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Teachers' knowledge is situated, event-structured, and episodic. Technology, pedagogy and content knowledge (TPACK) – one form of highly practical professional educational knowledge – is comprised of teachers' concurrent and interdependent curriculum content, general pedagogy, and technological understanding. Teachers' planning – which expresses teachers' knowledge-in-action in pragmatic ways -- is situated, contextually sensitive, routinized, and activity-based. To assist with the development of teachers' TPACK, therefore, we suggest using what is understood from research about teachers' knowledge and instructional planning to form an approach to curriculum-based technology integration that is predicated upon the combining of technologically supported learning activity types within and across content-keyed activity type taxonomies. In this chapter, we describe such a TPACK development method.

## TPACK

Successful technology integration is rooted in curriculum content and students' content-related learning processes primarily, and secondarily in savvy use of educational technologies. When integrating educational technologies into instruction, teachers' planning must occur at the nexus of standards-based curriculum requirements, effective pedagogical practices, and available technologies' affordances and constraints.

The specialized, highly applied knowledge that supports content-based technology integration is known as "technological pedagogical content knowledge," abbreviated TPCK or TPACK (Koehler & Mishra 2008). TPACK is the intersection of teachers' knowledge of curriculum content, general pedagogies, and technologies (see Fig. 1). It is an extension of Shulman's (1986) pedagogical content knowledge—the specialized knowledge required to teach differently within different content areas--which revolutionized our understanding of teacher knowledge and its development.

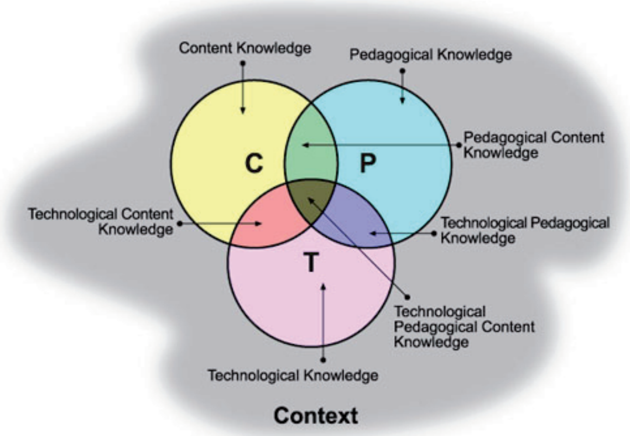


**Figure 1.** Technological Pedagogical Content Knowledge (Koehler & Mishra 2008).

In the same ways that TPACK (appearing in the center of Fig. 1) is knowledge that results from teachers' concurrent and interdependent content, general pedagogy, and technology understanding, it is comprised, in part, by three particular aspects of that knowledge that are represented by the other three intersections depicted. These are:

- *Pedagogical Content Knowledge*: How to teach particular content-based material
- *Technological Content Knowledge*: How to select and use technologies to communicate particular content knowledge
- *Technological Pedagogical Knowledge*: How to use particular technologies when teaching

Each and all of these types of teacher knowledge are shaped by a myriad of contextual factors, such as culture, socio-economic status, and school organizational structures. Thus, TPACK as it is applied in practice draws from each of seven interwoven and interdependent aspects of teachers' knowledge, making it a complex and highly situated educational construct that is not easily applied, learned or taught.

Still, as professional knowledge, it can be developed over time, and the educational technology community is beginning to explore ways to help teachers to build and use TPACK. Koehler & Mishra have tested a collaborative learning-by-design approach in which educators work with content and technology specialists to plan instruction, each building TPACK concurrently, yet in different ways (2005; Koehler, Mishra & Yahya 2007). Niess (2005) advocates a content-based modeling approach to developing TPACK, in which use of educational technologies supports content-based instructional strategies that are modeled for teacher-students by teacher educators. Dawson's (2007) and Pierson's (2008) teaching inquiry approaches suggest that TPACK can be developed when educational technologies become one of the foci of teachers' reflective action research. Our TPACK development strategy (Harris 2008; Harris & Hofer 2006), described below, draws upon the literature about teachers' planning practices to suggest an activity-based, curriculum-keyed approach to planning instruction that incorporates systematic and judicious selection of technologies and teaching/learning strategies.

