



## Technology Feature

Kathleen Owings Swan & Mark Hofer  
Feature Editors

### **Content-Specific Technology Infusion Program in Pre-Service Teacher Education: *The Technology Leadership Cadre (TLC)***

**Kathleen Owings Swan  
University of Kentucky**

**Mark Hofer  
College of William and Mary**

#### ***Abstract***

*Efforts to prepare new teachers to integrate technology into their teaching have a lengthy history. Increasingly, scholars are beginning to understand the importance of linking technology with specific content areas and pedagogy (Zhao, 2003). Mishra and Koehler (2006) refer to this intersection of technology, pedagogy, and content as Technological Pedagogical Content Knowledge (TPCK). Structuring field experiences that systematically address curriculum-based technology integration in the context of specific content areas is one way that teacher preparation programs can operationalize this development of TPCK in pre-service teachers (Bolick, 2002; Dawson & Nonis, 2000). Analysis of the data in the Bolick study revealed three benefits for the pre-service teachers working within a content-specific technology field placement: (a) increased knowledge and skill related to digital history pedagogy, (b) increased content-area knowledge, and (c) increased confidence in developing and teaching technology-integrated lessons (2002). Using Bolick's findings as initial assertions, this study investigated the use of collaborative field placements, digital history, and an apprenticeship model of training to teach pre-service teachers about technology and elementary social studies instruction. This paper discusses the results of the Technology Leadership Cadre (TLC) collaboration and provides recommendations for future studies in this area of research.*

## Introduction

There has been a long history of efforts to prepare new teachers to integrate technology into their teaching. The approach most commonly made to systematically address technology integration in teacher preparation programs has focused on a separate technology course (ISTE, 1999; NCATE, 1997). Unfortunately, these courses have tended to be more techno-centric (Betrus, 2000) and perhaps not well connected to teaching methods courses (Mehlinger & Powers, 2002; Willis & Mehlinger, 1996). Increasingly, however, scholars are beginning to understand the importance of linking technology with specific content areas and pedagogy (Zhao, 2003). Mishra and Koehler (2006) refer to this intersection of technology, pedagogy, and content as Technological Pedagogical Content Knowledge (TPCK). Even with “full integration” of technology in a teacher preparation program (Mehlinger & Powers, 2002), assisting pre-service teachers to make these connections is no easy task. One way that teacher preparation programs can operationalize this development of TPCK in preservice teachers is to structure field experiences that systematically address curriculum-based technology integration in the context of specific content areas (Bolick, 2002; Dawson & Nonis, 2000).

This study is an attempt to uncover meaningful technology integration informed by TPCK within the methods experience of a pre-service teacher education program. The starting point for this discussion began by revisiting a pilot project (Bolick, 2002) in which a methods professor facilitated the design, development, and implementation of a Web-based digital history lesson with four pairs of pre-service and in-service teachers as a way of enriching the students’ technical skills and content-area knowledge. The current study extends this initial examination to include collaboration between a group of selected teacher education students, the Technology Leadership Cadre (TLC), and eight local elementary teachers. Under the guidance of a mentor and the in-service teacher, six student teachers designed units that incorporated elements of historical thinking, using digital history and various presentation technologies, including web pages, PowerPoint, and databases. An additional project included an economics curriculum for first graders that used digital cameras to create web pages for the student-created businesses. The students met once a week for a seminar class that would help in building a theoretical framework for their projects and also assist with facilitating their design in a shared environment. This paper discusses the results of this collaboration and provides recommendations for future studies in this area of research.

### *Theoretical Framework*

Appropriate and meaningful technology integration into the social studies curriculum is guided by five principles, adopted by the College and University Assembly (CUFA), the governing professional organization of social studies academicians. Three of these principles apply to this research study and accordingly provided a conceptual framework for the student’s projects and the seminar class (Mason et al., 2000). They include the following:

- Learning experiences should be extended beyond what could be done without technology.
- Technology should be introduced in context.
- Research in the area of technology and social studies should contribute to the research and evaluation of social studies and technology.

