Technological Pedagogical Content Knowledge (TPACK) in Action: A Descriptive Study of Secondary Teachers' Curriculum-Based, Technology-Related Instructional Planning

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Abstract

How does teachers' technological pedagogical content knowledge (TPACK) inform their instructional planning? How can this knowledge be enhanced? In an interpretivist study of experienced secondary social studies teachers' planning, we sought to discover clues to the nature and development of these teachers' TPACK-in-action as it was expressed in their planning processes. Comparisons of interview data and planning products before and after engaging in professional development that addressed content-focused, TPACK-based learning activity types (Harris & Hofer, 2009) revealed three primary findings, each supported by participating teachers' oral and written reflections upon their learning. The participating teachers'(a) selection and use of learning activities and technologies became more conscious, strategic, and varied; (b) instructional planning became more student-centered, focusing primarily upon students' intellectual, rather than affective, engagement; and (c) quality standards for technology integration were raised, resulting in deliberate decisions for more judicious educational technology use. (Keywords: technological pedagogical content knowledge, TPACK, learning activities, instructional planning, curriculum, professional development)

Successful technology integration is rooted primarily in curriculum content and content-related learning processes, and secondarily in savvy use of educational technologies (Harris, Mishra, & Koehler, 2009). To effectively integrate educational technologies into instruction, K–12 teachers' planning must occur at the nexus of curriculum requirements, students' learning needs, available technologies' affordances and constraints, and the realities of school and classroom contexts. The complex knowledge needed for such planning is known as technological pedagogical content knowledge (Mishra & Koehler, 2006) —"the total package" of technology, pedagogy, content, and context knowledge (TPACK) (Thompson & Mishra, 2007–2008).

How does teachers' TPACK inform educators' instructional planning? How can this knowledge be developed? In an interpretivist study done with seven experienced secondary social studies teachers, we sought to discover the nature and development of these teachers' TPACK as it is applied in
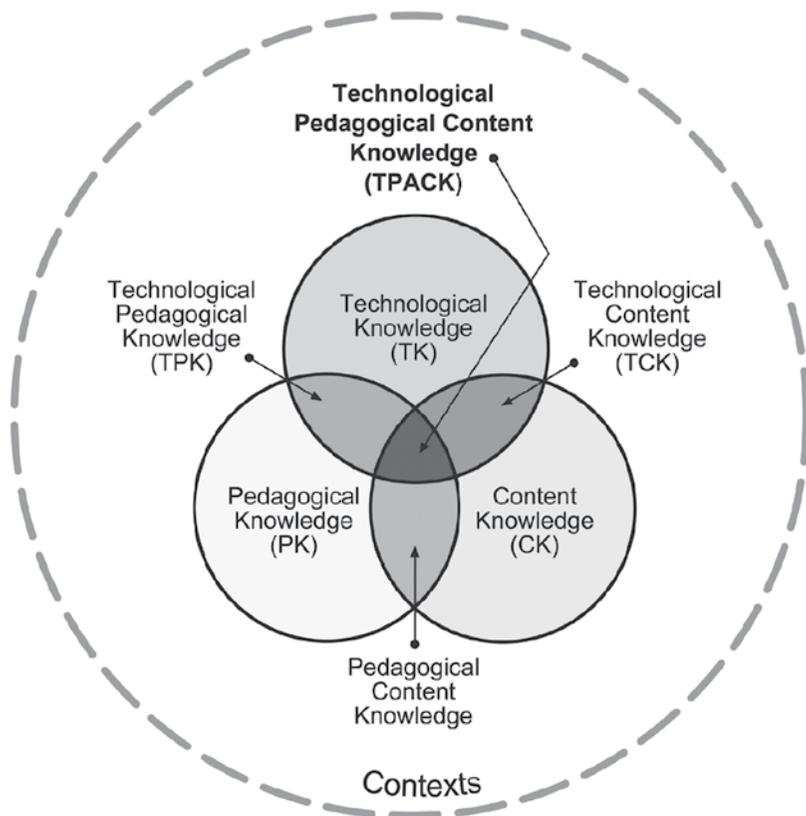
Figure 1. Technological Pedagogical Content Knowledge (Koehler & Mishra, 2009; adapted from Koehler & Mishra, 2008)

instructional planning. We also examined how (and if) planning changes when professional development focuses upon the design of content-based learning activities that are supported by selective and purposeful integration of educational technologies.

