Understanding Teachers' TPACK Through Observation

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Understanding Teachers' TPACK Through Observation

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Understanding Teachers' TPACK Through Observation: A Case Study

This chapter examines how a case study approach can be used to understand teachers' technological pedagogical content knowledge (TPACK). Classroom observations and follow-up interviews were used to document the TPACK knowledge and competency of exemplary teachers who are using technology as an integral part of their teaching practices. A qualitative case study approach, guided by the Data Analysis Spiral (Creswell, 2013), was used. Each participant was observed twice teaching in a classroom and interviews were conducted with teachers after each classroom observation. A coding system and comparative analysis were used to identify themes from the observation and interview data collected to describe teachers' TPACK. Ultimately, the goal of this research is to better understand how to assess the nature of teachers' TPACK using triangulated measures within the context of K-8 classrooms. First, we begin with a brief review of various research methods that have been used to assess teachers' development of TPACK.

Literature Review

The TPACK framework, proposed by Mishra and Koehler (2006), functions as a conceptual lens that helps researchers examine how teachers are using technology in teaching. While first generation TPACK research mainly focused on defining and conceptualizing the seven constructs of TPACK, recent studies have shifted their focus to using the framework to comprehend teachers' knowledge of integrating technology, hence TPACK, to facilitate and enhance their teaching and if such knowledge develops through technology interventions.

Building on the history of using survey methodology to examine teachers' knowledge with regards to technology integration, researchers designed survey instruments to assess teachers' TPACK. Several questionnaires were designed to examine the development of TPACK (e.g., Archambault & Crippen, 2009; Chai, Koh, & Tsai, 2010; Koehler & Mishra, 2005; Sahin, 2011; Schmidt et al., 2009-10). For example, Archambault and Crippen (2009) constructed a 24-item questionnaire and surveyed 596 K-12 online teachers who rated their PK, CK, and PCK knowledge at the highest level, but were not as confident in the knowledge domains related to technology. Schmidt et al. (2009-10) developed a questionnaire targeted on elementary preservice teachers who will be teaching multiple subject areas. That instrument contains 47 items using a 5-point Likert scale and 3 open-ended questions with the goal of measuring the development of preservice teachers' self-perceived TPACK. Within a pre- and post-survey design, Schmidt et al. (2009-10) found that after completing an introductory instructional technology course statistically significant gains were found in all seven knowledge domains among preservice teachers, with the largest growth in the areas of TK, TCK, and TPACK. Although each of these instruments were designed and implemented for different participants and in different contexts, all have contributed to informing the field about the development of teachers' knowledge in TPACK using self-reported measures.

Studies are now being designed that use other data sources to examine teachers' TPACK development (Koehler, Shin & Mishra, 2012). These include approaches and tools such as performance assessment rubrics (e.g., Angeli & Valanides, 2009; Harris, Grandgenett, & Hofer, 2010), open-ended questionnaires (e.g. Robertshaw & Gillam, 2010; So & Kim, 2009), teacher interviews (e.g., Harris et al., 2012; Mishra, Peruski, & Koehler, 2007; Ozgun-Koca et al., 2009-

10; Williams, Foulger, & Wetzel, 2010), and observations (Agyei & Voogt, 2011; Hofer, Grandgenett, Harris, & Swan, 2011; Koehler, Mishra, & Yahya, 2007; Suharwoto, 2006). Harris and colleagues emphasize that "self-report data should therefore be triangulated with external assessments of teachers' TPACK" (Harris et al., 2010, p. 324). Thus, research efforts focused on using multiple data sources are needed to advance our understanding of teachers' TPACK.

Despite the abundance of studies that focus on investigating teachers' development of TPACK, the majority of results published come from self-reported data. While self-report data can shed important light on this topic, there is still a chance that potential errors can occur while participants attempt to recall their experiences (Kilickaya, 2009), and that such data do not provide compelling evidence or capture actual technology integration practices in classrooms (Marquez Chisholm & Padgett, 2004). Thus, it is timely and critical that research around this important topic begin to utilize systematic and empirical methods in order to measure TPACK (the intersection of TK, PK, and CK). This study seeks to understand teachers' TPACK by conducting both classroom observations and interviews. As past researchers have noted, direct observation in classrooms yields abundant information about the nature of effective teaching (Good & Brophy, 2000), while others add that the successful integration of technology in relationship to effective teaching is dependent on how well teachers plan instruction (Harris & Hofer, 2009). The next logical step is to observe how a teacher applies TPACK while executing a lesson (Kereluik, Casperson & Akcaoglu, 2010), and afterwards talk with the teacher to unpack the actual planning and execution of that lesson.

The purpose of this study was to observe exemplary technology-using teachers' in classrooms to examine their TPACK. Two research questions guided the investigation: 1) How frequently do exemplary technology-using teachers exhibit TK, PK, CK, PCK, TCK, TPK, and TPACK? and 2) What TPACK characteristics were identified for each TPACK domain respectively? The next section describes the research methodology used for this study.

Methodology

This study follows a descriptive holistic single case study approach (Yin, 2003) to examine the phenomenon of exemplary technology-using teachers' TPACK using two different data sources: observation to identify teachers' TPACK through the execution of lessons and interview to unpack teachers' planning and rationale.

