

Technological Pedagogical Content Knowledge in Action: A Case Study of a Middle School Digital Documentary Project

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Abstract

In recent years researchers in educational technology have begun to look closely at the complexity of integrating technology in K–12 classrooms. The development of the notion of Technological Pedagogical Content Knowledge (TPCK) provides a useful theoretical framework to explore the requisite forms of teacher knowledge required to effectively integrate technology in classroom work. This case study explores the three domains of teacher knowledge and their intersections in a sixth grade digital documentary project. On the surface, the setting for the work (particularly the skilled teachers with whom we worked) seemed to be the “best-case scenario” for technology integration, and yet, challenges arose in the intersections of the domains of knowledge. This study explores the different areas of teacher knowledge in this project and provides directions for future work to further explore the notion of TPCK in practice. (Keywords: technology integration, moviemaking, history, TPCK, educational technology.)

Over the last several decades, educators have witnessed increased interest and emphasis on integrating technology in teaching. However, while there have always been pockets of “promising practice” in integrating technology in teaching, Cuban (2001) and Pflaum (2004) argue that even in schools and districts committed to technology integration, teaching practice remains largely unchanged. Researchers have attempted to explain this modest impact of educational technology in terms of barriers and challenges that educators face when integrating technology in their teaching practice, particularly in regard to time, training, and access (Cuban, Kirkpatrick & Peck, 2001; Diem, 1997; Hicks, Tlou, Lee, Parry & Doolittle, 2002). More recently, Mishra and Koehler (2006) posit that teaching with technology is a complex challenge for teachers and assert the importance of exploring the unique challenges encountered when integrating technology in the K–12 classroom.

One promising area of inquiry focuses on the benefits of student-produced digital video. Over the last several years, free software tools like Apple’s *iMovie* and Microsoft’s *Movie Maker* and *Photo Story* provide low-threshold, high-ceiling tools to enable even young children to produce their own short videos. A number of researchers assert that student-produced digital videos provide a va-

riety of benefits. When students create their own videos related to coursework, their motivation and engagement increase (Burn, Brindley, Durran, Kelsall, Sweetlove, & Tuohey, 2001; Hoffenberg & Handler, 2001; Kearney & Schuck, 2004; Ryan, 2002), and new opportunities to engage their creativity arise (New, 2006; Reid, Burn, & Parker, 2002). Student-produced digital video can also enable more authentic learning experiences (Kearney & Schuck, 2004) and provide students with a sense of ownership (Kearney & Schuck, 2005). In many instances, the creation of student-produced films also provides opportunities for students to engage more deeply in the subject matter than might otherwise have been possible. Shafer (2000), for example, engaged his high school English students in a “vigorously independent interpretation of various works of literature” in a video project that required students to synthesize literary criticism related to their chosen works. Fahlberg, Fahlberg-Stojanovska, & MacNeil (2007) discuss the engagement of students in mathematics principles and techniques in the creation of “whiteboard movies,” in which the students capture a screen recording of their writing and voices in explaining a mathematical concept. Michalski, Hodges, & Banister (2005) demonstrate that with the appropriate scaffolding, middle school students with cognitive delays were able not only to complete an autobiographical PowerPoint “film,” but to surpass their prior written work. Despite these promising stories, however, planning and implementing a student movie project represents a considerable challenge.

In an attempt to realize the potential regarding digital video in the class, we have worked in a number of settings over the last several years with teachers to challenge their students to create digital movies (Hofer & Swan, 2006; Swan, Hofer & Gallicchio, 2006; Swan & Hofer, 2006; Swan, Hofer & Levstik, 2007; Yow & Swan, in press). While each of these interventions met with at least some success, none were ideal. Based on the literature cited above and our own pilot work, we were optimistic about the efficacy and promise of digital movie-making within a social studies classroom. In each case, however, significant challenges arose for our partner teachers in terms of their content, pedagogical, and technological knowledge. For example, in one project (Swan & Hofer, 2006), the classroom teacher’s limited content knowledge proved difficult for her in guiding an open-ended project like the creation of a documentary. In another case (Yow & Swan, in press), the emergent, student-centered pedagogy required in a video project proved too far from the teacher’s typical pedagogical approach. Finally, in each case, the inevitable technological challenges (access to computers, file management, and software crashes) provided additional challenges for our partner teachers.

In contrast to our previous work, in the current study we have partnered with two classroom teachers who appear to be strong in all three areas (content, pedagogy, and technology). In many ways the context of this current intervention appeared to be an ideal setting for exploring this type of work. Our hope was to mitigate some of the teacher variables that have proved problematic so that we could shift our focus to the student products to determine how we might more effectively design moviemaking projects. Even in this “ideal” case, however, more nuanced barriers have arisen in the intersections among the different

domains of teacher knowledge. In this paper, we explore the successes and challenges our partner teachers encounter in implementing a digital documentary project in the sixth grade. Specifically, we consider the following research questions:

- What types of teacher knowledge (content, pedagogical, and technological) are required to implement a digital moviemaking project?
- In what ways do these domains of knowledge intersect?

THEORETICAL FRAMEWORK

In the mid-1980s Shulman (1986) coined the term “Pedagogical Content Knowledge (PCK)” to illustrate the complex and interconnected nature of content knowledge and pedagogical strategies. Traditionally, teachers have been trained separately in their content area knowledge (science, history, etc.) and in teaching strategies. With his theory of PCK, Shulman (1987) asserted the importance not only of developing a knowledge base in each of these areas, but of the intersection and synergy of the two. For example, a history teacher needs to not only be able to find compelling historical documents for students to read, but also know how to structure students’ analysis of them. The premise of PCK is that expertise in only one of the two areas is insufficient for excellence in teaching. Experienced teachers draw on a broad and deep knowledge of their subject, an understanding of effective ways to represent the content knowledge, and an awareness of appropriate pedagogical approaches to inform their instruction.

