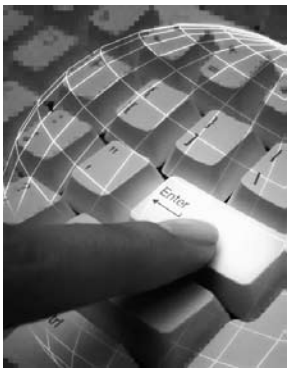

When Curriculum and Technology Meet: Technology Integration in Methods Courses

Christy G. Keeler

Abstract

Reporting on the results of an action research study, this manuscript provides examples of strategies used to integrate technology into a content methods course. The study used reflective teaching of a social studies methods course at a major Southwestern university in 10 course sections over a four-semester period. In alignment with the research question, the original course design used technology-rich instructional approaches. Throughout the study period, elements of those strategies altered to better meet the needs of preservice teachers and take advantage of technological innovations. The result is a description of technology productivity and instructional strategies applicable in a variety of content-specific preservice teacher education courses. (Keywords: TPACK, content methods courses, productivity and instructional strategies, social studies, course Web sites.)

Subject-specific methods courses in colleges of education focus on teaching preservice teachers instructional strategies used to deliver content. Typically, elementary level teachers are required to take mathematics, language arts, science, and social studies methods courses while secondary-level educators take only those methods courses relating directly to their primary discipline. A concern is that instructors teaching those methods courses are rarely versed in instructional technology. Yet, paradoxically, preparing teachers to integrate technologies throughout their curricula requires providing opportunities to experience content-specific instructional strategies that use technology.

The purpose of this study was to identify means for preparing future teachers to integrate technologies into their content-specific curricula. Using action research, technology integration methods as well as other instructional and assessment alterations occurred throughout the delivery of an elementary social studies methods course over a four-semester period. The intent was to find ways to increase preservice teachers abilities to: a) master technology skills needed within educational contexts, b) identify and justify ways technology can enhance productivity and instruction, and c) integrate technologies into future content area instruction. Using action research, the researcher sought to identify methods that would work across content area methods courses.

Theoretical Framework

The National Educational Technology Standards (International Society for Technology in Education, 2004a, 2004b, 2007) are unique from other content-area standards because they cross all subject areas. There is an expectation that teachers of all disciplines use the standards for productivity and instructional purposes and that they prepare their students to competently use technology by integrating the standards throughout instructional delivery. Likewise, there is an expectation that teachers prepare students for success in the 21st century by ensuring they are competent in use of 21st century content, skills, and tools (Partnership for 21st Century Skills, 2004).

Bringing together expectations of content-specific technology-infusion and pedagogical methods is the newly coined field of Technological Pedagogical Content Knowledge, or TPACK (Harris, Mishra, & Koehler, 2007; Mishra & Koehler, 2006, 2008). Even with this loud call for greater technology integration in K–12 classrooms, teachers tend to neglect using technology in their classrooms, or they tend to use technologies ineffectively (Cuban, 2002). Despite this neglect, subject area professional standards blatantly call for greater inclusion of technology when delivering content-specific objectives. Because of this, preservice teachers need opportunities to learn strategies fitting within a TPACK model.

Content Standards

All subject area standards directly address technology integration in some capacity. For example, standards presented by the National Council for Teachers of Mathematics as early as 1989 noted the importance of integrating technology into mathematics curricula and included an expectation that technologies be available when teachers deliver instruction. The Council states: "Calculators, computers, courseware, and manipulative materials are necessary for good mathematics instruction; the teacher can no longer rely solely on the chalkboard, chalk, paper, pencils, and a text" (1989, p. 253).

Similarly, the National Council for Teachers of English (1996) includes a content standard stating: "Students use a variety of technological and informational resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge." The Council also states that "technology opens up new worlds to students"; it stimulates students by providing "new motivation for writing and allow[ing] students to assume greater responsibility for their own learning" (1996).

The National Council for the Social Studies Standards (1994) offers a third example. It addresses the content of technology by recommending students learn about a core theme of "Science, Technology, and Society" that includes standards such as: "Seek reasonable and ethical solutions to problems that arise when scientific advancements and social norms or values come into conflict" (p. 43). Additionally, it directs social studies teachers to integrate technology into instruction. In 1994, powerful social studies education was defined in the following way by the Task Force on Teaching Standards for Teaching and Learning in the Social Studies:

> Integrated social studies teaching and learning include effective use of technology that can add important dimensions to students' learning. Teachers can provide students with information through films, videotapes, videodiscs, and other electronic media, and they can teach students to use computers to compose, edit, and illustrate social studies research reports. Computer-based learning, especially games and simulations, can allow students to apply important ideas in authentic problem-tackling or decision-making contexts. If students have access to com-

> puterized databases, they can search these resources for relevant research information. If they can communicate with peers in other states or nations, they can engage in personalized cultural exchanges or compare parallel data collected in geographically or culturally diverse locations (1994, p. 165).

Likewise, the national science education standards also address technology integration both in terms of content and instruction (National Committee on Science Education Standards Assessment & National Research Council, 1996). Regarding content, standards encourage students to gain "fundamental understandings about the enterprise of science and its various linkages with technology." In relation to instruction, the National Committee on Science Education Standards Assessment and National Research Council (1996) notes that as students advance in grade levels, "Science experiences go into greater depth, are more quantitative, require more sophisticated reasoning skills, and use more sophisticated apparatus and technology." The science standards recommend professional development courses that "support teachers in using a variety of technological tools, such as computerized databases and specialized laboratory tools" (1996), and they continue by suggesting collegiate training experiences that include opportunities to "interpret data using appropriate technology."