## Instructional Planning

Teachers' knowledge is situated, event-structured, and episodic (Putnam & Borko 2000). Wilson, Shulman, and Richert (1987) describe it in pedagogical content knowledge terms, saying

> In teaching, the knowledge base is the body of understanding, knowledge, skills, and dispositions that a teacher needs to perform effectively in a given teaching situation, e.g., teaching mathematics to a class of 10 year olds in an inner-city school or teaching English literature to a class of high school seniors in an elite private school (p. 106).

Similarly, teachers' planning is situated (Clark & Dunn 1991) and contextually sensitive (Brown 1990). It is also routinized and activity-based (Yinger 1979). Arguably the pre-eminent researcher on instructional planning, Yinger asserts that all of teachers' planning "could be characterized as decision making about the selection, organization, and sequencing" (p. 165) of routinized activities. More recent studies of teachers' planning (e.g., McCutcheon & Milner 2002; Tubin & Edri 2004) have reached similar conclusions, while calling for research into instructional planning that incorporates use of digital technologies.

Though planning instruction that is facilitated by use of digital tools and resources can be complex, with each decision determining aspects of other decisions already made or yet to be determined (as the TPACK model above illustrates), our work suggests that planning a particular learning event can be described as the end result of five basic instructional decisions:

- Choosing *learning goals*
- Making practical *pedagogical decisions* about the nature of the learning experience
- Selecting and sequencing appropriate *activity types* to combine to form the learning experience
- Selecting formative and summative *assessment strategies* that will reveal what and how well students are learning
- Selecting *tools and resources* that will best help students to benefit from the learning experience being planned

Since research on teachers' planning has established it to be activity-based and content-keyed (Wilson et al. 1987), planning for effective instruction in which educational technologies are well-integrated should be similarly curriculum-specific and activity-focused. Thus, our approach to helping teachers to develop TPACK is to suggest that they use curriculum-specific, technology-enhanced learning activity types as the building blocks for instructional planning.

## Developing TPACK Using Learning Activity Types

Learning activity types function as conceptual planning tools for teachers; they comprise a methodological shorthand that can be used to both build and describe plans for standards-based learning experiences. Each activity type captures what is most essential about the structure of a particular kind of learning action as it relates to *what students do* when engaged in that particular learning-related activity (e.g., "group discussion;" "role play;" "fieldtrip"). Activity types are combined to create lesson plans, projects and units. They can also serve as efficient communication tools for educators wanting to share their plans for students' learning with each other, as science education lesson study research in Japan has shown (Linn, Lewis, Tsuchida, & Songer 2000). After teachers are familiar with a complete set of technology-enriched learning activity types in a particular curriculum area, they can effectively choose among, combine, and use them in standards-based learning situations, building their TPACK in practical ways while doing so.

This differs substantially from how teachers typically learn to integrate educational technologies into their teaching. In most cases, the technologies' particular educational affordances and constraints are examined, and then curriculum-based goals are chosen. In the activity types approach, educational technology selections are not made until curriculum-based learning goals and activity designs are finalized. By selecting the technologies that best serve learning goals and activities *last,* both students' learning and maximally appropriate educational technology uses are assured, with the emphasis remaining upon the former. By focusing first and primarily upon the content and nature of students' curriculum-based learning activities, teachers' TPACK is developed authentically, rather than technocentrically (Papert 1987), as an integral aspect of instructional planning and implementation.