More recently, scholars have begun to assert the importance of connecting technology, pedagogy, and content in teacher preparation and professional development (Koehler & Mishra, 2008; Mishra & Koehler, 2006; Zhao, 2003). To assist educators in understanding the interplay of content, pedagogy, and technology Koehler & Mishra (2008) have developed a framework that extends Shulman’s notion of PCK with technology—Technological Pedagogical Content Knowledge (TPCK). Koehler & Mishra (2008) argue that the intersections in each of these three areas must be explored and delineated in the context of specific content areas (see Figure 1, page 182).

Just as Shulman (1987) emphasizes the intersection between content and pedagogy, Koehler and Mishra (2008) assert that to really understand teacher knowledge for technology integration, we have to be conscious of all areas of intersection between content, pedagogy and technology. For example, to effectively use a Web-based digital archive of the Italian Renaissance in a World History course, the teacher must have broad knowledge of the period (Content Knowledge), how to navigate the archive (Technological Knowledge), and how to design a learning experience in which students conduct research (Pedagogical Knowledge). In addition, knowledge of specific strategies to employ in guiding Web-based research (Technological Pedagogical Knowledge), understanding challenges students encounter as they learn the content (Pedagogical Content Knowledge), and acknowledging the limitations in reading historical texts online (Technological Content Knowledge) all contribute to how well the teacher is able to facilitate the project in total (Technological Pedagogical Content

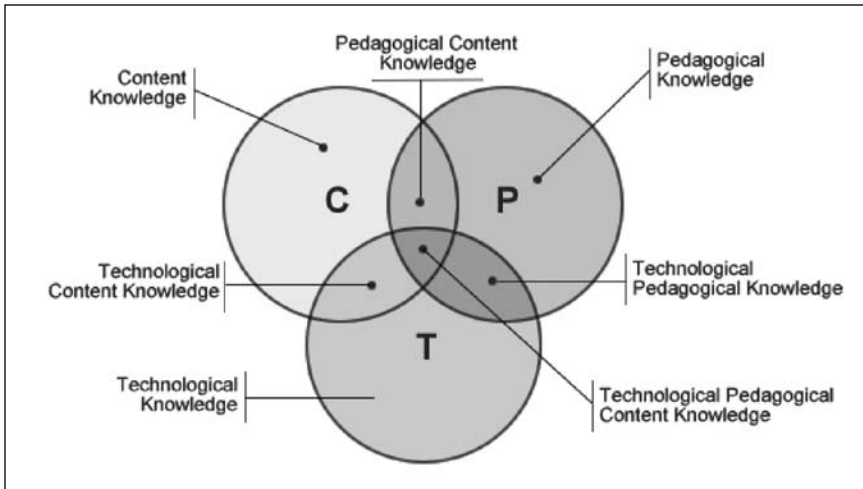


Figure 1: Technological Pedagogical Content Knowledge (TPCK) (Koehler & Mishra, 2008, p. 12)

Knowledge). Clearly, the knowledge and experience required to integrate technology into teaching and learning is a complex, multi faceted challenge.

Recently, educational technology researchers are exploring teacher knowledge for technology integration in a variety of areas (see Koehler & Mishra, 2007, for an extensive list of references). Over the last several years, we have worked around the periphery of the concept of TPCK in trying to understand how and why teachers integrate technology into their teaching practice in the social studies and where they face difficulty in the process. In particular, we noted significant challenges in student-created video projects related to pedagogy and content (Hofer & Swan, 2006; Swan, Hofer, & Levstik, 2007) and pedagogy and technology (Swan, Hofer & Levstik, 2007; Yow & Swan, in press). The challenges presented in these cases were nearly insurmountable for our partner teachers and even led one of the teachers to consider leaving the profession (Yow & Swan, in press). The purpose of this current study is to help build the knowledge base in TPCK by exploring the experience of two teachers in a digital documentary project in depth.

METHODOLOGY

Site Selection

In four sixth grade social studies and language arts classes, students participated in a three-week project to create three-to-five-minute documentary films on key people and events from the U.S. Civil War. The school at which the project took place is a suburban/rural middle school with a student population of 836 in grades six through eight. The school is both racially and socio economically diverse, including 25% minorities. The four classes of students who participated in this study (total of 98 students) reflected these demographics. The school is at the mean for student test scores on state standardized tests. While not technologically cutting edge, the school does have two computer labs, two carts of

17 laptops each, and nine LCD projectors that can be reserved for classroom use, and various other peripheral devices including digital cameras and scanners.

Instructional Context

The site for this study is located in a mid-Atlantic state with published statewide curriculum standards and standardized tests of content knowledge in reading and language arts in grades six through eight and history and social sciences at grade eight. Schools, teachers, and students are evaluated, at least in part, relative to these test scores, and consequently, there is a high level of focus on preparing students to score well on these exams. The curriculum standards in both social studies and language arts consist of both content and process standards. These standards and the school division curriculum guide were both instrumental in the development of the instructional goals and design of this project.