It is not enough to include these statements in the standards without providing opportunities for teacher candidates to learn how to teach using technology-infused methodologies. Kajder (2007) informs teacher educators that integrating technology requires "a very different type of teaching." This need is further pronounced by the fact that few preservice teachers experienced learning in technology-infused environments. Niess (2005) writes:

> Given the recent inclusion of technology in education, many preservice teachers have had limited experiences in learning their subject matter with technology. They have not seen or experienced many instructional strategies and representation of their subject within a technology framework.

This lack of exposure leaves teachers unprepared to integrate technologies. Because the financial and time costs of re-training teachers is exorbitant, it behooves those in colleges of education to ensure teachers enter the teaching field having basic knowledge of curriculum-specific technology integration methods.

Research Methods

This study asked: "In what ways can technology be integrated into subject-specific methods courses?" In response to this question, the researcher chose a process of creating and refining a face-to-face social studies methods course taught at a public research-intensive university in the southwestern United States. Course development began in August of 2005 with data collection concluding in May of 2007. Using an action research approach, the technology-rich course was taught to 10 sections of approximately 25 students each, two-to-three sessions per semester over four semesters. The same instructor taught all sections and engaged in reflective practice throughout the study period.

Action research is a form of self-reflection (McNiff & Whitehead, 2002; Schmuck, 2006) designed to assist practitioners in improving the effectiveness of their educational practice (Schmuck, 2006). Unlike in traditional research where the focus is seeking objective explanations and truth from an external source, action research focuses on the researcher's own practice through self-reflection, continuous change, and personal involvement (Schmuck, 2006). Credibility arises when the researcher collects and reflects on data, generates evidence from data, and creates knowledge based on data-driven conclusions.

The action research process begins with an explicit plan to implement a new instructional method (Mohr et al., 2004; Schmuck, 2006). In this case, the basis for the new plan was a desire to integrate technology into content methods courses. Course development involved a concentrated effort to integrate technology without sacrificing content normally introduced in social studies methods courses. In addition, there was a pronounced effort to utilize technology whenever possible to assist in course management as well as instruction. The basis for this decision was that both productivity and instruction are critical components of the teaching profession—use of productivity methods by the instructor would model additional applicable technology uses.

Using a proactive action research model, this study continued with implementation of the new plan. During that first semester as well as during subsequent semesters, data collection involved systematically gathering and analyzing several artifacts and artifact sets (Mohr et al., 2004), as well as engaging in solitary dialog (Schmuck, 2006). Feedback artifacts contributing to the course refinement process included:

- Formal teacher evaluations mid-semester and at the end of the semester;
- Informal teacher evaluations collected at four-week intervals surrounding the mid-term and final evaluations;
- Informal communications including e-mail communications;
- Audio feedback provided by the students for the instructor at the end of each semester;
- Student assignments completed throughout the course;
- Instructor's general reactions to successes and failures of technology use during instruction and for student independent work; and,
- Student portfolios completed throughout the semester and submitted at the conclusion of the course.

In alignment with practitioner-based research, the instructor carefully reflected on each artifact or artifact set immediately when it became available by reading and sorting the information, determining the starting point of the analysis (Robinson & Lai, 2006). Data analysis then included four phases: reviewing the instructor's actions, considering student reactions to implemented strategies, evaluating student learning when using the strategies, and confronting the results of that data (Schmuck, 2006). For example, following grading student-developed concept maps, the instructor carefully considered the quality of student work including student ability to comfortably address the content as well as student ability to competently use the software. Based on instructor perception of students' strengths and weaknesses, the instructor was able to modify or refine the lesson plan so instructional delivery would improve during the current or future semesters. This "just-in-time" attention to detail and flexibility to change enabled immediate course alterations necessary within the practitioner setting and improved future course iterations.

The process of initiating an action, detecting needs for improvement through monitoring and adjusting actions based on real-time reflection, and judging options for altering delivery methods (Schmuck, 2006) led to either a new plan for action or refinement of the current plan. Practitioners continually use this spiral method (McNiff & Whitehead, 2002; Schmuck, 2006) of initiation, detection, and judgment to improve practice throughout their careers.

Upon completion of the data collection period, the instructor collectively examined all artifacts holistically to identify common patterns, themes, or concerns. Based on experience with the course, the instructor used a filtering method (Mertler, 2006) of deleting some instructional strategies and combining others to develop a categorization schema. In addition, the instructor reviewed previous iterations of the course to identify how strategies were addressed over the full research period and whether the methods employed in the final course iteration resulted in greater student success with the course content and technology integration objectives than those in earlier versions. This manuscript reports on those strategies identified as contributing to positive learning gains that also appeared to have cross-curricular applications. The manuscript's format follows the identified categorization schema.

Results

Technology integration occurred in two primary formats: administrative productivity and instructional delivery. In terms of administrative productivity, course resources were made available online and the instructor modeled technology-rich record keeping strategies. Technology-infused instructional methods, then, were interspersed throughout the course with an expectation that students would ubiquitously utilize technologies to complete course tasks. The below sections address, first, productivity uses, and, second, instructional uses such as in-class activities and student assignments.

Productivity Uses

The Course Web Site

Contributing to the creative commons.

A key feature leading to technology-intensive instruction requires making course materials available electronically. Many instructors now make their syllabi and course outlines available online and some include additional course resources such as lecture slides and assignment requirements. Often, these resources are available only to students in the course and are password-protected within a content management system (e.g., Blackboard). Though some resources in this study were made available via WebCT (the content management system available for use with the sample course), most resources were available via a publicly accessible Web site (see http://coe.nevada.edu/ckeeler/SSM/). Only resources requiring copyright protection, most communications, and private student information appeared within password-protected areas.