Theoretical Framework

TPACK is a specialized, highly applied type of knowledge that supports content-based technology integration. It has been characterized as the multiple intersections of teachers' knowledge of curriculum content, general pedagogies, technologies, and contextual influences upon learning (Koehler & Mishra, 2008) and is only recently starting to be explored in depth in terms of teachers' professional learning. TPACK is an extension of Shulman's (1986, 1987) notion of pedagogical content knowledge—the specialized knowledge required to teach differently within different content areas—which revolutionized our understanding of teacher knowledge and its development.

Though TPACK is knowledge that results from teachers' concurrent and interdependent understanding of content, general pedagogy, technology, and

learning contexts, it is informed particularly by four intersections of knowledge types depicted in Figure 1, upon which data generation and analysis in this study focused. These are:

- Pedagogical content knowledge (PCK): Shulman's construct about how to teach specific content-based material
- Technological content knowledge (TCK): How to select technologies that best embody and support particular content-based precepts
- Technological pedagogical knowledge (TPK): How to use particular technologies in teaching
- Technological pedagogical content knowledge (TPCK/TPACK): How to teach specific content-based material, using technologies that best embody and support it, in ways that are appropriately matched to students' needs and preferences

Each and all of these types of teacher knowledge are influenced by contextual factors, such as culture, socioeconomic status, and school organizational structures. Thus, TPACK as it is applied in practice must draw from each of its interwoven aspects, making it a complex and highly situated educational construct that is not easily learned, taught, or applied. Given this comparatively new understanding of the multifaceted, interdependent, and nuanced knowledge required of teachers for curriculum-based technology integration to succeed, it is no small wonder why sustained, large-scale technology integration efforts in K–12 schools to date have been only minimally successful (Harris, Mishra, & Koehler, 2009).

Teachers' Planning

Teachers' technological pedagogical content knowledge is enacted, in part, during instructional planning. Studies of teachers' planning show it to be organized and communicated primarily by content goals and learning activities (John, 2006; Yinger, 1979). Learning activities are "routinized" by teachers over time to simplify planning and classroom activity (Yinger, 1979, p. 165). Using planning routines, rather than building all lessons, projects, and units as new constructions, allows teachers to demonstrate greater flexibility and responsiveness to students when enacting the plans, given classrooms' highly situated and contextualized nature (John, 2006). Little is known, however, about how digital educational technologies are integrated into teachers' planning (Tubin & Edri, 2004).

Learning activities are differentiated, in large measure, by content area (Stodolsky, 1988). Though some activities are used in multiple curricula—such as reading text, generating solutions to problems, and peer editing, for example—they are designed and implemented quite differently in different disciplinary (and classroom) contexts. Other learning activities, such as doing science labs, interpreting historical documents, and analyzing sentence structure, are content-area-specific.

Table 1. Sample Knowledge-Building Activity Types

Activity Type	Brief Description	Possible Technologies
Listen to Audio	Students listen to audio recordings of speeches, music, radio broadcasts, oral histories, and lectures; digital or nondigital	Digital audio archives, podcasts (e.g., "Great Speeches in History," etc.), audiobooks
Engage in a Simulation	Students engage in paper-based or digital experiences focused on a content topic that that mirrors the complexity of the real world	Content-specific simulation (e.g., Fantasy Congress, Stock Market Game)

Table 2. Sample Convergent Knowledge Expression Activity Types

Activity Type	Brief Description	Possible Technologies
Create a Timeline	Students sequence events on a printed or electronic time-line of through a Web page or multimedia presentation	Timeline creation software, presentation software, concept-mapping software, word processor
Complete a Review Activity	Students engage in some sort of question and answer to review content; paper-based to game-show format using multimedia presentation tools	Student-response systems (SRS), interactive whiteboard review games (e.g., Jeopardy), survey tools

Technological Choices in Teachers' Planning

Because teachers' instructional planning tends to be content-focused and activity-based (John, 2006; Yinger, 1979), because teachers conceptualize and use learning activities differently in different disciplines (Shulman, 1986; Stodolsky, 1988), and because effective technology integration requires interdependent content, technological, and pedagogical knowledge (Koehler & Mishra, 2008; Mishra & Koehler, 2006), the TPACK development strategy used in the professional development experience provided to this study's participants was organized around a taxonomy of learning activities that the authors developed in a particular content area—in this case, the social studies. Each activity had several suggested digital and nondigital educational technologies from which teachers could choose. The focus for the instructional planning strategy shared with the teachers linked students' content-related learning needs directly with combinations of consciously chosen, content-based learning activities supported by suggested educational technologies (Harris & Hofer, 2009).