Both the social studies teacher, Mrs. Barnes, and the language arts teacher, Mrs. Randall (both pseudonyms), are engaging, effective, and experienced teachers. Mrs. Barnes has taught American history for 18 years and Mrs. Russell has taught English or language arts for six years. Both teachers vary their instructional strategies and consider the needs of their students in designing instruction. Neither teacher regularly uses any form of educational technology in their teaching beyond the use of instructional videos and occasional Internet research. Mrs. Barnes could be categorized as a Stage 2 teacher in terms of adoption of technology (Moersch, 1995), in that she has a relatively high level of skill with personal productivity tools (word processing, Web research, e-mail, Web-based grading software, etc.), but she does not integrate these skills in her teaching or into student work on a regular basis. Mrs. Randall could be rated similarly, although perhaps slightly lower than Mrs. Barnes, particularly in terms of Web-based research. For both teachers, the technology component of creating student-created digital documentary films was a significant extension of their typical practice.

When we approached Mrs. Barnes about partnering on this project, she was intrigued by the idea of student-created documentaries. She is passionate about history and the Civil War in particular and is very knowledgeable about the period. In fact, she has completed more than 30 hours of graduate work in history and hopes someday to complete her PhD. Over the years, she has collected a myriad of ancillary materials related to the Civil War, including numerous books, videos, artifacts, maps, and diaries that she uses in her instruction. While she has tried many ways to engage students at a deep level in the content (including re-enactments, simulations, developing trading cards, etc.), she has not been satisfied that students have come away with the depth of understanding that she desires. She immediately viewed this project as a way to not only introduce the core content contained in the curriculum standards, but also as a means to achieve the connection and depth with the content that she desired. Mrs. Randall focuses closely on reading, writing, and presentation in her curriculum. She regularly engages students in different forms of writing (expository, persuasive, creative, etc.) and in the creation of products (dioramas, posters,

book reviews, etc.). She has great enthusiasm for her content and employs a variety of strategies to capture her students' imaginations. We worked closely with Mrs. Barnes, and later Mrs. Randall, the language arts teacher on her team, to develop the instructional goals, specific content, materials, lesson planning and sequencing, and the assessment rubric for the student work. For both teachers, it was important to break the project down into its key components and build in formative evaluation and checkpoints throughout the three-week project. To this end, we segmented the project into three sequential phases: research, writing, and production.

Research Phase

The research phase comprised the first week of the project. In groups (twos or threes), the students selected a person or topic from a list provided by Mrs. Barnes or proposed their own person or topic. Mrs. Barnes also provided the students with a note card format they would be using to collect their research notes—a format they had used in earlier projects in the class. She introduced the students to the different print-based materials she had collected for their use including a set of encyclopedias, collections of primary source historical documents, fiction and non fiction books on topics relevant to the students' work, and printouts of useful Web sites. She emphasized print-based research over Web research due to the challenge in arranging for the computer lab and the efficiency provided by the teacher-selected print sources. As they were researching in their groups, students scanned pictures at one of four stations set up in the classroom and saved the images for later use. She built in three checkpoints to monitor their progress and sent them off to work. At the end of the first week, students (to varying degrees of success) had collected a great deal of information and images relevant to their chosen topic.

Writing Phase

The second week of the project took place primarily in Mrs. Randall's language arts classroom. In this phase, students were to transform the information they had collected in the research phase into a script for the documentary. This required students to synthesize the information they had collected, determine how they wanted to tell the story of their topic, and write a script from either a first or third person perspective. Students worked individually to develop a draft script that they would later synthesize with their partner's to create a composite script for the documentary. The primary challenge Mrs. Randall faced was the complexity and scope of the writing process. The fact that this was a new style of writing for the students necessitated a significant amount of structure for the week-long writing period. First, Mrs. Randall decided to divide the script into five sections: the opening, the events, the defining moment, the conclusion and the resolution. Each day the students were to work on one section of the script in class and share the section with a family member or another adult to revise that section of the script. The following day in class, Mrs. Randall had an individual conference with each student, suggesting changes and stylistic elements they might incorporate in their writing. Reduced class time on three of the days during the writing phase severely truncated the time for students to work in

class. Although the writing phase proved to be a tight schedule and the students did considerable work at home, the majority of the students had all five sections of the scripts written and revised by the end of the second week.

Production Phase

The third and final week of the project took place primarily in Mrs. Barnes' classroom and focused on production of the movies. Students brought their individual scripts together and selected the best elements or sections from each and developed a synthesized version of the script for the film. Once the scripts were finalized, the groups were then tasked with developing a storyboard for their film, in which they paired the scripts with relevant images and notations to include music or other audio elements. The project timeline included two days to complete the storyboard. In reality, however, many of the groups had not quite finished this process in three days.

The completed storyboards served as the "blueprints" for the video production. Creating the movies spanned three days for the students. This work was also completed in Mrs. Barnes' classroom, using a set of laptop computers loaded with Microsoft's *MovieMaker* software. She led students through the process in a stepwise fashion. Each day started with a brief discussion and demonstration of the tasks they would be working on that day. On the first day of production, students imported the images they intended to include in their movie and arranged them in order on the timeline. On day two, they created the titles and credits for the movie and began recording the narration for their film either directly into the computer or using a handheld digital audio recorder. On the third day, the groups completed their narration and added any audio and visual effects they desired. Once the students had recorded their narration and selected appropriate music for their films, the students exported their projects as video files.

DATA COLLECTION AND ANALYSIS

For this research study, we employed an interpretive case study approach (Stake, 1995), using the constant comparative method for data analysis (Glaser & Strauss, 1967). This approach to framing the study, data collection and analysis, and presentation of findings allowed us to closely examine the context and dynamics of the intervention (Darke, Shanks, & Broadbent, 1998). Data were collected in the spring of 2006. The partner teachers were interviewed multiple times during the project, including one formal interview during the development process; multiple, informal interviews during the implementation phase; and one formal interview immediately following the work. Teaching materials and student products were also collected at each stage of the process, including the teachers' lesson plans, handouts, and other materials. We also conducted classroom observations to supplement these ancillary materials. Additional data included the statewide curriculum standards and the county-wide curriculum maps.