The Web site was made publicly available because the goals for the course extended beyond the semester during which the course was in session. To provide an ongoing, robust, and enduring site, the instructor added features that would aid students throughout the course, but would also provide adequate detail needed to replicate course strategies in students' future classrooms. For example, during one class session, the instructor introduced learning styles using a "Hershey's Personality Type Indicator" (a humorous way to help students see their similarities and differences). One semester after taking the course, a student e-mailed with the following request: "I really want to do the icebreaker you did with the chocolate bars and the personality test.... Can you send me the information..." Another student e-mailed: "[C]ould you please e-mail me back with your class Web site? I was wanting that lesson plan that you did about the boat traveling to America (it might have been the Pilgrims traveling) and you had a boat drawn on the floor and everyone had to stand on it." For both questions, the instructor responded with a single URL. The lesson plan relating to each question linked to all materials needed to complete the activity including a K–12 lesson example, online extension resources, a list of needed resources, and detailed activity descriptions. Developing a Web site that includes basic course resources like a course syllabus and outline, but links to more materials including detailed, replicable course session lesson plans, audios of class lectures, lecture slideshows, actual resources needed to engage in the lesson activities (such as student hand-outs, links to online games, and books), and links for more information, is extremely time consuming for the instructor. But, it models good instructional design, reinforces lesson planning techniques, provides an advance organizer for student review before class, and offers a resource for students to revisit even after leaving the institution. Finally, many institutions (e.g., MIT OpenCourseWare) and organizations (see, for example, the College and University Faculty Assembly's online syllabi portal at http://www.ncsscufa.org/syllabi.html) find rich, publicly accessible course Web sites act as resources for instructors developing new courses and students seeking to extend personal knowledge.

Class Web sites: A growing, morphing resource.

Throughout this study, the basic structure of the course Web site did not change, but the number and quality of available resources did change. For example, though the original site included session lesson plans, all required materials to implement those lessons, and links to lecture slideshows, it did not include audios of in-class lectures (recorded using an iPod, digital voice recorder, and microphone during class sessions). These were added to assist students who missed class, and they further proved useful for students with hearing impairments. The number of embedded links also grew over the semesters. Added links were helpful when invited speakers addressed the class because as they mentioned a Web site, it was added to the course resource list. During later semesters, it was easy to share these Web sites during the speaker presentation and students did not feel obligated to quickly write down URLs; instead, they focused on the presentation. Another added feature was links to just-in-time training videos. When students needed to use an unfamiliar computer program, instructor-developed video trainings appeared within lesson plans and assignment expectations. Though online video resources exist, most that were available during the research period required a financial cost to students. By using instructor-developed videos, students could access free videos directly designed for educators (to view all videos, see the "Keeler's Training Videos" podcast available via iTunes).

Over the course of this study, even more added resources proved beneficial. For example, adding pictures and a slideshow from a previous class session to the homepage increased the sense of community. Another added Web site improvement related to course readings. Because one of the required texts was royalty-free, students could elect to purchase the printed text from the bookstore, or review an online version.

As the study progressed, the instructor added classroom-ready K–12 lesson plans as examples on the course Web site. While the site always included detailed lesson plans for each class session, activities seldom perfectly mimicked methods in K–12 classrooms. With the addition of K–12 lesson plan samples, students could: 1) directly use the lesson plans in their future classrooms; 2) see the flexibility of the teaching methods as they spanned K–16 environments; and, 3) view model lesson planning techniques.

The course Web site proved to be an important resource for students because of its rich collection of resources. Though the end-of-course evaluations focused on content of the course, several students specifically noted in their evaluations that one of the most positive elements of the course was the course Web site. For example, one student wrote: "… Expansive and engaging material. Everything could be viewed online. Great instructional planning..." Another wrote: "I am keeping your e-mail address and the Web site URL so I can e-mail you with any social studies questions I may have when I begin teaching!"

Communication Methods

Instead of using e-mail capabilities available within the content management system (CMS), students were encouraged to e-mail the instructor directly. This taught them that the instructor was available outside of the CMS (surprisingly, some students were unaware that they were able to contact instructors outside of the CMS structure); and, it contributed to their continued communications following completion of the course. Other course communication methods included use of blogs, cell phones, and audio files.

Blog-Based Class Communications

Blogs, existing within the CMS to maintain student confidentiality while providing open access to all class members, were used for student-to-students and instructor-to-students communications. The blogs helped develop a sense of community for class members by allowing them to introduce themselves at the beginning of the semester and share personal information and thoughts throughout the semester. Some course sections had very active blogs while others remained relatively silent. There appeared to be a correlation between course sections in which students

actively engaged in academic communiqués within the course blog and those in which students were socially active within the classroom. Likewise, those sections with few social communications in the face-to-face environment seldom used the blog for academic purposes. This finding is worthy of further study.

Handhelds/Cell Phones

Students received the instructor's personal cell phone number, were invited to contact the instructor via e-mail or phone with any questions or comments, and informed that they would likely receive calls from the instructor. Instructor-initiated communications generally occurred after an unarranged absence or following either exceptional or poor performance. The purpose of these contacts was to demonstrate good school-to-home communications in K–12 environments. Charles Sposato, the founding principal of Boston's Media and Technology Charter High School (MATCH), perfected this method of regular cell phone-based school-to-home communications. He used his cell phone, iPAQ, and commute time to make an average of one hundred phone calls per week to parents of students in his school (Shorr, 2004).