Though teachers already use activity types in educational parlance (e.g., "KWL activities"), comprehensive sets of content-specific activity types that incorporate appropriate uses of the full range of digital technologies in each predominant curriculum area have not been published, to our knowledge. At the present time, our work is focused upon collaborative development and vetting of learning activity type taxonomies in six curriculum areas K-12: elementary literacy, secondary English, mathematics, science, social studies, and world languages. Plans for similar taxonomy development in the arts, physical education, and early childhood education have also been made. The first curriculum area to be addressed was the social studies. The resulting taxonomy of 42 social studies learning activity types appears below to help to illustrate our content-keyed, activity-based TPACK development strategy.

## Sample Activity Types Taxonomy

Of the forty-two social studies activity types that have been identified to date, thirteen are focused upon helping students build their knowledge of social studies content, concepts, and processes. Twenty-nine provide students with opportunities to express their understanding in a variety of ways. Six of these knowledge expression activity types emphasize convergent learning and twenty-three of these activity types offer students opportunities to express their understanding in divergent ways. The three sets of activity types (knowledge building, convergent knowledge expression, and divergent knowledge expression) are presented in the tables that follow, including compatible technologies that may be used to support each type of learning activity.

As the table of knowledge building learning activity types below (Tab. 1) shows, teachers have a variety of learning activity options available to assist students in building social studies content and process knowledge. They are able to determine what students have learned by reviewing their expressions of knowledge (Tabs. 2 - 7) related to the learning goals targeted. Opportunities for students to express their knowledge can be incorporated during a unit of study (as part of formative assessment) or at the conclusion of a unit (as a summative assessment).

At times, social studies teachers deem it appropriate for all students to come to a similar understanding of a course topic. This kind of understanding is expressed by engaging in convergent knowledge expression learning activities (Tab. 2). While in many cases teachers may want their students to express similar understandings of course content, at other times they will want to encourage students to develop and express their own understandings of a given topic. The twenty-three written, visual, conceptual, product-oriented, and participatory divergent knowledge expression learning activity types (Tabs. 3 - 7) afford students opportunities to each share unique understandings of a topic or concept.

**Table 1**

Knowledge Building Activity Types

| Activity Type | Brief Description | Possible Technologies |
|---|---|---|
| Read Text | Students extract information from text-books, historical documents, census data, etc.; both print-based and digital formats | Web sites, electronic books |
| View Presentation | Students gain information from teachers, guest speakers, and peers; synchronous/asynchronous, oral or multimedia | PowerPoint, Photostory, iMovie, MovieMaker, Inspiration, videoconferencing |
| View Images | Students examine both still and moving (video, animations) images; print-based or digital format | PowerPoint, Word, Photostory, Bubbleshare, Tabblo, Flickr |
| Listen to Audio | Students listen to recordings of speeches, music, radio broadcasts, oral histories, and lectures; digital or non-digital | Podcasts ("Great Speeches in History," etc.), Audacity, Garageband, Odeo, Evoca, Podcast People |
| Group Discussion | In small to large groups, students engage in dialogue with their peers; synchronous/asynchronous | BlackBoard, discussion in Wikispaces, e-boards |
| Field Trip | Students travel to physical or virtual sites; synchronous/asynchronous | Virtual fieldtrips, Photostory to develop their own virtual tours |
| Simulation | Students engage in paper-based or digital experiences which mirror the complexity of the real world | Civilization, Revolution!, Fantasy Congress |
| Debate | Students discuss opposing viewpoints; formal/informal; structured/unstructured; synchronous/asynchronous | BlackBoard, discussion in Wikispaces, e-boards |

| | | |
|---|---|---|
| Research | Students gather, analyze, and synthesize information using print-based and digital sources | Digital archives, Google Note-book, Inspiration to structure |
| Conduct an Interview | Face to face, on the telephone, or via email students question someone on a chosen topic; may be digitally recorded and shared | Audacity, MovieMaker, iMovie, digital camera |
| Artifact-Based Inquiry | Students explore a topic using physical or virtual artifacts | Digital archives |
| Data-Based Inquiry | Using print-based and digital data available online students pursue original lines of inquiry | CIA World Factbook, Thomas, census data, Excel, Inspire Data |
| Historical Chain | Students sequence print and digital docu-ments in chronological order | Bubbleshare, Photostory, Moviemaker |
| Historical Weaving | Students piece together print and digital documents to develop a story | Word, Scrapblog, Google Pages, Historical Scene Investigation (HSI) |
| Historical Prism | Students explore print-based and digital documents to understand multiple perspec-tives on a topic | Wikispaces, Google Pages, Inspiration using links |