Our role in the project was as co-instructional designers with the teachers prior to implementation and some facilitation of the technology portions of the

work. For example, Mrs. Barnes and one group of students were introduced to each of the phases of the work (e.g., scanning documents, saving images from the Web, importing images into MovieMaker, etc.), and then Mrs. Barnes took over the facilitation of the work. Other than in these two areas, we remained observers throughout the process.

We utilized the TPCK framework to develop our initial categories. We then began to identify potential themes for analysis that we recorded in analytic memos. This process enabled us to refine our focus for the study and data collection and to “try out” initial themes we saw unfolding (Merriam, 1998). The development of these initial categories was informed by challenges inherent in technology integration (Bauer & Kenton, 2005; Byrom, 1998; Norum, Grabiner, & Duffield, 1999) and by our own previous research (Hofer & Swan, 2006; Swan, Hofer & Gallicchio, 2006; Swan & Hofer, 2006; Swan, Hofer & Levstik, 2007, in press; Yow & Swan, in press). We used these broad issues and themes to develop an initial set of categories for the data. We used a focused coding approach (Glaser, 1978) in coding the classroom observations, comments from the teacher interviews, content from the collected instructional materials, and notes from research memos through a method of constant comparison (Glaser & Strauss, 1967). The initial categories were refined and developed as necessary according to the data. We then individually coded all the relevant data into these categories, discussing any discrepancies or revisions to the categories to reach consensus. A subsequent analysis of the categories yielded subsets of themes that are discussed in the findings section.

While we recognize that the results of this study cannot be generalized beyond our sample, our attempt was to provide a rich discussion of the instructional context and intervention to allow readers to determine the degree to which they could be applicable in a new setting (Lincoln & Guba, 1985).

FINDINGS AND ANALYSIS

Given the experience and content, pedagogical, and technological knowledge of our partner teachers, we expected this project to flow smoothly. As Mishra and Koehler (2006) suggest, we expected to see a “thoughtful interweaving” of these three domains as they were operationalized in the classroom (p. 1029). When we explored the data—particularly the classroom observations—we realized that many different types of knowledge were required of the teachers to effectively implement the project. In this section we reflect on the specific knowledge and skills required in each of the three domains and their intersections and how we saw this knowledge play out in the project.

Content Knowledge

Both Mrs. Barnes and Mrs. Randall are quite experienced in their content areas. For teachers, content knowledge includes not only their subject area knowledge, but their understanding of the applicable curriculum standards. It was clear from an examination of the teachers’ lesson plans and in the interviews that they were able to effectively connect the project with multiple curriculum standards. In fact, while both Mrs. Barnes and Mrs. Randall were concerned with synchronizing their instruction to the curriculum map of the

district and to the statewide curriculum standards for sixth grade, they collaboratively designed the documentary project to address far more content than contained in the standards. The teachers are concerned with providing a strong foundation for their students and treating the standards as minimum competencies rather than the sole curricular expectation or outcome. In one interview, Mrs. Barnes explained, "I want to go beyond, and I want my kids to know that [the state curriculum standards] are the bare minimum, and that I want more for you. This kind of teaching allows us to go beyond just basic [the state curriculum standards]." As a result, the projects were constructed so that students researched the roles of military/political leaders cited in the standards but also went beyond learning about these individuals to include lesser known historical figures, such as Clara Barton and John Mosby. The majority of the topics that students selected were not even referenced in the course textbook.

In language arts, Mrs. Randall believed the project covered "all of the aspects of writing, all of the aspects of the grammar." She explained, "You had to have all of the grammar. You had to have all of the aspects of the narrative. It was a narrative presentation, and narratives are one of the standards that we have to teach, which we had done, but this took it to a whole different level."

This documentary project required the teachers to creatively match the local and state curriculum standards to the specific learning activities. While this is true for the design of any learning activity, the student-centered and open-ended nature of this kind of work presents challenges that have proved difficult for other teachers with whom we have worked (Swan & Hofer, 2006, Yow & Swan, in press). The teachers in this project were able to navigate this challenge effectively. In fact, they were able not only to match the curriculum standards to the project, but also to pull in standards from multiple content areas and seamlessly incorporate far more content than specified in the standards.

In addition to the content focus of the project, the history standards ask the teacher to address historical thinking skills throughout the curriculum, including the ability to "identify and interpret primary and secondary source documents to increase understanding of events and life in United States history to 1877," as well as to "interpret ideas and events from different historical perspectives." Students used a variety of historical sources to research their topics and later write the script for their documentaries. Mrs. Barnes was very skilled at facilitating this process, challenging students to corroborate different accounts and read for significance. She insisted that the students continually answer the question, "So what?" In many ways Mrs. Barnes framed historical research as a quest. In one class she described her own experience in researching a local Confederate soldier in that she scoured local courthouses and collections of soldiers' dossiers. By using these facilitation strategies and personal stories, she continually emphasized to students that historical processes are at the core of learning history.

Pedagogical Knowledge

A documentary project requires simultaneously giving students latitude to take ownership of the project, while providing the necessary structure, guid-

ance, and feedback to help them through the process. The pedagogical demands of this kind of work are difficult for some teachers—particularly those with more directive, teacher-centered instructional approaches (Swan & Hofer, 2006; Yow & Swan, in press). Both teachers in this study are experienced teachers who routinely match pedagogical strategies to the needs of their learners. They employ a variety of instructional approaches, depending on the learning goal and activities they select for their students. They routinely employ student-centered strategies and are comfortable and skilled in facilitating this type of work.