To facilitate these communications, on the first day of class students in the sample course provided their personal contact information including their name, phone number(s), home and e-mail addresses, and a picture. To collect this information quickly, all information was downloaded from the university system so students only had to update the information and add pictures. They updated the information either at a laptop computer station or using a handheld phone/computer passed around the classroom. Both technologies had embedded cameras; and, data synchronization occurred following each session. Collecting this information began to create a feeling of accountability while teaching students about information access and databases. Over the study period, calls to the instructor increased each semester. Though some students called more often than others, no students abused the privilege of having the instructor's personal cell phone number. In addition, some students chose to text message the instructor's cell phone, a method reinforcing their technological comfort levels.

Because the sample course was experiential and required active participation, attendance in all class sessions was mandatory; this provided another method for using the handheld computer/cell phone for record-keeping. To ensure student participation as well as make a personal connection with each student during each session, the instructor took attendance using "Documents to Go" with a native Excel file on a handheld. Because the information was available via cell phone, the instructor could easily review attendance and contact students using a hands-free headset during long commutes. While the medium assisted in record keeping, it also modeled Sposato's method of using handhelds and cell phones in K–12 schools.

Using Audio for Feedback

A third communication method was audio. Following completion of formal end-of-semester evaluations, students were asked to leave audio messages using an iPod and voice recorder. This provided the instructor with immediate feedback since new semesters often commence before receiving official feedback from the institution. Few students chose to leave audio messages and many felt uncomfortable speaking into a microphone. Most messages were very short (approximately 10-15 seconds) and though some messages included detailed feedback (i.e., suggesting which readings to keep and which to delete), most were very general (e.g., "I learned a lot in this class…"). This activity presented the opportunity for the instructor to discuss instructional uses of student-generated voice recording in K–12 classrooms (e.g., digital storytelling, writing and performing songs about content, assistance for students who are non-native English speaking).

In addition to student-generated audios, the instructor used audio to provide feedback to students on their final course portfolios. While this method has practical applications (it decreases the stress of writing on the carpal tunnel), it also teaches students the benefits of audio feedback. Surprisingly, the amount of feedback provided to students increased exorbitantly when compared between verbal and written methods. While students received approximately 200-word written responses, audio feedback varied from four to twenty minutes. Preservice teachers realized they could document student progress in an auditory and portable format (i.e., using a microphone while commuting).

Administrative Record-Keeping

Students always had accurate and timely access to their progress via the grade book feature within the university's CMS. Using this system taught students the importance of timely grading, the importance of accuracy, and the ease of using electronic grade books. This is particularly important because K–12 school districts are beginning to offer online access to student grades. Parents use these services to monitor their child's progress and success in school. In this new electronic environment, teachers must maintain accurate, timely grade books if they are to foster positive school-home relationships so modeling it in higher education is imperative.

The Importance of Using Technology for Productivity Purposes

There are two main reasons for heavily using technologies as productivity tools within subject-area methods courses. First, the technologies ease the work of the instructor while providing up-to-date and accurate data. Second, and more importantly, teachers should be prepared to immediately begin using technologies when they enter their own classrooms. Preservice teachers must be ready to "apply technology to increase productivity," and "use technology to communicate and collaborate with peers, parents, and the larger community in order to nurture student learning" (International Society for Technology in Education, 2004b). This preparation begins with modeling (West & Graham, 2007) and content integration begins in methods courses.

Instructional Uses

Though it is important to train future teachers to use technologies for productivity purposes, the true power of the technologies comes when using the tools and techniques instructionally. Moreover, though instructors can practice and demonstrate productivity methods throughout all teacher education classes, curricular integration of instructional technologies finds its panacea in methods courses. In the sample course, instructional uses appeared in two formats. First, students utilized technologies during in-class activities allowing them to witness model uses of instructional technologies as they relate to, in this case, social studies. Second, students used technologies to complete required assignments. In some cases, technology use was required; in other cases, it was optional. When using technologies for assignments, preservice teachers practiced both productivity skills and instructional integration skills.

In-Class Activities

In-class activities included use of concept mapping software, content-specific software, online tools, video streaming, and digital still and video cameras. In each case, technology use was expected to be transparent and ubiquitous after an explanation and demonstration of the individual technology type. For example, students were introduced to Inspiration (concept mapping software) during the second class session. To introduce the software, the whole class created a concept map of the previous sessions' readings. This reinforced the importance of timely completion of readings, demonstrated the software, and showed how it could be used for instructional brainstorming. In addition, students saw examples of K–12

student-made content-specific concept maps (i.e., a push-pull comparison of immigration factors and a K W L of the Battle of Bull Run).

Throughout the course, the instructor also demonstrated a variety of online tools. One such use occurred with an online countdown timer during a timed activity. The related lesson plan included a link to this timer for students' future use. In another instance, a rubric generator helped introduce students to developing assessment rubrics.

Other than simple instructor-led demonstration, there were times in the sample course when students engaged with technologies during class time using university-supplied laptops. These lessons often required tool demonstrations before beginning the assigned work. For example, when teaching about content-related inquiry, one learning station required review of streaming video clips. In preparation for this station, students received a demonstration of Discovery Streaming™ and an introduction to its content-specific resources. Afterward, students moved to assigned stations and began using the technologies with the instructor remaining available to assist with technical and content-based questions.