**Table 2**
Convergent Knowledge Expression Activity Types

| Activity Type | Brief Description | Possible Technologies |
|---|---|---|
| Answer Questions | Students respond to questions using traditional question sets or worksheets, or through the use of an electronic discussion board, email or chat | Inspiration, Word, Black-Board, e-boards |
| Create a Timeline | Students sequence events on a printed or electronic timeline or through a Web page or multimedia presentation | Timeliner, Photostory, Word, Bubbleshare |
| Create a Map | Students label existing maps or produce their own; print-based materials or digitally | PowerPoint, Google Earth |
| Complete Charts/Tables | Students fill in teacher-created charts and tables or create their own in tradi-tional ways or using digital tools | Word, Inspiration, Power-Point |
| Complete a Review Activity | Students engage in some form of question and answer to review content; paper-based to game-show format using multimedia presentation tools | PRS systems, Jeopardy (or other games) on Power-Point, survey tools like SurveyMonkey |
| Take a Test | Students demonstrate their knowledge through paper-based, traditional format to computer-generated and scored assessments | Scantron forms |

**Table 3**
Written Divergent Knowledge Expression Activity Types

| Activity Type | Brief Description | Possible Technologies |
|---|---|---|
| Write an Essay | Students compose a structured written response to a prompt; paper and pencil or word processed; text-based or multimedia | Word, Inspiration, Wikispaces (to track contributions from multiple authors) |
| Write a Report | Students author a report on a topic in traditional or more creative format using text or multimedia elements | Word, PowerPoint, Excel, Google Pages |
| Generate an Historical Narrative | Using historical documents and secondary source information, students develop their own story of the past | Word, Wikispaces or Google Docs (to track contributions from multiple authors), blogs |
| Craft a Poem | Students create poetry, paper and pencil or word processed; text-based or multimedia | Photostory, Moviemaker, iMovie, PowerPoint, VoiceThread |
| Create a Diary | Students write from a first-hand perspective about en event from the past; paper and pencil or digital format | Blogs, Word, Google Docs, Google Pages |

**Table 4**
Visual Divergent Knowledge Expression Activity Types

| Activity Type | Brief Description | Possible Technologies |
|---|---|---|
| Create an Illustrated Map | Students use pictures, symbols, graphics to highlight key features in creating an illustrated map | Google Earth, PowerPoint |
| Create a Picture/Mural | Students create a physical or virtual image or mural | Paint, Photoshop |
| Draw a Cartoon | Students create a drawing or caricature using a paper and pencil or digital format | Comic Creator, DFILM video, digital cameras |

**Table 5**
Conceptual Divergent Knowledge Expression Activity Types

| Activity Type | Brief Description | Possible Technologies |
|---|---|---|
| Develop a Knowledge Web | Using teacher or student created webs, students organize information in a visual/spatial manner; written or digital format | Inspiration, PowerPoint, Word, Imagination Cubed |
| Generate Questions | Students develop questions related to course material/concepts | Word, Wikispaces or Google Docs (to track contributions from multiple authors) |
| Develop a Metaphor | Students devise a metaphorical representation of a course topic/idea | Wikispaces (to track contributions), Inspiration |