Analysis of the data in the Bolick study revealed three benefits for the pre-service teachers working within a content-specific technology field placement: a) increased knowledge and skill related to digital history pedagogy, b) increased content-area knowledge, and c) increased confidence in developing and teaching technology-integrated lessons (2002). Participants in the Technology Leadership Cadre (TLC) differ from those in Bolick's study in that they have not completed their semester student teaching experience and that they are all elementary pre-service teachers whose undergraduate degrees are from a range of disciplines. In addition, the aim of the TLC is ongoing mentorship throughout the pre-service teacher's program with a recruited body of students. What this study investigated is whether this newly conceived process of instruction will yield the same results as the Bolick study under a different set of circumstances and with a different population. Using Bolick's findings as initial categories for exploration, this study investigated the use of collaborative field placements, digital history, and an apprenticeship model of training to teach pre-service teachers about technology and elementary social studies instruction. In doing so, this study examined the following question: *How does the Technology Leadership Cadre (TLC) model assist preservice teachers in developing TPACK?*

### **Methodology**

Data was collected for this study using a number of approaches. Students in the cadre answered both pre- and post-study surveys using an Internet-based anonymous feedback form. The structured interview on both occasions was sent to the students in advance, and they completed the surveys using the online feedback mechanism. In the pre-study survey sent at the beginning of the semester, students were asked to discuss their experiences with technology in the elementary classroom, in their field experiences, and during their pre-service program to date. Further, students were asked questions regarding historical thinking and its use within the social studies classroom as well as their expectations of the semester experience and collaborating with an in-service teacher. In the post study survey, students were asked to describe their experience as a participant in the TLC during the semester, to identify any strengths or weaknesses of the Wednesday seminar, and to discuss uses of technology within elementary social studies.

Observations during the students' field placement were also completed two to three times for each pair of participants. Using the Spradley matrix (Spradley, 1980), the observations focused on several key components of the instruction including the pedagogical approaches to the social studies lesson, the interaction between the in-service teacher, pre-service teachers, and elementary students and the use of educational technology within the social studies lesson. The following guidelines were used to discriminate between appropriate and inappropriate uses of technology with the social studies lesson: (a) The technology extended learning beyond what could be done without its use; (b) the technology was introduced within context; (c) the use of technology included opportunities for students to study relationships among science, technology, and society; (d) the technology fostered the development of the skills, knowledge, and participation as good citizens in a democratic society (Mason et al., 2000).

Interviews of each in-service teacher were also conducted at the conclusion of the field experience. Teachers were asked to describe their use of technology within social studies, their experience as a participant in the semester project, and any challenges and/or benefits they encountered during the experience. Documents were also collected during the study. These

products included the curriculum jointly developed throughout the semester by the in-service and pre-service teachers. This included the several iterations of the curriculum and the final drafts that were implemented. These pieces reflect the process of technology integration, beginning with the social studies content and moving towards the chosen use of technology to support the semester experience.

Data analysis was conducted using Erickson's (1986) model of analytic induction. This method allows the researcher to generate themes based on the collected data. During fieldwork and data analysis, several key themes emerged which were associated with the research question. These themes serve as the basis for assertions related to the creation of Technology Leadership Cadre (TLC) and a content-specific Technology Infusion Program (TIP). They include the following:

1. The student teachers demonstrated increased knowledge and skill related to digital history pedagogy,
2. The student teachers demonstrated increased content-area knowledge, and
3. The student teachers demonstrated increased confidence in developing and teaching technology-integrated lessons.
4. The structure of the leadership cadre was critical to this experience of the student teachers.

Each of these assertions will be discussed in detail below and accompanied by at least one descriptive vignette. These vignettes, as a whole, are intended to ground the abstract concepts presented in the assertions, to provide more evidence in support of the assertions, and to give the reader a greater and more detailed awareness of what took place during fieldwork.

## Findings

### *Increased Knowledge and Skills Related to Digital History Pedagogy*

At the beginning of the semester, most students in the cadre were unable to describe effective uses of technology within the elementary classroom, but by the end of the semester experience, they were able to list specific uses of instructional technology and justify their use.

One pre-service teacher expressed at the beginning of the spring semester, "I have not seen any use of technology yet in the elementary classroom. We did teach one math lesson in an elementary school, and the students seemed to find the site interesting, but I don't know how the lesson would have worked with the whole class." Another student stated, "Other than those isolated instances, I really have not seen technology used effectively in the classroom." While most pre-service teachers were able to identify the practice of using WebQuests in social studies and some had even designed an activity using this practice, very few listed this as an effective use of technology within the social studies classroom. As one student responded, "I have also seen a lot of so-called WebQuests that do not really promote a deeper understanding of history. Basically I have seen technology used to perpetuate the teaching of social studies as a fact-based enterprise, rather than an understanding based enterprise."