Note that the emphasis in this approach to technology integration was upon content-based learning activities (as they are the primary elements in teachers' instructional plans), rather than the affordances and constraints of educational technologies that can support learning activities for students (e.g., Freidhoff, 2008). Because teachers' planning is conceptualized around content goals and organized according to learning activities, technology integration methods should be similarly focused. Possibilities for technology use should be considered according to the types of learning activities that have been selected, which, in turn, have been chosen to match students' learning needs and preferences.

As the numbers of possible learning activity types—even within a single curriculum area—are large, activity-type collections become easier to use when they are sorted into functional subcategories. The resulting content-

Table 3. Sample Divergent Knowledge Expression Activity Types

Activity Type	Brief Description	Possible Technologies
Create a Diary	Students write from a first-hand perspective about an event from the past; paper and pencil or digital format	Blogs, word processor
Draw a Cartoon	Students create a drawing or caricature using paper and pencil or digital format	Comic creation software, drawing software, scanner
Develop a Knowledge Web	Using teacher- or student-created webs, students organize information in a visual/spatial manner; written or digital format	Concept-mapping software, presentation software, word processor
Design an Exhibit	Students synthesize key elements of a topic in a physical or virtual exhibit	Wikis, presentation software, video creation software (e.g., Movie Maker, iMovie)
Roleplay	Students take on a character, role, or persona to experience or experiment with a concept or event; live, videotaped, or recorded	Video-creation software (MovieMaker, iMovie), digital video camera

specific taxonomies can then serve as organized collections of options for teachers to consider, once they select learning goals, acknowledge contextual constraints, and note student learning styles and preferences. Because these taxonomies recommend compatible technologies for each type of learning activity, as teachers select activities to combine to form lessons, projects, and/or units, they are also learning to integrate educational technologies into their instructional planning in authentic, learner-centered, content-keyed ways. The results of this study suggest that as the plans are implemented and evaluated, teachers' TPACK can grow.

For example, in the social studies, 44 learning activity types (ATs) have been identified to date. They are divided into two categories of student action: knowledge building and knowledge expression. The 17 knowledge-building activity types assist students in developing their knowledge of the social studies. They range from more general activities (e.g., read text, discuss) to more discipline-specific activities (e.g., engage in artifact-based inquiry, sequence information). The 27 knowledge-expression activity types can be classified as either convergent or divergent. The six convergent knowledge-expression activity types (e.g., answer questions, create a timeline) encourage all students to present their understanding in comparatively similar ways. The 21 divergent knowledge-expression activity types (e.g., design an exhibit, create a film, create a game) are subdivided into five written, three visual, three conceptual, six product-oriented, and four participatory ATs. These challenge students to share their unique understandings of curriculum content in individualized ways.

Sample activity types from each of these subcategories, with accompanying suggested technologies, appear in Tables 1, 2, and 3. The full taxonomy is available on the Activity Types Wiki (Hofer & Harris, 2011).

The ways that teachers cultivate and use TPACK should be as flexible and accommodating of the complete range of curricula and teaching approaches as possible. Mishra and Koehler (2006) express this idea by saying:

There is no single technological solution that applies for every teacher, every course, or every view of teaching. Quality teaching requires developing a nuanced understanding of the complex relationships [among] technology, content, and pedagogy, and using this understanding to develop appropriate, context-specific strategies and representations. (p. 1029)

In particular, though some types of learning activities may be applicable across many curricula, there are enough differences in how educational technologies are best applied in service of students' learning in different content areas to warrant separate and careful consideration of each. Thus, this study examined technology-enriched instructional planning—that is, TPACK in action—in social studies specifically, rather than in a range of curriculum content areas.

Research Methods and Data Sources

What was the nature of these social studies teachers' TPACK as it was applied in instructional planning? How, if at all, did it change after experiencing a TPACK-based form of professional development that focused on planning? The data generation and analysis for the study that addressed these research questions occurred as described below and was guided by Corbin and Strauss' (2008) interpretivist methodological recommendations.

Data Generation

During the summer and fall of 2007, seven experienced social studies teachers from six different U.S. states participated in a university-funded, Web-based resource and curriculum development initiative. At the same time, they were asked to engage in a TPACK-oriented professional development effort that was based on the strategic use of a curriculum-based taxonomy of technology-supported learning activity types developed by the authors. (For a complete description of this approach, including the learning activities taxonomy used, please see Harris & Hofer, 2009.) The teachers' TPACK, as it was applied in instructional planning, was documented at both the beginning and end of the 5-month professional development experience through:

- In-depth interviews
- Unit plans
- Reflections on their unit/lesson planning and technology integration processes

Although both authors interpreted all of the data collaboratively, as described below, one served as the professional development instructor and the other as the researcher who co-constructed the data with the study's participants in the interviews.