**Table 6**
Product-Oriented Divergent Knowledge Expression Activity Types

| Activity Type | Brief Description | Possible Technologies |
|---|---|---|
| Produce an Artifact | Students create a 3D or virtual artifact | Imaging tools |
| Build a Model | Students develop a written or digital mental model of a course concept/process | Inspiration, PowerPoint, InspireData |
| Design an Exhibit | Students synthesize key elements of a topic in a physical or virtual exhibit | Wikispaces, PowerPoint, Scrapblog, Bubbleshare |
| Create a Newspaper/News Magazine | Students synthesize course information in the form of a periodical; print-based or electronic | Word, Letterpop, Scrapblog |
| Create a Game | Students develop a game, in paper or digital form, to help students learn content | Word, Puzzlemaker, Imaging tools, Web design software |
| Create a Film | Using some combination of still images, motion video, music and narration students produce their own movies | Photostory, Moviemaker, iMovie |

**Table 7**
Participatory Divergent Knowledge Expression Activity Types

| Activity Type | Brief Description | Possible Technologies |
| --- | --- | --- |
| Do a Presentation | Students share their understanding with others; oral or multimedia approach; synchronous or asynchronous | PowerPoint, Photostory, Moviemaker, iMovie, Audacity |
| Engage in Historical Role Play | Students impersonate an historical figure; live, video-taped, or recorded | Moviemaker, iMovie, Audacity, digital camera |
| Do a Performance | Students develop a live or recorded performance (oral, music, drama, etc.) | Photostory, Moviemaker, iMovie, Audacity |
| Engage in Civic Action | Students write government representatives or engage in some other form of civic action | Web, email, videoconferencing |

### Combining Activity Types

As helpful as providing taxonomies of learning activities may be, the true power of utilizing activity types in designing learning experiences for students is realized when combining individual activities into more complex lessons, projects and units.  The breadth of a plan for students' technology-integrated learning is reflected in the number of activity types it encompasses. Though activity types can be used alone, more types included in a single plan typically help students address more curriculum standards simultaneously and in more varied and engaging ways than when fewer activity types are combined.  The parameters of different activity type combinations—which reflect the complexity, amount of structure, and types of learning planned—are what help teachers to select among them.

- *Combining 1 – 2 activity types* usually produces a class time-efficient, highly structured, and easily repeatable experience, comprised primarily of convergent learning activities. It is completed often in just one or two class periods.
- *Combining 2 – 3 activity types* yields a class time-efficient, yet longer duration learning activity that is more flexibly structured, and is comprised often of more divergent learning activities.
- *Combining 3 – 5 activity types* produces a medium-term, somewhat structured, both convergent and divergent exploration of curriculum-based content and process.
- *Combining 5 – 8 activity types* forms a learning experience of variable length that is a somewhat structured, yet flexible, and usually mostly divergent exploration of content and process.
- *Combining 6 – 10 activity types* creates a learning experience of rather flexible duration, structure, and content and process goals. It is the longest and most complex of these combinations, and therefore would be planned relatively infrequently for use in most classrooms.

It should be noted here that in practice, the nature of instructional plans that are structured by activity type combinations of different sizes are typically distinguished more by the learning needs and preferences of the students they were designed to serve than the number of activity types used. We provide the information above only to help our readers to better understand this aspect of the activity types approach to instructional planning.

## EXAMPLE UNIT

What does an instructional plan identified by its component activity types look like? An example created and used by local teachers with whom we have collaborated can illustrate an end result of the activity types planning process. In the Civil War Voice Wall project (Bray, Russell & Hofer, 2006) teachers Julie Bray and Darlene Russell challenged their sixth grade history students to develop short documentary films about a person or key event from the U.S. Civil War. The purpose of the project was to engage students more deeply in their study of the Civil War, enabling them not only to learn key factual content, but also to understand the multiple perspectives of different people who lived through the war. The teachers agreed that having the students develop a story about their chosen person in narrative form (as opposed to using a standard report format) might be more engaging for the students, encouraging them to go beyond creating an "electronic encyclopedia entry." To this end, throughout the research and writing phases, the teachers continually emphasized finding the "defining moment" for the chosen characters, challenging the students to work from that focus.