During the semester, students designed and instructed sophisticated social studies projects that demonstrated their understanding of how educational technology might be used to connect with social studies pedagogy. In one project covering the Civil War, cadre partners

created a database that housed a number of primary sources depicting hardships from a variety of perspectives, including soldiers, women, slaves, and children. Using the database and a series of exercises aimed at deconstructing the sources, students in the class then created PowerPoint presentations to answer the question: To what extent did Americans suffer hardships during the Civil War? In another project, the students created a three-day exercise to better understand the events leading up to the American Revolution using an inquiry-based approach and digital history. Within the first two class periods, fourth-grade students used laptops to examine a series of primary source documents housed online that presented conflicting accounts of the Boston Massacre, the Boston Tea Party, the Battle of Lexington and Concord, and the First Continental Congress. At the end of the two days, students wrote a one-page letter to the editor in which they addressed the following question: Were the colonists justified in their revolt against the crown? On the third day of the unit, students used their letters and the exercises to consider/debate the following: Is history reliable? In all of four of the projects, students were able to introduce technology in context and extend learning beyond what could be done without technology (Mason et al., 2000).

By the end of the semester, answers to the question, “From your experience or observation, what would you say are some successful uses of technology in the elementary classroom?” evolved considerably. One cadre member listed the following uses:

1. Teaching students how to convey information to a broader audience through PowerPoint presentations and/or web pages
2. Making use of digitized primary source documents provided by special collections of various governmental agencies like the National Archives (these are resources that would otherwise not be inaccessible to students if it were not for the enormous storage capacity of computers and the Internet)
3. Utilizing a digital camera enables students to capture images, transfer them rapidly, and import them to be used for creating a story or to communicate an idea.

Another cadre member articulated the following:

Technology can be used successfully with younger children to embed a topic in meaningful experiences. Capturing children’s images with digital photography and creating iMovies both help children to better understand a topic because they are afforded hands-on experiences. I also see the Internet as a powerful tool for conveying information that may not be included in texts because of its timeliness, a way to interact with people we would never have personal access to, and alternate ways to use manipulatives. Finally, I see the value of PowerPoint for children with disabilities that limit note-taking and the value of Word and Excel for graphing, drafting, and editing.

As Bolick noted in her study of the Digital History TIP, students were able to triangulate their pre-service experiences to include the instructional practices gained during their methods courses, the content from their undergraduate experiences, and the technology skills obtained during the educational technology courses to apply during this field experience (Bolick, 2002). One cadre member seemed to sum up the semester with the following statement:

We were introduced to the idea of historical thinking and the use of primary source

documents in our elementary methods course, but I was unable to visualize how this would actually play out in a classroom. Being able to take the theoretical and implement it on a practical level is what is most beneficial for me.

### *Increased Content-Area Knowledge*

One of the major differences between the Bolick study (2002) and the current one is the background of the pre-service teachers. In the Bolick study, the pre-service teachers were all enrolled within the secondary social studies program in which they were required to take a number of social studies classes in the College of Arts and Sciences, including history, geography, and economics. In this study, the participants were elementary pre-service teachers whose programs were designed to give them experience in all four core content areas. Because of the generalist nature of the elementary program, very few of the cadre members had a strong background or concentration in social studies. As part of their projects, cadre members spent time researching the respective time periods to complete their curricula. These included the following topics: the Civil War, the American Revolution, the New Deal, and economic goods and services. By design, students were able to gain insight into those particular time periods and events.