We used four topics as a guide for both sets of interviews. The researcher asked follow-up questions in response to the information that the participants shared to garner as deep an understanding of each participant's planning-related professional knowledge and practice as possible. We also incorporated frequent member checking into the interviews to help ensure an appropriately nuanced understanding of each participant's stated planning processes. The following are the four topics addressed, with follow-up questions for each suggested by participants' responses:

1. Pedagogical content knowledge: "How did you decide how to teach the content that this unit addresses?" "How, if at all, did these decisions change the content (e.g., scope, depth, or nature of the content)?"
2. Technological pedagogical knowledge: "How did you decide which materials, tools, and resources to use to teach the content of the unit?" "How, if at all, did these decisions change your teaching (e.g., classroom management, assessment of student learning, or ways in which you interacted with the students)?"
3. Technological content knowledge: "How did the materials, tools, and resources that you used 'fit' the content of the unit?" "How, if at all, did these decisions change the content (e.g., adding or subtracting unit subtopics based on available resources)?"
4. Technological pedagogical content knowledge: "How and why was this particular combination of content, pedagogy, and technology most appropriate for this unit?"

These same topics organized and guided data analysis of all data sources: interviews, curriculum units, and written reflections upon instructional planning.

Data Analysis

The interviews were transcribed verbatim to prepare them for analysis. After coding the first three interview transcripts together to establish common data units, codes, definitions, and interpretations, we then reviewed the remaining interview documents independently, using the discrete idea as the unit of analysis and seeking and recording clear evidence of pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPCK) in the teachers' statements. We met repeatedly to discuss our analyses, surfacing and debriefing both within-participant and across-participant patterns for each of these four types of professional knowledge.

We analyzed the curriculum units described in participants' initial written reflection statements and the unit plans created as part of the professional development experience holistically and independently, identifying both the social studies activity types included in each and any evidence of PCK, TCK, TPK, and TPCK that appeared. We analyzed the participants' final

written reflections similarly, seeking to characterize and describe pre- and post-planning processes, notions of technology integration, and overall depictions of what, if any, changes in planning conceptualizations and practices the professional development experience had catalyzed.

From these independent and collaborative analyses, we constructed descriptions of each participant's planning processes, both before and after the professional development experience. Data summaries were constructed across participants for each subcategory of knowledge (PCK, TCK, TPK, and TPACK). Condensed forms of individual depictions of planning practices and across-participant knowledge type summaries appear below.

Participants

During the initial interviews, a researcher asked each study participant to describe the content, grade level(s), learning activities, and digital and non-digital technologies used in the example unit about which they wrote before coming to the summer course. We addressed the four questions listed above during the remainder of this first interview in a semi-structured format to garner a sense of these teachers' approaches to instructional planning. We triangulated initial interview data with analyses of the content of participants' precourse written reflections.

Elizabeth is a high school world history teacher in the midwestern United States with considerable prior experience as a middle school social studies teacher. In her first interview, she described a World War I unit primarily in terms of the content it addressed (e.g., the causes of the war, the technologies that emerged because of the war effort, and the global nature of the war) and the learning activities it encompassed, focusing particularly on the use of graphic organizers. She said that she chooses learning activities to use based on the levels of engagement that students demonstrated with similar activities in her past experience. Engaging activities, according to Elizabeth, "help [the students] to retain the content." Though she spoke in considerable detail about the learning activities her students engaged in for this example unit, Elizabeth remarked repeatedly that it was "good professional development" for her to think about learning activities, because she is not accustomed to doing so. Instead, her decisions about the particular combinations of content, pedagogy, and technologies to be used in a particular unit are based primarily on the nature of the content, as it is dictated by state curriculum standards, and secondarily upon what was successful with past groups of students.

Deborah is also a high school world history and Advanced Placement (AP) Government teacher who teaches in the northeastern United States. The example unit she described focused on the European Renaissance. As the students had already had a course during the previous year that introduced some of the content in the unit, Deborah used the arts and biographies of famous individuals as ways to help her students connect with the

content in deeper ways. She emphasized the importance of making the content engaging for students with the interactive nature of the learning activities selected. Deborah described the ways in which she observes her students' responses to both content and process closely to give her clues about how to teach. She said that, as a teacher, she is "a chef"—that "anyone could combine ingredients" in cooking, but that it's necessary for her to go beyond that to know what to combine and how to make sure that the "meal" (the students' learning experience) is both nutritious and appealing. She used this metaphor partially to explain that her learning activities need to be balanced between "being fun" and having sufficient depth, breadth, and challenge in terms of the content addressed. She returned to this notion of balance between the "fun" and "educational" aspects of her teaching several times during the first interview.

