity or lead a discussion with their college peers or elementary children (during our elementary school field experience component). This real-world application helps students understand how a PowerPoint presentation can enhance a science or mathematics lesson (synthesize the main points or organize hands-on investigations). One such assignment, Electronic Stories, helps future teachers connect appropriate science content and motivational teaching and learning techniques. Students choose a personal interest, link it with grade level teaching standards, and create an elementary teaching story (http://www2.tltc.ttu.edu/thomas/stories/default.htm). Such a lesson introduces the creative power of technology as a teaching tool. In one story, a child notices some workmen on the lake across the street from his house and writes letters to find out more about his geese and "why the workmen are scaring them away." The story teaches about the migratory behaviors of Canada geese and the urban problems of storm water management – in a format suitable for elementary teaching.

Students also explore the idea of introducing themselves via PowerPoint using mathematical terms and numbers in an activity called Meet Me Mathematically (see Figure 1; for the full slideshow, see http://www2.tltc.ttu.edu/cooper/Meet%20Me%20Mathematically.ppt). For example, students think of significant dates, number of family members, shoe size, height, distances traveled, and more. Using PowerPoint, they create slides that present each of these facts about themselves (with photographs, clip art, and text). These can be shared electronically or printed to create a booklet.

Figure 1. *Powerpoint slide from the Meet Me Mathematically assignment.*

Designing and Applying WebQuests

First begun by Bernie Dodge at San Diego State University, WebQuests are inquiry-oriented activities in which most of the information used by learners is drawn from the Internet. The Dodge WebQuest Page (http://webquest.sdsu.edu/webquest.html) provides background, examples, and helpful teacher tools. We are especially impressed with the way in which a WebQuest encourages critical thinking and problem solving. In science, our students develop a WebQuest about a possible classroom pet (i.e., rabbit, sugar glider, or tarantula) to help children decide how they might provide care in the classroom (http://www2.tltc.ttu.edu/thomas/classPet/1999/classPet.htm). Each WebQuest is expected to help elementary students gather data to help them choose the right pet for their classroom (based on animal habits, diets requirements, and habitat limitations). Following the recommendations of Flick and Bell (2000), this WebQuest work enhances science activity and involves preservice teachers in lesson planning focused on science process skills.

In mathematics methods courses, students actually follow WebQuests guiding them to review the National Council of Teachers of Mathematics standards (NCTM, 2000) and find lesson plans on the Internet. After a discussion of the NCTM standards in class, the WebQuest introduces students to the perspectives of various leading authors. Using this information, they respond to a first-year-teacher scenario replete with challenges of supporting their teaching philosophy (http://www2.tltc.ttu.edu/cooper/MathEducationCourses/nctmquest.htm). The Lesson Plan WebQuest encourages students to discover numerous lesson plan sites. Their task is to choose two lesson plans on a specified topic and analyze them according to a given set of quality criteria (http://www2.tltc.ttu.edu/cooper/MathEducationCourses/lpwebquest.htm). And, consistent with the recommendations of Flick and Bell (2000), students assess teaching models and learn to discriminate among the online lesson resource banks.

Creating Internet Resources

We want our students to recognize the number and value of teacher resources on the Internet. These can help improve teacher background knowledge – or provide learning references and activities for students, as well. Our students choose a topic and practice search techniques to seek out "cool links" to share with others via our course web sites (see Figure 2; http://www2.tltc.ttu.edu/thomas/coollinks/coollink.htm) and (http://www2.tltc.ttu.edu/cooper/Cool%20Links/coollinks.htm). This exercise helps students become discerning *linkers* and encourages them to visit the course sites once they become credentialed teachers. Such an Internet assignment helps make science and mathematics content more accessible and helps manage for misconceptions (as advocated in Flick & Bell, 2000). The class assignment often expands students' content knowledge, but it also encourages students to share high-quality resources with other students and teachers. These students return to this course site and the new, updated resources created by students who follow them (and continue to maintain the quality of the links).

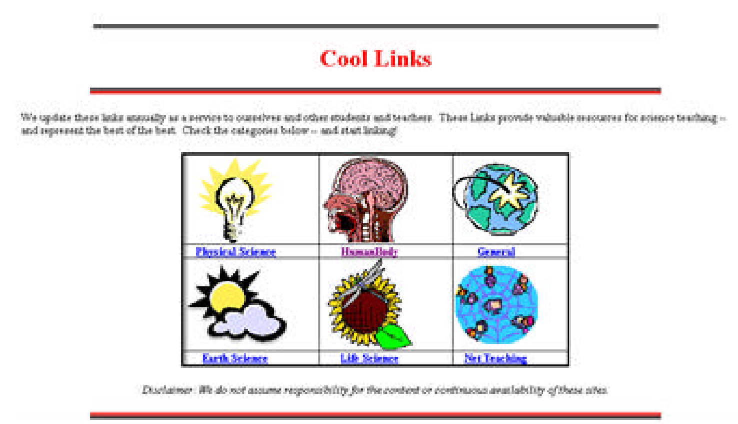

Figure 2. *Screenshot from the science Cool Links Web page* (http://www2.tltc.ttu.edu/thomas/coollinks/coollink.htm).