In another lesson, students used digital video and still cameras during class time to record events of a mock trial. Because these are common technologies, there is no need for instruction on tool use, but there is a need to describe potential uses of capturing still and video images for learning or reinforcing subject-specific content. Another way of teaching how to use digital cameras for reinforcing discipline-specific content was through a semester-long picture-taking project. During nearly every class, the instructor or students took pictures of in-class activities. This was another means of helping develop a sense of community, it was intrinsically motivating for students, and it provided a documentary of events from the semester. At the end of the semester, the instructor compiled the pictures into a video with music and displayed these on the last day of class. The video worked as a review of the content introduced throughout the semester and helped students gain a gestalt of course themes. In addition, students received these videos in DVD format as gifts and the instructor was able to use them as part of a personal teaching portfolio. One student wrote: "I will love the DVD and can't wait to get it in my portfolio!"

Though the course design focused on transparent technology integration methods, there were in-class lessons in which technology took "center stage." In one lesson, students were introduced to curriculum-specific software by playing a Tom Snyder "Decisions, Decisions!" simulation. This introduced students to one popular social studies software package, and illustrated how software can be used to guide whole class instruction. During a lesson on learning centers (popular in elementary classrooms), one of the centers required students play "Where in the World is Carmen Sandiego?," showing how instructional software can be used with small groups and individuals to reinforce skills.

Another lesson required students engage in a WebQuest (see http://coe.nevada.edu/ckeeler/SSM/Materials/WebQuest/KeelerESNeedsSSTechHelp.html) that required them to find online subject-specific resources. The lesson introduced them to WebQuests, virtual fieldtrips, and general content-area Web sites, provided examples of each Web site type, and required students locate and record quality social studies Web sites using social bookmarking (see http://del.icio.us/Social_Studies). The lesson also provided a platform for instructing students on educational and content-specific uses of social bookmarking. During the session following the WebQuest experience, many students reported they had acquired and started populating their own social bookmarking sites. For more information on this lesson, read "Modeling Technology-Based Social Studies Instruction: A Simulated WebQuest" (Keeler, In Press).

Assignments

Students truly practice technology skills when completing independent course assignments. Some of the assignments required students use technology instructionally, but almost all required using technology for productivity purposes. One goal of requiring students to use technology to complete assignments is to increase student comfort level with technology. Decade-old research, such as the Apple Classrooms of Tomorrow studies (Dwyer, 1994) and the Office of Technology Assessment Report (1995), supports that teachers begin the process of instructional integration by first getting comfortable with the technologies.

Readings and Journal Writing

Of the sample course assignments, one spanned the entire semester. When students completed each assigned reading, they posted synopses of the reading in a private blog within the CMS. The instructor required the time/date stamp for each entry come before the class session following the reading assignment. This ensured students were prepared for the content of the session; and, it required students reflect on their readings while practicing professional writing skills. Through the research period, the expectations for this assignment changed based on student feedback. In later course iterations, students were permitted more writing variety after mid-term and sometimes offered the opportunity to collaborate in pairs. When engaging in paired reading, students practiced electronic collaboration and time management. An unexpected result was that collaborative entries were frequently much more detailed than individual entries. Though each student in the pair was only responsible for reading half of the assigned reading, students tended to construct posts of much higher quality when aware that their peers would be using their entry as well. Note that although grading all submitted posts can occur electronically, it is still necessary to review all posts for content accuracy; therefore, this method is very time consuming for the instructor.

Students also engaged with technology to complete their readings and most readings were available online. To support the notion of a paperless society and align with ecological mindedness inherent in social studies and science education, students were only required to print a minimum number of readings.

In some cases, students were responsible for listening to podcast episodes in lieu of reading text. Though some preferred audio, others found that they were weak auditory learners. In fact, one hearing-able student was unable to complete reading assignments available only in audio format because the format for learning was so uncomfortable. It became apparent that students prefer shorter podcasts because, unlike text-based media, it is not possible to skim audio files. This results in more study time.

For some readings, students had choices in "reading" formats—they could choose to read the text or listen to MP3 readings of the text. Though no students with documented visual impairments have enrolled in the course, the one student with a hearing impairment was able to be successful with the audio "readings." For these, she was able to increase the volume to meet her needs. It would be ideal to offer all readings in both audio and text formats to accommodate both students with disabilities and those with varying preferred learning styles.

e-Portfolios

One attempt to integrate technology into assignments proved to be a failure. During the first semester of the study, the syllabus required students create online e-portfolios in lieu of taking final exams. The instructor quickly learned that few students had the technical ability to create their own Web sites, and fewer had the skills needed to efficiently create a full e-portfolio. This was true despite the fact that the university required a technology course at the 200-level in which students created e-portfolios. Because of the lack of technical skill, the instructor altered the assignment to include hard-copy and electronic portfolios. As blogging technology eased the process of creating online portfolios, the instructor began encouraging use of e-portfolio submissions while continuing to accept paper-based submissions. Some students self-selected to use other media formats such as slideshow-based portfolios.

Concept Mapping

Most assignments required students to competently use technology in some format. The first assignment of the semester required students develop their social studies philosophy of education. They had created general education philosophy statements in earlier courses so this assignment only required they reposition those ideas within a content-specific context. A second difference from their previous philosophy of education assignment was that the product must appear in concept map format. Students struggled with the assignment because they knew little about framing their ideas within a content-specific construct, but they did not struggle with the use of concept mapping software. In fact, most enjoyed the opportunity to create a visual product as it offered an alterative to the usual "papers" written throughout their program and it modeled an instructional method they could use with their students.