Carol is a high school American history teacher with prior experience teaching world history and middle school social studies in the northeastern United States. Her approach is decidedly student-centered; her depiction of the activities and design principles undergirding a sample pre-Revolutionary America unit that focused on the founding of Jamestown, Virginia, referred continually to students' experiences and engagement. She prefers using primary source historical documents and other media—especially period music and visual media—and simulation exercises to help students connect in deeper ways with the historical, social, and cultural content of the material. Carol expressed considerable frustration with pressure to "cover material" instead of encouraging students to delve deeply into their study of history. She described several instances when she consciously chose to extend the length of a unit when students were actively engaged with its content, which caused her not to be able to address some of the required standards in sufficient depth later in the school year. In general, Carol emphasized "lack of time" as an overarching challenge with which she struggles daily for in-depth lesson planning, collaboration with other teachers, grading students' work, learning to use more educational technologies, and differentiation of instruction. At the same time, she described her own practice as much in terms of teaching as learning, as she addresses the challenges of teaching with her ongoing professional learning.

Janet, an experienced middle school history teacher in a southeastern U.S. state, is a self-described "U.S. history lover." She says it is "what I love to eat, walk, talk, and sleep about." Her "love for the subject" prompts her to figure out ways to help her students to "go beyond" the required state content standards without omitting any of them. Her instructional planning is puzzle-like; she begins by listing the essential knowledge and skills that students need to have developed by the end of a unit, then dividing those specific objectives among the number of class days available for a particular unit, which is specified by the school district she works for. She balances skills (e.g., reading maps, timelining)

among multiple units. Projects and other learning assessments are compilations of thematically related content and skills, with component activities chosen according to how well each one worked in previous units and years, based on students' observed engagement levels and the quality of their work. Though she chooses learning activities primarily according to the curricular objectives that they help students to meet, it is important that they also are as historically accurate as possible, so Janet uses many primary-source historical documents and other supplementary materials. Despite her extensive teaching experience, she sees the learning in her classroom as a collaboration: "We are in a relationship together, learning together.… I am trying to learn the skill of teaching. They are learning content that I know and have a passion for."

Ted is a self-described "old school" secondary civics teacher in a private college preparatory school in the southeastern United States. Recent professional development in his school in "constructivist" instructional methods, however, has transformed his teaching to be much more student centered, project based, and interactive. He described his new role as "facilitator," contrasting that with the more directive teacher role that he had assumed in the past. The example unit that Ted described was thematically designed, focusing on the principle of the separation of church and state in early American history and examining how it was framed and expressed both then and now. Ted said that he originally designed the unit to address only two or three state social studies content standards, because those were the only standards that directly addressed the issue. Once his students became engaged in the unit's "constructivist" learning activities, however, Ted quickly noted that the students were addressing another eight or nine standards in their very engaged work. Ted counts this as an important professional development lesson for himself concerning the "interconnected" nature of the social studies standards—a lesson that he did not expect to learn when planning this unit. When asked to consider how he chose the particular combination of technology, pedagogy, and content that he used for the unit described, Ted said that he "began with the content" and then chose resources appropriate to the content that were of sufficient quality and depth. He attributed his pedagogical decisions primarily to his new-found constructivist leanings and what experience has taught him works well with students of a particular age.

Charles is a secondary AP Government teacher in the southeastern part of the U.S. He described a "project-based unit" that he does with 12th grade government classes in the weeks after the AP test is taken. He assigns small groups of students countries that have not been studied in the class to date, and they collaboratively prepare "presentations" to teach the other students about the political structure of their countries. Most of the class time is spent in group work, with Charles rotating among the groups informally, offering questions, guidance, and responses to students' questions and

requests. Charles said that the way he teaches in this project is different from his typical approach, which is based more in interactive lectures/discussions, with students responding to assignments individually rather than as members of learning groups. Charles explained that the large amount of content dictated by the AP Board and the timing of the AP exam each year necessitates this emphasis on these particular pedagogical strategies. Overall, Charles described his planning approach as based on the content to be covered (as dictated by the AP Board and his state's content standards) and the amount of instructional time in the school calendar. He described how he allots time to each topic based on how many instructional days are available before the AP exam in the school calendar, balanced with the difficulty of the topic and its relative weight on the exam.