The teachers divided the project into three phases: research, writing, and production. During the research phase, students had access to a range of print materials as well as selected Web sites that the teacher had bookmarked prior to beginning project work. The students collected appropriate images for their documentaries both by scanning pictures from books and via image searches online. They used a standard format and index cards to capture their research notes.

During the writing phase, students created sections of the script (e.g. the opening; the defining moment, etc.) one at a time in their notebooks. The students took their notebooks home and received feedback on each section from their parents. During each class period devoted to project work, the teachers circulated and provided feedback on students' writing. At the end of this phase, each student had developed a complete script for a film.

During the production phase, the students paired their scripts with images to develop a paper-based storyboard for their films. In this process, they also identified any music, sound effects, titles, and transitions they wanted to incorporate in their films. Once complete, they used the storyboards as the blueprint to develop their documentaries using Microsoft's Moviemaker software. They used the scripts to record their narration and arranged the images and other elements into a complete Ken Burns-style film. They then "screened" all of the films in class to prepare for their exam on the Civil War.

The teachers combined eight different activity types to form this project, including reading text, viewing images, researching, answering questions, historical weaving, creating a diary, engaging in historical role play, and creating a film. The combination and sequencing of these activity types moves the project beyond a typical research report by incorporating historical weaving and role play to develop a documentary film. Both digital and nondigital tools and resources were used, based upon the practicalities of students' equitable access both during class and at home. While many of these activities were assessed formatively (e.g. research; answer questions), the final documentary films provide rich, summative assessments of the nature and depth of students' learning.

## CONCLUSION

Planning for students' curriculum-based learning that integrates appropriate and pedagogically powerful use of the full range of educational technologies is challenging. Considerably detailed and deliberate planning decisions need to be made, based upon multiple decision points, and chosen wisely from among a full range of possible educational activities that incorporate technologies in powerful ways.

Unfortunately, many teachers wishing to incorporate educational technologies into curriculum-based learning and teaching begin with selecting the digital tools and resources that will be used. When instruction is planned in this way, it becomes what Seymour Papert (1987) calls "technocentric"– focused upon the technologies being used, more than the students who are trying to use them to learn. Technocentric learning experiences rarely help students to meet curriculum-based content standards, because those standards did not serve as a primary planning focus. Accompanying pedagogical decisions (including the design of the learning experience) often focus more upon use of the selected technologies than what is most appropriate for a particular group of students within a particular educational context.

Alternatively, if learning goals have been selected well, if pedagogical decisions have been made according to students' instructional and contextual realities, and if activity types and assessment strategies have been selected to address those goals and realities, then choices of instructionally appropriate tools and resources to use in the learning experience being planned are more obvious and straightforward. This is true as long as the teacher doing the planning is familiar with available tools' instructional affordances and constraints, which is an aspect of technological pedagogical knowledge.

As we hope has become apparent, the activity types approach to instructional planning and preparation is focused squarely upon students' standards-based, curriculum-related learning processes and outcomes, rather than upon the technologies that can assist in their creation. The approach is designed to help teachers to plan effective, efficient, and engaging learning experiences for their students. The process is based upon a series of deliberate, balanced, and well-informed pedagogical choices, which, when taken together, can result in an instructionally effective plan for students' learning that incorporates digital and non-digital tools and resources in appropriate ways.

Activity-based instructional planning strategies are not new. Aligning learning activities with compatible educational technologies, and developing comprehensive, curriculum-keyed taxonomies of activity types that incorporate content, pedagogy, and technology knowledge, along with all of their intersections, is the unique contribution of this TPACK development method. Like the patterns of teachers' instructional planning processes, from which this method was derived and with which it is designed to assist, this approach to TPACK development is a quintessentially pragmatic thought process. Why? As pragmatist philosophers have asserted, the primary function of thought is to guide action.

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