During the research period, some students did struggle with the technology. In particular, students who had not enrolled in college courses for extended periods tended to approach the concept map assignment with more fear than excitement. Adding just-in-time training videos alleviated many students' fears. Ultimately, all students had success with the use of the concept mapping tool and many remarked on their pleasure with having used it. One student e-mailed the following:

> I want to thank you for taking the time to explain the Inspiration software. I was so excited to have been introduced to a program that will help us be more effective teachers and students. Clearly I have not developed my philosophy for the assignment, but I am having a great time learning the variety of products Inspiration can create. At the end of class I was feeling slightly overwhelmed, but I am certain this class is going to be rewarding and has already provided resources to help me be a more effective teacher. Thus far in my education I have not utilized the technology that is available and am interested to learn more of some of the areas you mentioned in class tonight. I am still in awe about the information you post online for your students. Thank you for the guidance and introduction to the Inspiration software.

Templates

Students also used electronic templates to complete assignments. One assignment required students complete a detailed textbook evaluation form. Using the "Forms" option within Microsoft Word, these are easy to create, guarantee student products look uniform, and ensure students include all components of assignments. In one case, students received an option of using their own or a pre-formatted lesson plan template. Students also received templates for unit planning; but, because most students had no experience with thematic unit planning before the course, they were required to use the template. The original rendition of this course used printed samples for student review, not electronic forms. The printed examples led to a lack of professionalism in student products whereas the assignment quality increased when provided with electronic forms. An added benefit of the use of forms was that more technically adept students learned to use the "Forms" feature for educational purposes.

Multimedia and Student Choice

In one assignment, students chose the media for reporting their results. They critically observed two classroom lessons taught in K–8 environments and reported their findings (based on pre-defined criteria supplied in an instructor-designed rubric). Though many students chose to submit projects using paper-folding techniques introduced in class (see Zike, 1992), many others chose electronic formats or used technology to enhance their paper-folding products. Students chose to submit electronically developed tri-fold brochures, newsletters, slideshows, movies, and, yes, even papers. Two students submitted audio files of which one used the "Notebook" feature of Microsoft Word while the other used an MP3 recording device. Students commented that they enjoyed this assignment because it allowed them to learn the content while being creative in their area of preference. They also noted that this gave them an opportunity to practice alternative assessment techniques for their future classrooms.

Finally, the instructor required students include technology components as part of their unit plans. In addition to using software including common productivity programs, they were encouraged to use online resources. Of course, students knew how to complete online searches; however, many forgot to look for online instructional resources such as games, WebQuests, or general tools such as interactive maps.

Rubric Generators

When addressing alternative assessment for social studies classrooms, the instructor introduced rubrics by demonstrating online rubric generators. The instructor highly encouraged students to use these tools when developing the required rubric accompanying their assessment assignment. One surprising finding was that many students felt uncomfortable using online rubric generators. Their hesitancy was not because of their inability to use the tools, but because they felt they were "cheating" by using these easily available resources. The instructor regularly heard students encouraging one another to use the resources because "it makes it so easy," but the instructor found it necessary to reinforce the recommendation by stating that one course goal was to create successful learning opportunities, regardless of whether that meant using a process that eased their loads. This provided an avenue to discuss the intensive workloads of teachers and helped them see that there are tools to help manage their time.

Access to Exemplary Student Work

Other than the course outline, the one course Web site feature that most attracted students was a webpage called "Exemplary Student Works." With student permission, the instructor posted assignments displaying exemplary work. Future students were encouraged to visit these examples as they prepared their own unique products. Many students felt it was an honor to be asked to have their products posted and were excited and humbled when asked to have their work included. As the study progressed, assessment product qualities increased—a finding the instructor attributed to the "Exemplary Student Works" Web site feature.

Cross-Curricular Transferability

Though action research does not result in analytic generalization (Blichfeldt, 2006), this research does evidence that opportunities for successfully integrating technology into social studies methods courses exist. Furthermore, these strategies are seemingly transferable across all content area methods courses. For example, content-specific methods courses tend to teach about adjunct materials including audio-visual material. To introduce this material, instructors from all content areas may opt to present video clips using video-on-demand or audio via podcasts or MP3 files. A science methods instructor may wish to show online videos enabling students to witness experiments too dangerous to demonstrate in class. Or, an English methods instructor may have students listen to podcast readings of Shakespearean sonnets to teach about cadence or inflection. Additionally, methods instructors tend to address means of identifying content-related resources. In a technology-intensive methods course, this process can be taught by having students complete a WebQuest requiring them to identify online resources. A math methods instructor may send preservice teachers on a quest to find online examples that reinforce trigonometric concepts, and a science teacher may have students edit a Wikipedia article to improve its quality. A third technique for integration is particularly useful in elementary-level courses. Elementary-level methods instructors tend to introduce examples of learning centers. Along

with typical learning station examples, instructors might add computer software (allowing students to practice using the software on laptops), handheld computer games and simulations, and other computer-based educational toys (e.g., LeapFrog products). The math methods instructor may have teacher candidates play Knowledge Adventure's Math Blaster™; the language arts instructor may have students use handheld concept mapping software to practice pre-writing; and, the science instructor may have future teachers "play with" Lego® MindStorms NXT. Methods instructors may also choose to use digital voice recording. In English methods, instructors may suggest teachers record student fluency throughout a single academic year to show progress. The math instructor may have students write chants or rap songs to reinforce knowledge of formulae. And, the science instructor could have students take audio-based notes when engaged in field study.

Can Teacher Candidates Transfer Learning across Content-Areas?