Peter's prior teaching experience, unlike the other participants in the study, was in elementary-level science. He had left elementary-level teaching prior to the summer when the professional development course occurred, but he had some previous experience teaching undergraduate philosophy courses. Given his interest in early American history and his plans to eventually teach at the university level, he decided to participate in the professional development course. His example unit addressed states of matter with students in fourth grade with hands-on activities, graphic organizers, and peer-edited writing. He described his planning process in terms of "backwards design," in which he chooses the unit learning objectives and the assessments that will be used to measure students' understanding first, then plans individual lessons according to the skills and content needed to develop that understanding. Peter described this as starting "from the back forward," choosing the content to address and the learning activities "depending on the schedule" and how much time he knew he would have with each class he taught. He emphasized how important it was for the learning objectives to be measurable and preferably quantifiable. Peter described his process of choosing particular learning activities as "a "fit factor." He explained:

> It is the combination of how well I think my students will respond…, what works for me as an instructor, and the resources available.… The lesson that I am doing is where all three of those converge and I feel like it is a good fit for the classroom.

Analyses of the data generated in final interviews, unit plans, and reflections that participants wrote after completing the professional development course and testing the planning strategy in their classrooms yielded differences in several aspects of their instructional planning practices when compared with prior experiences and works. Because what changed and what remained the same were similar across participants, the patterns will be discussed across, rather than between, participants, noting similar, rather than dissimilar, changes.

Across-Participant Results

When we considered all data summaries together, comparing pre- and post-professional development themes that were common across participants, and debriefed them to ensure trustworthiness of results (Lincoln & Guba, 1985), the following key findings emerged.

Knowledge for Teaching Content (PCK)

During planning, both before and after the professional development experience, participating teachers noted the specific nature of the curriculum content to be addressed and matched planned learning activities primarily to the nature of that content, rather than to the developmental learning needs of the students. Three participants discussed learning activity choice comparatively frequently in terms of students' needs and preferences, but they too first and primarily considered the nature of the standards-based content to be learned when selecting learning activities. For all of the participants, "content goals" emphasized what students need to know and to be able to do, whether for future planned learning activities (including formative and summative assessments) or in preparation for standardized testing.

Once the participants identified a range of possible activities that addressed a particular set of content standards, they matched specific activity choices to predicted student engagement, based primarily on the teachers' extrapolated past experience. They selected the activities that were perceived to be most engaging for students, as long as they were also perceived to satisfy a "content-first imperative." Following the professional development experience, participants more often emphasized using technology to intellectually, rather than affectively, engage their students. Affective engagement was sought more frequently before learning to plan instruction with activity types. Learning activity choice was also based on strategic time decisions—how much class time was available balanced against the totality of what "had to be covered" according to state or district content standards.

Assessments described both preprofessional development and afterwards were both traditional (e.g., tests) and authentic (e.g., projects), but many more authentic assessments were described than traditional ones. Therefore, across the seven participants, more subjective and holistic assessments were planned than objective and specific. Each teacher reported using both formative and summative assessments.

Knowledge for Teaching Content (PCK): Contextual Considerations

Time considerations were primary in terms of how much content to include in each learning activity and to what depth and in which way(s) the content could be addressed. This was a conscious, strategic decision for the participating teachers. They spent considerable time and effort estimating time-related probabilities based on past experience. Given a finite amount of class time, they determined the content that is most

essential for learning— based first on mandated content standards, but also upon their own expertise as teachers. They then selected the learning activities that would help students to most directly and completely address that content in the time available.

Knowledge for Content-Appropriate Technology Selection (TCK)

Though we offered a substantial number of interview probes and prompts for written reflection in an attempt to uncover the participating teachers' technological content knowledge used during planning, comparatively little was reported. The most commonly expressed notion was that curriculum content drives the selection of resources to incorporate into learning activities. Participants explained that, in making decisions about whether and how to use the resources, they match the nature of the resources and/or how the students will use the resources to the nature of the content being addressed. As Ted explained with an example from his postprofessional development planning:

> I looked at the [primary source] documents and decided how could [they] get the information from the documents; how could the students learn the information in the documents in the clearest, most simple form. With the idea that they were going to read through the documents. That's one of those [processes] that's hard to describe. I just saw two documents and said, "You know, two documents; that sounds like a Venn diagram." That's immediately what I thought. Two documents, a Venn diagram, let's compare the two documents [and display the results using a Venn diagram].