In addition to these efforts at strengthening the pre-service teachers' content knowledge, the Wednesday night seminar spent many sessions discussing articles and books related to the social studies pedagogical process of historical thinking. Students in the cadre gained an appreciation for this practice and the nature of history as well as insight into how it could be used in younger grades. The following comments by cadre members are offered as evidence of the growth through the semester:

My views of what should constitute social studies instruction have also been changed and shaped by this experience. It has been valuable to take theoretical concepts such as historical thinking and see how such concepts can be incorporated into social studies instruction in a way that is worthwhile for the students and challenges them to re-think the question, "What is history?" I am not sure that I had a really good understanding of what the term historical thinking meant and even less understanding of how to teach it prior to participating in the TLC experience. As I had mentioned, it is one thing to discuss the idea or hear it mentioned one or two times in a class and another to understand how it can be used in the classroom in an authentic way. Without the field experience I worked on, which incorporated historical thinking and the discussions we had about historical thinking, my sense of how to use it in the classroom would have been lacking. It has really developed my understanding of historical thinking and also made me realize why it is hard to do. You have to be well prepared; you are asking kids to think for themselves, so you have to be ready for the consequences. They will ask tough questions...that's the point!

This deliberate focus on pedagogy rooted in the social studies, paired with research in the content, enabled the students to apply general pedagogical knowledge to design effective learning experiences for their students.

### ***Increased Confidence in Developing and Teaching Technology-Integrated Lessons***

At the beginning of the semester, cadre members expressed consensus that they were unsure of how to create and/or implement a technology-rich elementary lesson. One member articulated it this way:

I did learn some new programs and quite a bit about some of the issues surrounding technology in my *Introduction to Elementary Technology* class. In most of my methods classes, there does seem to be an attitude of “Do one technology lesson plan.”

While this is better than nothing, there is very little chance that by doing one lesson per class, pre-service teachers will be capable of effectively using technology in their classroom. By actually creating and implementing a social studies project whose centerpiece was to use technology in a meaningful way, cadre members were able to build their confidence in duplicating these efforts in the future. One cadre member felt that using digital cameras to capture goods and services allowed her first-grade students to delve deeper into the nuances of economic terms, something she believed impractical at the beginning of the semester. Another cadre member began the course uncertain as to whether technology could be meaningfully integrated into the elementary classroom. Later, she expressed, “Being able to implement instruction using technology has been a confirming experience that it is possible to make technology an effective part of classroom teaching.” Further, another member commented that her comfort level with pedagogical approaches to technology had risen considerably. She writes, “Presenting primary documents on-line would probably not have occurred to me had I not been involved with this group.”

The question of whether these pre-service teachers can transfer their knowledge of technology pedagogy in social studies to other content areas remains to be seen. However, one cadre member indicated that her comfort level in this domain had risen enough to convince her of this possibility, and she asserted:

Previously, my experience in using technology in the classroom had been limited to high achieving, gifted children. In this field experience, I was working with a middle- and low-ability group, including several learning disabled and ESL learners. This allowed me to add many layers to my understanding of how digital images can be used to teach...not just social studies but other subjects as well.

### ***Structure of the Leadership Cadre Critical to This Experience***

From the beginning of this experience, pre-service teachers were given a vision of an apprenticeship model organized in the model of a cadre for a select group of students. In the letter of invitation, members were told the following:

We intend to build upon the program expertise in educational technology to develop among a small cadre of teacher education students whom we believe will be the future technology innovators and leaders within schools... It is with great pleasure that I invite you to join a unique program designed to provide support and mentorship within the

teacher education program, as well as in your induction years of teaching after graduation.

Students unanimously agreed that the structure of the cadre played a pivotal role in the experience. When asked to describe the essential elements of the cadre, the members communicated the following benefits to this approach:

1. *A small number of members*

Cadre members believed that a group of eight allowed for individual attention from the TLC mentor and a collaborative format in which each pair of students could be heard and supported. One member writes, “It is a rare opportunity in academia to be part of a small educational experience where students receive personalized instruction, mentoring, and support... The small cohort allows for more accountability and personal exchanges.”

2. *A selection process*

While a few members expressed concern about the process of selection and its lack of formal criteria, they agreed that a selection process helped create a suitable composition for the group. One cadre member expresses it this way, “The fact that we were chosen to be a group was also good, in my opinion. There was diversity of perspective, but we all worked within a similar framework. We were selected, I believe, not just on the basis of interest and talent, but also there was a rightness of fit’ about the group. We balanced and checked each other in a variety of ways...”