In another class experience, a group of postbaccalaureate preservice students helped to create a virtual field trip (see Figure 3; for the full virtual field trip, see http://www7.tltc.ttu.edu/jthomas/) as part of an environmental education program at our university. As Flick and Bell (2000) suggested, this assignment involved preservice students in the design of student learning using features of technology resources to contextualize learning. Local school groups of children visit the wetland on our campus each fall and spring; science and mathematics methods students lead tours and onsite learning activities. The virtual field trip provides a resource for children who do not actually visit the wetland – and extends the understanding of all children about similar wetlands and related community issues.

Figure 3. *Screenshot from the Virtual Playa Tour* (http://www7.tltc.ttu.edu/jthomas/)

Applying Authentic Interactions

Flick and Bell (2000) recommended technology experiences that allow students to collect and organize worthwhile data and share conclusions with others. Some lessons allow students to interact directly with information they find on the Internet and provide a forum for data collection as well. In the mathematics methods course, one site we have used is the Mighty Mouthwatering Math site (http://mighty-mm-math.caffeinated.org/). This site sets up a probability and statistics activity with candy, allowing students to add their own data to the online database. The site also provides a summary of all the results submitted so that classes can compare their results with others to extend the data analysis.

Technology can provide authentic, worthwhile science inquiry as well (Flick & Bell, 2000). In a science application, preservice teachers work with elementary children who are working alongside a research biologist. The biologist has fixed satellite transmitters on female pintail ducks; the posted satellite data (http://www.werc.usgs.gov/pinsat/tracking.html) help scientists (teachers and children) develop explanations for a decline in the duck population. Preservice teachers are helping children understand the data (read maps and compare migratory routes) and participate in the online discussion forum.

Managing Virtual Discussions

We keep password-protected student rosters, support listservs and threaded discussions, and facilitate synchronous chat discussions on our science (http://www2.tltc.ttu.edu/thomas) and mathematics (http://www2.tltc.ttu.edu/cooper) Web sites. Students are able to contact fellow classmates by using these photo rosters that also include e-mail addresses and telephone numbers. Student communication is further enhanced by listservs and threaded discussions through a specified topic or question posed. Periodically, students are involved in a synchronous chat (in groups of three to five) to discuss course material, current events, or special projects.

One group of science students participated in something of an electronic jigsaw in shared scientific inquiry. Student groups were experimenting with toy cars and ramps. Each group of three to four students worked independently, but interacted electronically (via chat rooms) as they developed and refined their research questions, conducted research, collected data, analyzed data, compared their results to explanations they could find online, and developed new research questions. Our work simulated group work in a face-to-face classroom but generated improved discussions and details. The online format allowed wait time, encouraging deeper thinking and more thoughtful, analytical responses.

Getting Past *Go* With Support and a Framework

Our ideas about instructional models that integrate science and mathematics with technology continue to grow and change as we work with students, attend conferences, read journals, and visit elementary classrooms. We have certainly benefited from the PT3 funded technology assistant and the community of teacher educators we are developing at our university. We understand that educational technology courses may teach computer skills – but technology applications really can and should also be introduced and reinforced in methods courses – modeled in and applied to specific pedagogical constructs within the content areas.

Rogers (2000) found that faculty members need technical support and release time for training in order to incorporate technology into their classrooms. In our experience with TechLinks, we found that the just-in-time support of a technology assistant, confidence and persistence in learning new skills, and a community of university colleagues who shared enthusiasm in exploring new teaching ideas carved considerable headway with regard to long-term faculty development. And we found the technology instruction guidelines proposed by Flick and Bell (2000) – introduce technology in context, address worthwhile pedagogy, apply unique features of technology, link technology to accessing scientific views, and develop science and technology relationships – provided a helpful framework for science and mathematics teacher educators such as ourselves.

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Author Note:

Julie Thomas
Texas Tech University
Email: julie.thomas@ttu.edu

Sandi Cooper
Texas Tech University
Email: sandi.cooper@ttu.edu

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