Students in methods courses realize the usefulness and transferability of instructional technology techniques. Despite the fact that all classroom examples related to social studies content, when asked a question about positive learning gains from the sample course, one student wrote: "Focused on integrating technology into all subjects. Practical methods and lessons… Great use of technology. Many instructional strategies." Preservice teachers are grateful for the opportunity to learn about and use the technology tools and many students naturally realize that the tools they learn in one methods course are useful for cross-curricular purposes.

This study identified many means of integrating instructional technologies across all content area methods courses. Some of these include:

- Use of concept mapping for brainstorming and student assignments (for more information, see O'Bannon, Puckett, & Rakes, 2006 or htp//:cate.uoregon.edu:8100/);
- Use of electronic readings in addition to paper-based readings;
- Electronic availability of previous exemplary student works for current student examples (see McTighe & O'Connor, 2005);
- Universal access to course materials (including class lesson plans and referenced materials);
- Immediate availability of audios of class lectures (see Abowd, Harvel, & Brotherton, 2000);
- Access to just-in-time training videos to assist students in utilizing technologies;
- Use of templates to complete assignments (see Koszalka & Bianco, 2001; Moskowitz, 2004);
- Blogging as a means of answering student questions and providing peer-to-peer support while building classroom communities (Glogoff, 2005; Poling, 2005);
- Use of blogging for students to reflect on class readings (see Du & Wagner, 2005);
- Demonstrations of software and other tools that teach or reinforce skills or strategies; and,
- Use of online tools.

Limits to Cross-Curricular Strategy Usage

While many of the study strategies could be used cross-curricularly, this was not true in all cases. For example, the display of photo documentaries of student experiences throughout the semester is particularly important in a social studies methods course because of the social nature of the content and the importance of teaching about developing classroom communities. While other subject areas may have uses for digital photos and videos (e.g., reviewing content, engaging in digital scavenger hunts, documenting findings in the field, project-based learning), their versatility is probably best suited for the social studies classroom. Similarly, there were technology integration strategies not used in this study because they failed to naturally align with the content of the course. For instance, using probeware may be particularly useful in a science methods course, but not as important in a social studies methods course. Likewise, introducing Google Docs and Spreadsheets could be a very powerful way for English methods instructors to teach peer editing, math instructors to teach number crunching, and science instructors to teach data sharing. Though there are certainly many ways to use Google Docs and Spreadsheets to deliver social studies content, learning these tools in social studies may not bear the precedence it does in the other subject areas and other technologies may warrant more time in the course.

Limits to Heavy Technology Use

For students facing financial struggles, accessing online readings was quite helpful. For some students, however, the heavy use of online resources was detrimental. For example, when responding to ways to improve the course during end-of-course evaluations, one student wrote: "I would not expect or rely upon as much outside reading using technology. We all do not have as much access to technology as we would like to have." Another student wrote: "The reading assignments were very informative, however, it was a major strain since I don't have access to the internet daily." Note that students did have free printing available in the college and readings were posted before the semester commenced; yet, some were still frustrated by this change in instructional style.

Study Limitations

One complication with using these technologies in methods courses is that their use requires technical training during time that should be dedicated directly to the content of the course. Though some students came knowing how to use the technologies introduced in the sample course, many did not. Instructors must be knowledgeable about the technologies themselves and must counterbalance the need to teach technology tools with their content-specific usefulness. A second complication is that many methods used in this study will be quickly outdated due to the pace of technological change and that new, better, and more popular methods will emerge. In social studies methods courses, for example, accessing online primary sources to engage in historical inquiry is becoming more common (Lee & Molebash, 2004a, 2004b). Cross-curricular digital storytelling is also emerging as a popular teaching strategy (Salpeter, 2005). To provide state-of-the-art training to preservice teachers requires that in addition to knowing how to use and integrate technologies, methods instructors keep abreast of emerging technologies and their potential instructional uses (Abowd, 1999).

Conclusion

Through this study, it became clear that even though teacher candidates knew how to use specific technological tools, they seldom knew how to utilize those tools in educational contexts. Even fewer students had knowledge of how to use technological tools to enhance and reinforce content learning. As colleges of education prepare 21st century teachers, they must accept the responsibility of integrating technological tools throughout their curricula. This includes ensuring that content methods instructors teach instructional strategies that seamlessly connect 21st century skills and tools with 21st century content (Partnership for 21st Century Skills, 2004). While it is still necessary in many institutions to continue to teach a course on integrating technology into schools from a generalist perspective, it is no longer acceptable for higher education institutions to leave this responsibility solely to their educational technology faculty. All faculty members must prepare students for the 21st century and all methods courses must teach strategies enabling preservice teachers to transparently and ubiquitously integrate technologies into their future content-specific classrooms.

References

Abowd, G. D. (1999). Classroom 2000: An experiment with the instrumentation of a living educational environment. *Pervasive Computing, 38*(4), 508–530.

Abowd, G. D., Harvel, L. D., & Brotherton, J. A. (2000). *Building a digital library of captured educational experiences.* Paper presented at the Kyoto International Conference on Digital Libraries, Kyoto, Japan.

Blichfeldt, B. S. (2006). Creating a wider audience for action research: Learning from case-study research. *Journal of Research Practice, 2*(1), Article D2.

Cuban, L. (2002). *Oversold and underused*. Cambridge: Harvard University Press.

Du, H. S., & Wagner, C. (2005, January 3-6, 2005). *Learning with weblogs: an empirical investigation.* Paper presented at the 38th Hawaii International Conference on Systems Sciences.

Dwyer, D. (1994). Apple classrooms of tomorrow: What we've learned. *Educational Leadership, 51*(7), 4–10.