3. *An emphasis on community building*

Wednesday meetings were designed to build community among the members and this emphasis seemed to resonate with most of the group. Members commented that the lack of formality and its collaborative nature appealed to them and helped anchor the field projects. “I also felt that this was an opportunity to forge close bonds with members of my program... Sharing ideas and the ‘trials’ of implementing a new project brought us all closer together and helps us to better realize one another’s strengths... I’m not implying that we’re best friends and that we sing around campfires, but I feel we have a renewed respect and appreciation for each other and our contributions.” Another student commented that the informal nature allowed her to feel more comfortable speaking in the group, something she typically doesn’t do in other classes.

4. *The flexible instructional approach*

Another common theme among cadre members expressed was the appeal of a flexible instructional approach whose emphasis varied between the theoretical and practical and did not tie itself to rigid syllabus. At the beginning of the seminar, students in the cadre read a variety of articles and books establishing the theoretical foundation for the projects but for most of the semester created their own pace and purpose for the meetings. One cadre member provides the following example to illustrate: “When projects are under way, it was really important that the seminar time includes a chance for discussion of where those projects are going and how they are playing out.

It is important that TLC not be tied to some sort of curriculum; the experience was authentic because we discussed what we felt was meaningful and important to understanding how historical thinking and technology can be incorporated into the classroom in meaningful ways.”

### 5. *A Vision*

The final theme among members was the feeling that this was not a discrete semester experience but would be connected throughout the graduate experience and into the induction years of teaching. When asked how students saw the TLC beyond this semester, one member commented, “I see those of us who are still going to be here in the fall continuing and working with a new group of students to implement new projects. I also see those of us who will perhaps have classrooms in January continuing with the cadre, perhaps by providing a link to new schools and teachers who would be willing to take part in the technology infusion program.”

In summary, according to members, there was a relationship between the cadre and its impact on the other three assertions as demonstrated in Figure 1.1 below.

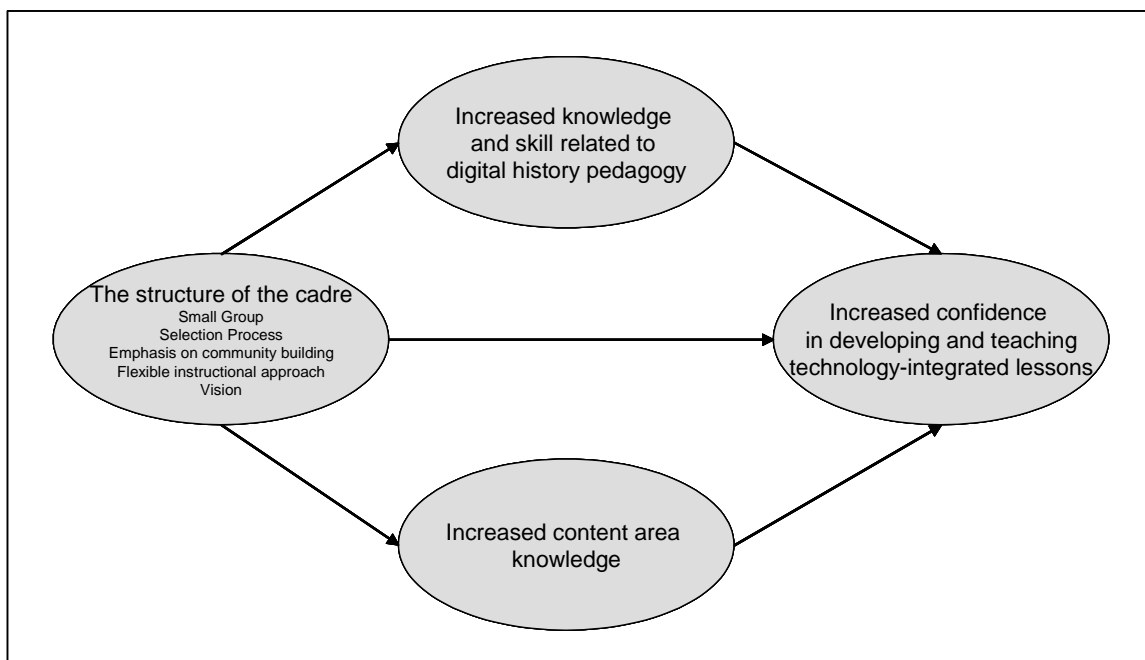


Figure 1.1 Relationships among the assertions

## Conclusion

Quality teaching requires developing a nuanced understanding of the complex relationships between technology, content and pedagogy, and utilizing this understanding to develop appropriate, context specific strategies and representations (Mishra & Koehler, 2007 p. 14).