It was clear in the classroom observations that both Mrs. Barnes and Mrs. Randall were experienced and comfortable with student-centered pedagogy. Both teachers had employed student-centered pedagogy in earlier units in the semester through project work and in practicing the writing process. For example, in recent years, Mrs. Barnes has challenged students to develop annotated timelines, exhibit boards, historical trading cards, historical dramas, and theme collages. Similarly, Mrs. Randall regularly engages her students in writers' workshops, reading circles, and collaborative class presentations. Neither teacher was concerned that she would not be able to cover the curriculum material or prepare their students with this pedagogical orientation effectively—a feeling not shared by many colleagues. For example, when asked whether the project had set them back in terms of covering the required curriculum, Mrs. Barnes replied,

I'm so glad you asked that question because I had teachers stop me in the hall and go, "How long did it take for you all to do that?" And I would say, "3 or 4 weeks." And they would say, "I can't stop my teaching and do anything of that nature." And I said, "who said we weren't teaching when we were doing the project?" And she looked at me with that weird look on her face. I specifically taught that knowledge was being shared at all points in the project. I was teaching, I was showing, I was working. They were teaching each other. It's not in a typical teacher-lecture approach. It does not mean that the material wasn't there.

Mrs. Randall echoed this sentiment, noting,

My children were still doing vocabulary, they were still doing other assignments, they were still doing things. And it didn't hurt them in any way, form or fashion and there was absolutely not a parent complaint at all. And I think that there was always teaching going on within the classroom, whether it was your regular class, or a combined class, or it was more of an in-depth study, as [Mrs. Barnes] was saying, but there was never a lack of teaching going on.

For both Mrs. Barnes and Mrs. Randall, student-centered pedagogy was nothing new. This is how they both typically operate. This was evident in the comfort level they felt during the intervention; comfort with the ambiguity inherent in letting go of control in the classroom, comfort with ill-defined curriculum,

and comfort with interruptions in the school schedule and shifting timelines. While the classroom might have been described at times as “organized chaos,” not only were the teachers pleased with the results, they quickly agreed that they would take on the challenge again. At one point, during a particularly chaotic day, Mrs. Barnes commented, “This is okay. This is the kind of day that makes me go home in a good mood.”

Watching Mrs. Barnes and Mrs. Randall teach quickly confirmed that they were not just *comfortable* in the student-centered approach; they were also *skilled* in facilitating project-based learning and assessment. Less than 10% of class time during the project was spent by the teachers lecturing or directing the whole class. Rather, in different styles, they both relied primarily on facilitating student work as the need arose. Mrs. Randall tended to be more directive and didactic in the writing process, but she spent the majority of her time in the language arts class. She began each class with a clear expectation for what the students should accomplish during the class and then allowed them to work independently. She frequently checked for understanding of instructions and was authoritative in her approach. Additionally, she repeatedly stressed the importance of revising their work, noting, “Cut it, clip it, fix it—there’s nothing final about it.” Her class was quiet and productive nearly all the time.

In contrast, Mrs. Barnes has a more informal, less directive style. Her classes were frequently more boisterous than Mrs. Randall’s, although their on-task behavior was nearly as high. She typically offered fewer instructions at the beginning of class than Mrs. Randall and was more likely to encourage students to get started right away. She often shared anecdotes with the students as a means to make a point. For example, when she introduced the project to the students for the first time, she shared a story from her childhood about a visit to a Confederate cemetery and the reverence her grandfather showed toward the buried soldiers. She indicated that this sparked a curiosity in her that continues to the present to lead her to study the Civil War. She went on to say, “I eat, live, and sleep history” and shared stories of her scouring battlefields for relics. In this way she was able to encourage a real enthusiasm for the study of history in her students. More than one student jokingly referred to her as a “history geek,” and that she “made them like history.” She also frequently had substantive, content-focused discussions with students, often prompting them to go deeper into the research. In different ways, Mrs. Barnes and Mrs. Randall both operationalized their pedagogical knowledge.

Technological Knowledge

In a digital documentary project, teachers must know how to conduct research on the World Wide Web, scan and save images, and complete the requisite tasks to create a digital movie (importing images, working with the timeline, recording narration, adding transitions and effects, and exporting the movie). While the software required is more user friendly than in the past, these technology tasks have proved to be significant barriers for other teachers (Swan & Hofer, 2006; Swan & Hofer, in press; Yow & Swan, in press). Despite the technological knowledge demands in a documentary project, both teachers were effectively able to work their way through the project.

Due to time constraints in Mrs. Randall's room and Mrs. Barnes' comfort level with technology, most of the use of technology during the project took place in the social studies classroom. Mrs. Barnes had considerable experience in using technology. Several years before, she worked on a major digital archive project centered on historical documents from the Civil War, digitizing materials and developing curriculum using archival sources. More recently, she had obtained her technology proficiency certificate after attending a myriad of technology professional development opportunities offered within her school division. She is also an amateur historian and has considerable experience and skill in using the World Wide Web for research purposes. Despite this personal experience with technology, however, Mrs. Barnes rarely used technology beyond films with her students. According to her, this was due primarily to her lack of convenient access to technology for student to use.