Glogoff, S. (2005). Instructional blogging: Promoting interactivity, student-centered learning, and peer input. *Innovate, 1*(5).

Harris, J., Mishra, P., & Koehler, M. J. (2007, April). *Teachers' technological pedagogical content knowledge: curriculum-based technology integration reframed.* Paper presented at the American Educational Research Association Annual Meeting, Chicago, Il.

International Society for Technology in Education. (2004a). *National educational technology standards for students*. Retrieved March 28, 2005, from http://cnets.iste.org/students/s_stands.html

International Society for Technology in Education. (2004b). *National educational technology standards for teachers.* Retrieved March 28, 2005, from http://cnets.iste.org/teachers/t_stands.html

International Society for Technology in Education. (2007). *National educational technology standards for students, refreshed*. Retrieved September 6, 2007, from http://www.iste.org/inhouse/nets/cnets/students/pdf/NETS_for_Students_2007.pdf

Kajder, S. B. (2007). Bringing new literacies into the content area literacy methods course. *Contemporary Issues in Technology and Teacher Education, 7*(2).

Keeler, C. G. (In Press). Modeling technology-based social studies instruction: A simulated WebQuest. In E. Heilman, R. Fruja & M. Missias (Eds.), *Social Studies and Diversity Teacher Education: What We Do and Why We Do It.*

Koszalka, T., & Bianco, M. B. (2001). Reflecting on the instructional design of distance education for teachers: Learnings from the instructors. *Quarterly Review of Distance Education, 2*(1), 59–70.

Lee, J., & Molebash, P. (2004a). Outcomes of various scaffolding strategies on student teachers' digital historical inquiries. *Journal of Social Studies Research, 31*(2).

Lee, J., & Molebash, P. (2004b). Using digital history for positive change in social studies education. *Journal of Computing in Teacher Education, 20*(4).

McNiff, J., & Whitehead, J. (2002). *Action research: Principles and practice* (2nd ed.). New York: RoutledgeFalmer.

McTighe, J., & O'Connor, K. (2005). Seven practices for effective learning. *Educational Leadership, 63*(3), 10–17.

Mertler, C. A. (2006). *Action research: Teachers as researchers in the classroom*. Thousand Oaks: Sage Publications, Inc.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A new framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054.

Mishra, P., & Koehler, M. J. (2008). Introducing technological pedagogical content knowledge. In AACTE Committee on Innovation and Technology (Ed.), *The Handbook of Technological Pedagogical Content Knowledge for Educators*: Lawrence Erlbaum Associates.

Mohr, M. M., Rogers, C., Sanford, B., Nocerino, M. A., MacLean, M. S., & Clawson, S. (2004). *Teacher research for better schools*. New York: Teachers College Press.

Moskowitz, S. (2004). Template-based teacher web pages. *Learning and Leading with Technology, 32*(2), 40–43.

National Committee on Science Education Standards Assessment, & National Research Council. (1996). *National science education standards*. Washington, D.C.: National Academy Press.

National Council for Teachers of English. (1996). *Standards for the English language arts*. Urbana, IL: National Council of Teachers of English and International Reading Association.

National Council for Teachers of Mathematics (Ed.). (1989). *Curriculum and evaluation standards for school mathematics* (1 ed.). Reston: National Council of Teachers for Mathematics.

National Council for the Social Studies. (1994). *Expectations of excellence: Curriculum standards for the social studies* (No. Bulletin 89). Washington, D.C.

Niess, M. L. (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. *Teaching and Teacher Education, 21*(5), 509–523.

O'Bannon, B., Puckett, K., & Rakes, G. (2006). Using Technology to Support Visual Learning Strategies. *Computers in the Schools, 23*(1/2), 125–137.

Office of Technology Assessment. (1995). *Teachers and technology: Making the connection* (Report No. OTA-EHR-616). Washington, D.C.: Office of Technology Assessment.

Partnership for 21st Century Skills. (2004). Partnership for 21st century skills. Retrieved March 27, 2005, from http://www.21stcenturyskills.org/

Poling, C. (2005). Blog on: Building communication and collaboration among staff and students. *Learning and Leading with Technology, 32*(6), 12–15.

Robinson, V., & Lai, M. K. (2006). *Practitioner research for educators: A guide to improving classrooms and schools*. Thousand Oaks, CA: Corwin Press.

Salpeter, J. (2005). Telling tales with technology. *Technology & Learning, 25*(7), 18, 20, 22, 24.

Schmuck, R. A. (2006). *Practical action research for change* (2 ed.). Corwin Press: Corwin Press.

Shorr, P. W. (2004). One call at a time. *Scholastic Administr@tor, June*, 35–38.

West, R. E., & Graham, C. (2007). Benefits and challenges of using live modeling to help preservice teachers transfer technology integration principles. *Journal of Computing in Teacher Education 23*(4).

Zike, D. (1992). *Big book of books and activities*. San Antonio, TX: Dinah-Might Activities, Inc.

Dr. Keeler is the pedagogy scholar for Clark County School District's Teaching American History Grant and a part-time instructor at the University of Nevada, Las Vegas. She is currently engaged in numerous research projects including case-based study of an elementary micro-community, use of digital audio-based storytelling, teacher use of service learning with intermediate level learners, use of technology during project-based learning with young learners, and use of Web 2.0 tools for teaching historical inquiry. Her recent publications are in the fields of educational technology, instructional design, and social studies education.

Christy G. Keeler, PhD
Phone: 702.577.2331
E-mail: christy@keelers.com