When probed repeatedly during the final interviews, all but one of the participating teachers were clear (as in the first interviews) that curriculum content doesn't change according to the resources used for learning, except in the depth of material that students can explore during learning activities. These perceptions are in direct contrast to Koehler and Mishra's (2008) assertion about the technological content knowledge (TCK) that teachers should have:

> Teachers need to master more than the subject matter they teach. They must also have a deep understanding of the manner in which the subject matter (or the kinds of representations that can be constructed) can be changed by the application of technology. (p. 16)

To the teachers participating in this study, using digital resources is a way to extend students' learning. The depth of content learned is increased, rather than fundamentally changed.

Knowledge for Teaching with Technology (TPK)

For the participants in this study, TPK decisions during instructional planning were balanced between technology and pedagogy, and interacted.

While, for example, tools' affordances were noted in line with students' potential intellectual and affective engagement with them, this was not reason enough to plan for the tool's use, especially following completion of the professional development course. Similarly, if a particular pedagogical approach would support use of a tool, that wasn't reason enough to plan to use it, either. These teachers saw use of selected tools and resources as allowing them to do a better job—that is, effecting deeper, more engaging, more self-directed learning—at what they already do, rather than allowing them to do something completely new pedagogically. For example, most of the participants mentioned instances when technology use enabled more authentic assessment of students' learning, especially formatively.

As a result of their experience in the class, the teachers said they had become more thoughtful and deliberate in their selection of learning activities as well as the technologies they used to support them. Despite pressures they perceived from their schools' administrators to integrate technology in their teaching, they made multiple references to how technologies should be used to enhance curriculum-based learning, rather than being used as an end unto themselves.

Knowledge for Teaching with Technology (TPK): Contextual Considerations
Six of the seven teachers who participated in this study mentioned technology availability as a limiting factor to its regular use for learning and teaching. For these teachers, "availability" refers primarily to limited knowledge of the locations of accessible historical documents (and other content-specific resources) online, rather than their students' access to computers to use to view the documents. They did not mention computer access as a constraint to technology integration, except for Carol, who described many types of limitations to her students' access, including over-scheduled labs, old and malfunctioning equipment, and unnecessarily limiting firewalls.

Knowledge for Curriculum-Based Technology Integration (TPACK)
Overall, the teachers in this study matched the nature of the curriculum content they "covered" (taught) with how they perceived their students learned best, and the ways that different technologies can be best used to support that learning in the time available.

When learning about new educational technologies, several of the teachers noted particular pedagogical affordances in the use of those new tools that "fit" with content that they teach. In other words, they used the content for which they are responsible as an arbiter in their decision-making about possible adoption of tools and resources. If they weren't able to discern a clear connection between a technology's affordances and the content to be learned, they didn't plan to use the tool instructionally.

The notion of "fit" came up repeatedly in the comments of five of the seven teachers consulted. "Fit" develops, according to these teachers, with experience planning and teaching in different ways with varying technologies. This notion may be the way these teachers directly experience, exercise, and develop their TPACK. "Fit" seemed to be how they consciously both conceptualized and operationalized TPACK.

Changes

In planning instructional units, these teachers first considered the content to be addressed, then predicted (based on past experience) what would engage students to learn that content in the deepest way possible. They made these decisions while factoring in awareness of available time, resources, and a myriad of other contextual constraints. Though most of the teachers described these steps in sequence, further analysis revealed that these are, instead, ordered priorities that the teachers considered concurrently. This mirrors contemporary notions of the interdependence of multiple factors that teachers consider when planning instruction (e,g., John, 2006) and that differ considerably from earlier descriptions of teachers' planning practices (e.g., Yinger, 1980).

These planning priorities remained the same for the participants at the end of the study. Yet all of the teachers also described thinking more consciously and strategically about both choosing learning activities to implement and the technologies to use to support them. Interestingly, all but one of the seven teachers expressed considerable difficulty during initial interviews and in their earliest written reflections describing how they chose the learning activities for their students to complete. These difficulties were not apparent during the final interviews.

The majority of the participating teachers said that they realized they had "gotten in a rut" before the course began and that the range of learning activity types that they were using in their teaching was much more limited than the range of possibilities, most of which were familiar, but not used that often or at all. All reported that they had new learning activities from which to choose as a result of participating in the professional development experience. The learning activity types reviewed during the course were seen as mostly familiar, but made conscious—as Elizabeth said, it was "a whole new toolbox," with names for activities where there were no names before.

After completing the professional development experience, the teachers also commented on their awareness of higher standards for technology integration. After learning and testing the planning strategy, they described how digital tools and resources should be used judiciously to enhance students' learning and their own teaching, rather than using technologies because it is required of them to do so. As Janet commented during her final interview, for example:

Now … I don't want to just "do technology" for the sake of technology. I want technology to be an effective tool for the … activities I am actually choosing. I guess I am more conscientious about [this now]. I think it was … the combinations [of activity types and technologies for each]…. To me, the class [was about] effective planning and leveraging technologies.