Because of her lack of experience in using technology with her students, we assisted the teachers in planning and organizing the work with the technology. For example, one of the researchers shared instructional responsibilities with Mrs. Barnes in introducing the technology use in the research and production phases. Despite this assistance, Mrs. Barnes quickly picked up both the skills that were new to her as well as strategies to assist students in troubleshooting difficulties. This ability to pick up the requisite technology skills led to productive work on the computers quickly. In fact, when Mrs. Barnes was asked if she would be willing to take on the same project the following year without any technical support, Mrs. Randall remarked, "I saw her class, and she [Mrs. Barnes] would, no doubt." Mrs. Barnes agreed, saying, "Yes. I would do it in a heartbeat." The challenges that did arise with the technology (discussed in more detail below) related more to facilitating student work with the technology.

Pedagogical Content Knowledge

In addition to being able to manage student-centered work and understanding the requisite content knowledge, the teachers in this project were tasked with determining the most effective ways to facilitate student learning of the content. In the case of this project, Mrs. Barnes not only had to understand the specific topics and key issues related to the Civil War, but also had to determine the best way to help guide students through the research project. She relied primarily on a standard note card format to help students capture salient research points from their sources. This format, explained in a handout provided to the students, was focused primarily on capturing facts and avoiding plagiarism. Essentially, the students were instructed to paraphrase important facts related to their topic and then create an associated bibliography card. She provided students with little formal guidance beyond this handout as students conducted their research. Instead, she relied on informal discussions with groups to ensure that they were on track. Throughout this research phase, Mrs. Barnes circulated among the groups and pointed out additional resources, questioning them on the significance of the person or event they were researching. On several occasions, she challenged students to go beyond factual recall to articulate the

significance of specific facts students had recorded. Due to the large number of groups in each class (13 groups on average), this facilitation was perhaps not adequate for some of the groups, resulting in some frustration. On the final day of the research phase, one exasperated student exclaimed, “I have no idea what I’m supposed to do with this!” For most groups, however, this approach was effective.

In the language arts classroom, although she had never guided students through the process of writing a script for a movie, Mrs. Randall was able to draw on her knowledge of the writing process and how best to facilitate this work with students and assist the students in avoiding an encyclopedic account of their topics. As discussed previously, she began by “chunking” the scripts into five sections. She had students work through one section at a time, providing feedback along the way. In this way, she was able to focus on connecting the style of writing with the content students had researched. For example, in the section of the script that dealt with a chronological explanation of the events leading to the character’s “defining moment,” Mrs. Randall focused on writing effective transitions between events. In the “opening,” she focused on grabbing the reader’s attention through the use of a powerful opening sentence. She worked with groups carefully on finding a way to introduce the topic in a way that would make their classmates want to read more. Her didactic and sequential approach to facilitating the writing process resulted in a high degree of engagement by the students as well as a high completion rate of the script (approximately 80%) in the allotted time.

Technological Content Knowledge

The main area where technology and content knowledge intersected in this project was in the research phase of the project. Although Mrs. Barnes had provided students with a plethora of print-based sources to assist them in the research, many students preferred researching on the computer. In addition, the pictures found in many of the books were too small to be scanned effectively for use in creating their movies, so the students relied heavily on the Web to find and save images. Because the students had such limited time on computers (either with the one networked computer in the classroom or the two days allotted in the computer lab), Mrs. Barnes had to ensure that the time was used efficiently. Throughout the research phase, she demonstrated effective technological content knowledge in drawing on her strong history content knowledge and her skill in locating and navigating Web-based historical archives to assist students in their research. She had pre-selected a number of sites for students to use and was able to point them quickly to specific sites where they could find useful and credible information. On several occasions, she not only directed students to a particular Web site to find a picture, but she was able to tell students how to navigate the cumbersome search features in some of the digital archives, including the National Archives.

In this process of helping students find the information and media they were searching for online, Mrs. Barnes simultaneously had to zero in on the kinds of information and materials that students needed and had to know where to

go to find it. As research demonstrates, the process of researching online is a considerable challenge for students (Lee & Clarke, 2004). Had Mrs. Barnes not been so knowledgeable on the digital archives, the students would have been far less productive, as many of the students remarked that they had never accessed many of these sites before. With minor redirecting and management by Mrs. Barnes, this process flowed smoothly and the students remained highly engaged and on-task. Many times during this phase Mrs. Barnes remarked how productive even the most easily distracted students remained throughout the process, which the observation data clearly confirmed.

Technological Pedagogical Knowledge

The intersection of technological and pedagogical knowledge was situated primarily in the movie production phase. In this phase, Mrs. Barnes had to demonstrate for and guide students through the process of using MovieMaker on the laptops in her classroom to create their movies. Although she had little prior experience with the moviemaking software utilized, Mrs. Barnes was able to draw on her technology experience and assist students in their work on the computers in their groups. In this phase of the project, students were involved in two simultaneous processes in Mrs. Barnes' classrooms. In addition to the actual process of creating their movies, many students had to cycle back through the teacher's computer for a quick bit of research, or, more often, to find additional pictures. This meant that there was considerable activity happening in the classroom with students up and out of their seats, loudly arguing over the type of transition between images, etc. Mrs. Barnes was not at all frustrated by this commotion. In fact, she commented, "These are the kind of days I like best. I go home exhausted, but I know that the students are exhausted too—from learning."

During the production phase, Mrs. Barnes initially needed assistance with many tasks, including transferring images from the teacher's computer to one of the student laptops, importing images into the movie creation software, and troubleshooting student difficulties. Mrs. Barnes commented several times over the course of the project that she wished she had created a model of the kind of movie she was expecting of the students. She noted that this would have helped her better understand the quirks and potential of the software as well as to provide a clear target for the students. When asked if she would go as far as to create a model storyboard to show the students as well, she answered, "Sure. Yes. Absolutely. To take them step by step." Despite the initial challenges with the software, she quickly picked up on the procedures and quickly took over in providing student assistance. While the students sometimes had to wait for a few minutes until she was able to help them, the process flowed relatively smoothly, and students were nearly 100% on-task over the three days of production work.