As Mishra and Koehler (2007) indicate in the above quote, integrating technology is not a static objective but rather a fluid and sometimes elusive process in which teachers learn, apply,

test, and revise their use of technology, sometimes simultaneously. Moreover, this process is occurring within specific school contexts that too shift and change as often as new technologies emerge. Within this initial study of the Technology Leadership Cadre (TLC), these dimensions have been triangulated so that students would be able to practice what they have learned in methods courses in a series of hands-on field experiences using the latest instructional technology pedagogies under a supportive apprenticeship model. The study described above hopes to address some of the complexities inherent in integrating modern technologies into teacher education and school curricula. As the findings suggest, the TLC model has at its core an apprenticeship in which students are building dispositions towards Technological Pedagogical Content Knowledge (TPCK). While labor intensive and small in scale, these types of models may hold potential for training teachers with an eye for the technology/pedagogy/content connections necessary for sustaining technology integration. Further research on the topic should focus on outcomes as a result of extending this set of experiences and apprenticeship through the pre-service teacher's student teaching and into the induction years. Additionally, this study extends the research done by Bolick (2002) and Dawson and Nonis (2000) by investigating the use of content-specific field experiences for pre-service teachers in elementary education. As these programs increase in number, it will be important for researchers to discuss the impact experiences such as these have on in-service teachers who participate in these school-university partnerships and its impact on student learning.

## References

- Betrus, A.K. (2000). The content and emphasis of the introductory technology course for undergraduate preservice teachers. Unpublished doctoral dissertation, Indiana University, Bloomington.
- Bolick, C.M. (2002). Digital history TIP: Preservice social studies experiences in a technology-rich field initiative. *Journal of Computing in Teacher Education*, 19(2), 54-60.
- Dawson, K. & Nonis, A. (2000). Preservice teachers' experiences in a K-12/university technology-based field initiative: Benefits, facilitators, constraints, and implications for teacher educators. *Journal of Computing in Teacher Education*, 17(1), 4-12.
- Erickson, F. (1986). Qualitative methods in research on teaching. In M.C. Wittrock (Ed.), *Handbook of research on teaching*. New York: Macmillan.
- Ingersoll, R.M. (2002, June). The teacher shortage: A case of wrong diagnosis and wrong prescription. *NASSP Bulletin*, 86(631), 16-31.
- International Society for Technology in Education. (1999). *National educational technology standards for students*. Retrieved April 22, 2003, from <http://cnets.iste.org/>
- Mason, C., Berson, M., Diem, R., Hicks, D., Lee, J., & Dralle, T. (2000). Guidelines for using technology to prepare social studies teachers. *Contemporary Issues in Technology and Teacher Education*, [online serial], 1(1). Available: <http://www.citejournal.org/voll/iss1/currentissues/socialstudies/article1.htm>
- Mehlinger, H.D., & Powers, S.M. (2002). *Technology and teacher education: A guide for educators and policymakers*. Boston: Houghton Mifflin.
- Mishra, P., & Koehler, M.J. (2006). Technological pedagogical content knowledge: A new framework for teacher knowledge. *Teachers College Record*, 8(6).
- National Commission on Teaching and America's Future. (2002). *No dream denied: A pledge to America's children*. Washington, DC. Available: <http://www.nctaf.org/dream/80303%20r1.pdf>
- National Council for Accreditation of Teacher Education. (1997). *Technology and the new professional teacher: Preparing for the 21<sup>st</sup> century classroom*. Washington, DC: Author.
- Spradley, J. (1980). *Participant observation*. New York: Holt, Rhinehart, and Winston.
- Willis, J.W., & Mehlinger, H.D. (1996). Information technology and teacher education. In J. Sikula (Ed.), *Handbook of research on teacher education*. (2<sup>nd</sup> ed.). New York: Simon and Schuster.
- Zhao, Y. (2003). What teachers need to know about technology? Framing the question. In Y. Zhao (Ed.) *What should teachers know about technology: Perspectives and practices*. Greenwich, CT: Information Age Publishing