Data analysis also revealed these teachers to be quite student-centered in their thinking about instruction throughout the study. Helping them to focus on the full range of social studies learning activity types and accompanying technology options seems to have made their planning even more student-centered, especially in terms of students' intellectual (as opposed to affective) engagement. Prior to learning to use this planning strategy, all but one participant noted and described student engagement more in affective than intellectual terms, e.g., "I knew they would love doing this."

The teachers said their teaching probably wouldn't be "revolutionized" as a result of learning to plan instruction using technology-supported learning activity types, but that it would be "enhanced," and therefore, they reasoned, students' learning would be more effective. They described how they are now more conscious of the multiple options available for technology-enhanced learning activities and therefore expect to incorporate a broader range of both learning activities and technologies into their planning in the future.

The results of this study suggest that a content-based, activity-types approach to technologically inclusive instructional planning is compatible with existing approaches to teaching. It is not a way to revolutionize teaching by way of technology integration. If the professional development goal is more pervasive and sustainable technology integration, then an activities-based approach can be effective. If instructional reform is the goal instead, then the full range of learning activity types should probably not be presented for teachers' consideration. Instead, a particular subset of activity types that were selected based on a common (and focused) approach to teaching and learning (e.g., problem-based or collaborative learning) could be emphasized.

Regardless of preferred pedagogical approach, however, it seems clear that an instructional planning strategy that is conceptualized and organized around curriculum content, teaching/learning context, and pedagogy primarily, and according to the digital tools and resources that can support different types of learning secondarily, such as the activity-types-based strategy explored in this study, can help teachers diversify their instructional approaches while concurrently encouraging appropriate educational uses of technological tools and resources. The key, perhaps—at least at the present time—is to include educational technologies in instructional planning

but shift the focus for technology integration away from the technologies themselves.

Educational Import

Unfortunately, much educational technology professional development to date has been technocentric (Harris, 2005)—a term that Seymour Papert (1987) coined to identify advocates' overemphasis on the design and features of the technologies rather than the learning that they can support:

> I coined the word technocentrism from Piaget's use of the word egocentrism. This does not imply that children are selfish, but simply means that when a child thinks, all questions are referred to the self, to the ego. Technocentrism is the fallacy of referring all questions to the technology. (Technocentrism section, ¶1)

Emerging conceptions of technology integration focus on curriculum-based, educational uses for digital tools and resources rather than the characteristics of the technologies themselves. As Earle (2002) asserts:

> Integrating technology is not about technology—it is primarily about content and effective instructional practices. Technology involves the tools with which we deliver content and implement practices in better ways. Its focus must be on curriculum and learning. Integration is defined not by the amount or type of technology used, but by how and why it is used. (p. 8)

During the 1990s, enthusiasm abounded regarding the potential power and utility of digital tools, resources, and networks for education. Although survey results still indicate that most teachers, administrators, and parents believe strongly that technologies should be used for educational purposes in schools (e.g., CDW-G, 2006), there is growing criticism and doubt as to whether their uses are effecting positive changes in students' learning (Schrum, Thompson, Maddux, Sprague, Bull, & Bell, 2007).

If there is such widespread (and long-term) support for educational use of digital technologies, why has the instructional efficacy of these applications lagged so far behind predictions for success? The answers to this question—which typically include insufficient computer access, budgeting challenges, and lack of instructional and professional development time (e.g., CDW-G, 2006)—are complex and interconnected. Our own research and development work with teachers point to another, often overlooked response. Many educators are simply not aware of the full range of different curriculum-based learning activities, projects, and approaches that they can use with the help of different educational technologies. Technology-related professional development to date has overemphasized hardware and software affordances,

awareness, and skills, giving short shrift to usable, customizable strategies for curriculum-based uses for educational technologies.

Learning what those instructional possibilities are, and how best to select and combine them to match students' standards-based learning needs, is the modus operandi of the professional development strategy that this study explored. It is a distinctive approach to professional development in technology integration for teachers. It seems clear that the experienced social studies teachers participating in this investigation experienced and valued the utility of the activity types and their own professional learning from applying them in practice. Before this approach to technology integration can be recommended in other curriculum areas and/or for widespread use, however, the approach and the taxonomies themselves must be systematically and repeatedly tested, vetted, and revised. Yet considering the results of this admittedly small-scale and descriptive study, we suggest that the activity types approach to technology integration is promising enough at least to warrant such further investigation and development.

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