Another, seemingly minor, concern was related to noise in the classroom. While Mrs. Barnes was comfortable with the students talking animatedly and arguing over points, the noise level posed a problem when the students were recording the narration for their movies. Mrs. Barnes stated, "The only techni-

cal thing that I was concerned with was that we needed to find quiet place for them to talk.” Consequently, students found any quiet spot they could, including the hallways, outside the classroom, and even on the baseball field. In terms of time and interruption, this was one of the most significant challenges related to the technology that the students encountered. However, Mrs. Barnes’ ability to think on her feet and manage the process enabled the students to finish their work.

Technological Pedagogical Content Knowledge

After closely examining the observation notes, interview transcripts, and students products, it was clear that the main exercise that was situated in the intersection of all three domains (TPCK) was the process of storyboarding. It was in this process that significant challenges arose. We had noted similar difficulties in past work (Hofer & Swan, 2006), attributing these problems in the last case study to issues of technology trepidation and/or a more teacher-directed approach. We were confident, however, that given the experience of our partner teachers and a revisioning of the storyboard template, that students would effectively and efficiently move through this process. As the project unfolded, it quickly became apparent that the process of storyboarding that we had developed for use within this setting was flawed. At the time of the project, we did not realize the complex nature of the task we were asking of the students and the requisite content, pedagogical, and technology knowledge required of the teachers.

In the storyboarding phase, students were challenged to create a synthesis of their individual scripts in their groups, parse the script to fit different scenes in the storyboard, select images to correspond with the script, and identify any music or sound effects that might be appropriate to support their story (see Appendix for the storyboard template). One particular challenge that students faced in the storyboarding process was in creating the final script for their films. The writing was done primarily in the language arts classroom, and often the students who were paired in the history classroom were not in the same language arts class. This resulted in the creation of two separate scripts that had to be merged in the storyboarding phase, which took place in the history classroom. This posed two challenges for the students. First, when working independently, the students often took very different approaches to their writing in terms of style and content. It was then understandably difficult for them to merge the two together. Some students were also confused about terminology on the storyboard. For example, the fifth period language arts class had a difficult time understanding what was meant by “resolution” in the writing process. After trying in vain to explain the term, Mrs. Randall finally coached two students in acting out a brief skit to illustrate the point in a more concrete way.

A more fundamental problem arose once the students had created their scripts and proceeded to select images and audio elements to include on their storyboards. Students had a difficult time selecting appropriate images to pair with their scripts. In many cases, Mrs. Barnes just directed students on what type of picture to find. So, while the students had collected pictures during the research

phase, it was not until they began to put their storyboards together that they really knew what they needed. This resulted in having to go back to the research phase late in the process and added extra time that perhaps wasn't necessary. This challenge was also true in identifying music or audio elements to include on their storyboards.

In combing through the data, we began to identify specific challenges relating to the storyboard process. The first problem seems to be in the linear format of the storyboard template. The process of storyboarding is inherently non-linear. Students are tasked with toggling among text, narration, music, and visual elements simultaneously, as they create a meaningful yet artistic narrative. This process is iterative and implies that the creator should be continually revising with a keen and sensitive eye and ear for design. It has been our experience that the nature and product of storyboarding and moviemaking is most appealing to students. Within the settings we have worked, it has been the first time students have explored history, in this case, within a multimedia environment in which the aesthetic matters. The storyboard template used within this study did not support the iterative nature of design or emphasize the artistry of movie-making. As a tool for both teacher and student, the storyboard needs to be rethought to incorporate these elements of moviemaking intuitively. In retrospect we recognize that we did not have the requisite content knowledge of the storyboarding and documentary creation process to identify the key elements.

This lack of content knowledge on all our parts also impacted our ability to structure the pedagogy to guide students through the storyboarding process effectively. More attention needs to be given to the way students are introduced to the storyboard and how teachers might facilitate student work. A complex and iterative task like storyboarding requires multiple levels and means of support to enable students to effectively navigate the process. Realistically, this may not be easily accomplished by teachers alone. Because documentary filmmaking is a kind of discipline in itself, it may be necessary to call on screenwriters or those involved in documentary creation to assist in "re-visioning" the storyboard template. From a pedagogical perspective, however, just recognizing the skills required to develop a storyboard is necessary but insufficient. The teacher then must structure the process in a way that facilitates a successful outcome for the students—a process beyond the more general pedagogical content knowledge of our partner teachers.

Finally, perhaps because the students completed their storyboards with pen and paper, we did not recognize the impact that technology—in this case, the multimedia elements encompassed in the storyboard—would have on the process. To create a blueprint for a documentary, the creator must understand how the visuals, voice, imagery, and sounds support and extend the written script. As Mishra and Koehler (2006) note, "The incorporation of a new technology or new medium for teaching suddenly forces us to confront basic educational issues since this new technology or medium reconstructs the dynamic equilibrium between all three elements" (p. 1030). The addition of the moviemaking software presents far more complex thinking than if they were to present their story orally or in writing. Mishra and Koehler (2006) go on to write, "...newer

technologies often disrupt the status quo, requiring teachers to reconfigure not just their understanding of technology but all three components” (p. 1030). Again, in retrospect, the teachers did not recognize that the incorporation of multimedia elements created a disequilibrium in the students’ process of creating the documentaries.

In summary, despite the complex nature of the work of implementing a student documentary project and the multiple domains and intersections of teacher knowledge required, Mrs. Barnes and Mrs. Randall were successful in navigating the process. In terms of content knowledge, pedagogical knowledge, technological knowledge, pedagogical content knowledge, technological content knowledge, and technological pedagogical knowledge, the teachers experienced few substantive challenges. It was only in the area where all the domains of teacher knowledge intersected—technological pedagogical content knowledge—that the teachers experienced significant difficulty. It is important to remember, however, that these teachers are experienced teachers with flexible pedagogy and significant content knowledge. Consequently, other teachers might experience considerably more difficulty. The implications, then, for scaling this type of work must be considered. In the conclusion, while we raise more questions than answers, we attempt to provide direction for future inquiry and practice.

CONCLUSION

Moviemaking in the K–12 classroom is challenging work. At this point, we have completed almost 10 iterations of the historical documentary project in K–12 settings, as well as in our own methods classes, and are still trying to home in on the facets that make this process difficult and yet so engaging. We have been purposeful in selecting a variety of settings and a variety of partner teachers with different knowledge bases in terms of content, pedagogy, and technology. In the latest iteration, we believe we are getting close. Mrs. Barnes and Mrs. Randall were the most ideal teachers in the most ideal setting to date—their understanding of their respective disciplines, their skill at facilitating student centered projects and their unwavering commitment to and facility with the technology helped isolate many of the variables researchers face when studying these kinds of interventions. Because of this, we were able to focus more clearly on the process of moviemaking and identify its paradox—the very thing that energizes students and teachers about moviemaking (e.g., the aesthetic, the multimedia, the complexity) is the same thing that presents the most complications (e.g., storyboarding). Coalescing the sounds, the visuals, the research, and the script into a dynamic historical presentation is complex and, indeed, messy.

What have we learned? We have learned from this study that we need to go back to the drawing board—literally. We need to revision a storyboard to support the iterative, multi-modal, multi-media understanding of a historical documentary. We need to rethink how this process best unfolds for students. For example, what types of scaffolds are most effective for storyboarding? How should a storyboard appear—on 8 x 11" paper, on butcher-block paper, or on some other representation? What are the necessary components of the storyboard? At what point during the moviemaking project should storyboarding be intro-

duced? How should students understand the storyboarding process? We know that part of the revisioning includes meeting documentary filmmakers and appropriating their content knowledge for the K–12 environment. And then, we need to go back into the classroom, focusing specifically on the storyboarding process—perhaps trying several iterations within one setting to compare and contrast various approaches.

Above all, we need to recognize the complexity and multi layered challenge of designing and implementing any type of technology project in the classroom that represents a departure from or extension of a teacher's comfort level. It is important to note that TPCK is a moving target. Each teacher has her own knowledge base in terms of content, pedagogy, and technology. TPCK even varies with a given teacher in different situations. For example, a teacher may have a strong knowledge base on the American Revolution, collaborative grouping, and digital imaging but have limited knowledge of the development of the Constitution, structured academic controversy, and databases of information.

Technology integration is a very personal and situated undertaking for teachers. A study of 10 classroom teachers by Zhao, Pugh, Sheldon, and Byers (2002) provides helpful guidance in considering factors that help to determine whether an innovative technology project would be successful in the classroom. Among the 11 factors the authors outline, one factor was particularly salient when considering TPCK in the case reported here: the innovation's *distance from existing practice*. Zhao et. al (2002) found that the degree to which the project was similar to their prior educational practices was a major determinant of the success of the implementation. In the results reported here, while the research and writing process (both with and without technology) was compatible with the teachers' prior practice, the development of the storyboard represented a departure from their past experience. It was at this point, when students were required to merge information—their writing, images, and sound—that the teachers had no past experience to draw from to inform their decisions and procedures. And while they were able to navigate the challenges successfully, other teachers might not have fared so well. In working with classroom teachers on technology projects, it is important to consider their existing knowledge base and how the project might be structured in ways that connect with their teaching approach and to be mindful of the teachers' zone of proximal development (Vygotsky, 1978) in terms of content, pedagogy, and technology.

In spite of the challenges of conceptualizing, planning, and implementing a project like the one described in this study, on multiple levels it is worth the effort (Burn, et. al, 2001; Hoffenberg & Handler, 2001; Kearney & Schuck, 2004; Kearney & Schuck, 2005; New, 2006; Reid, Burn, & Parker, 2002; Ryan, 2002). In the documentary process, students are challenged to deeply research, understand, and re-present content knowledge in dynamic and creative ways. One might be tempted to focus on the challenges outlined here and conclude that if this kind of work cannot be accomplished in this setting with the teachers described here, then maybe it's an unrealistic endeavor. We disagree. The energy that emanates from history classrooms engaged in developing documentaries is palpable. Beyond the engagement factor, students are sour-

ing historical documents, reasoning with evidence, and developing their own historical narratives and voices—but within a new medium, bringing altogether new challenges. Our hope is that we can continue to iron out the technical and pedagogical challenges so that we can begin to measure student outcomes that result from this kind of historical work.

Contributors

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APPENDIX A

Digital Documentary Storyboard: What's the BIG PICTURE?

This is your opportunity to tell the story of your person's life – not like an electronic encyclopedia entry, but more like an analysis of why the person is historically important.

Step 1 – The Opening: What and when is the setting? Who is the historical figure?

Step 2 – Defining Moment: What was a key moment in your character's life?

Step 3 – Events: What events led up to this defining moment? What were the complications or obstacles? What were the turning points?

Step 4 – Resolution: What happened? How was the situation resolved?

Step 5 – Conclusion: So what? What was the impact of this historical figure's contribution(s)? Why is it still important to remember this today?