Participants

Study participants were four K-8 classroom teachers teaching in three different school districts. Administrators and technology coordinators from school districts in close proximity to our institution were contacted to nominate K-8 teachers who they considered "exemplary, technology-using educators." This group was asked to nominate teachers who were viewed by others and themselves as their district's classroom leaders in respect to using technology in innovative and effective ways in classrooms. Proximity to each participant (within 60 miles) was important to the study design because of the multiple classroom observations that were required for each participant. Nine teachers were nominated and four agreed to participate in the study. Table 1.1 provides a description of participants.

<TABLE 1.1 HERE>

Research Procedures

After receiving consent, two classroom observations were scheduled with each participant, with a follow-up interview conducted right after the observations. The interview addressed questions that emerged from the classroom observations and allowed teachers the opportunity to elaborate on their actions and thoughts. Two researchers (one of the authors) were present for each observation and an observation protocol was used to guide the observations. Researchers documented what was observed in classrooms and wrote down questions that came up while observing the teachers. During the interviews, the participants were asked a list of predetermined questions (about background and teaching experiences) along with questions that emerged during the observations. Data collected from the observations and interviews were then sorted into units of meaning (UoMs) for coding and analysis based on Mohan's (2007) concept of a social practice (known as an "activity").

Data Sources

A descriptive case study approach (Yin, 2003) was used to examine what teachers' TPACK characteristics look like in a classroom. Data were collected using two data sources - observations and interviews. To ensure systematic measures between the observation and interview data, two instruments were developed for the data collection. An observation protocol guided by the TPACK framework and an interview guide were used.

TPACK Observation Protocol. The TPACK observation protocol was developed, piloted among multiple observers (i.e., the authors), and modified to advocate systematic observational

measures in the data collection process (Borg & Gall, 1996; Borrego & Cook Hirai, 2004). This protocol was created based on four of the seven knowledge domains within the TPACK framework - Content, Pedagogy, Technology, and TPACK (Mishra & Koehler, 2006). Three to five prompting questions were provided for each domain to guide and focus the observers during each observation. A brief lesson plan/description was collected from each teacher prior to the observation to situate the observers in that particular class. Observers can also note questions on the form that came up while observing the teacher. These questions were then asked for clarifying purposes during follow-up interviews (Duff, 2008; Gillham, 2008; Niess, 2011). All observers used this protocol to record two observations for each participant.

Interview Guide. The Interview Guide was created to collect participants' background information and to ask a set of questions that required teachers to examine and reflect on their teaching. The researchers used prompts from the interview guide, such as, "Why did you see the need to use technology in this lesson?", "What do you think went well? What did not?" and "What changes would you make if you were to teach the lesson again?" to help facilitate the participants' reflection process after each observation. All interviews were recorded, transcribed, and sorted into UoMs for coding and analysis.

Data Analysis

Data analysis was guided by the Data Analysis Spiral (Creswell, 2013). The intention of the study was to identify observable TPACK teacher characteristics in order to begin defining what TPACK "looks like" in classrooms. The study followed Cresswell's (2013) notion of a zigzag process where data are collected and analyzed by going "out to the field to gather information, into the office to analyze the data, back to the field to gather more information, into the office,

and so forth" (p. 86). While coding and analyzing the observation and interview data collected

from the four participants, the Data Analysis Spiral was used then to guide the analysis process

"in analytic circles rather than using a fixed linear approach" (Creswell, 2013, p. 142).

Data collected from each participant were organized into a "data set," which included four digital

files - two observations and two interviews. Mohan's (2007) concept of a social practice (known

as an "activity") was used to organize the observation and interview data into smaller units, units

of meaning (UoMs), for coding and data analysis. The open coding process began by analyzing

one participant's entire "data set."

Following this zigzag process of data collection and analysis, each participant's "data set" was

sorted into UoMs and then distributed to two researchers (i.e., two authors) for coding. Two

researchers coded each "data set" separately using a codebook that included codes identified and

developed to date. The goal was for each researcher to align each UoM in the "data set" with an

existing code or to create a new code as needed. After completing the coding separately, the

coding results from the two researchers were compared and recorded. The two researchers then

met to discuss the coding results with the goal to reach an agreement on codes assigned to all the

UoMs as well as on any new codes created. When the two coders were unable to reach an

agreement, the UoM was sent to a third researcher for blind coding. At that point, the three

researchers met to discuss and reach agreement on placing the final code for the UoM. This

procedure was repeated for coding each participant's "data set." After all four data sets were

coded, the occurrences of teachers' TPACK knowledge were counted based on the seven

knowledge domains in the TPACK framework to illustrate the teachers' demonstrated TPACK

knowledge in their teaching.

In sum, a recursive data analysis process using the Data Analysis Spiral (Creswell, 2013) was

applied while coding all four participants' "data sets." Although the researchers coded each

participant's data set separately, using clearly defined UoMs, they always returned to the

previous analysis and results to review and revise existing codes and themes. New codes were

created when necessary and all codes were recorded in a codebook. After the coding was

completed, the occurrences of each TPACK domain in all participants' classrooms were counted

and calculated into a percentage to present the frequency in which these four technology-using

teachers exhibited in their classroom.

Findings

Based on the analysis of the observation and interview data, these four technology-using teachers

were found to exhibit all seven TPACK knowledge domains in their teaching with the highest

percentage recorded as TPACK. Second, 11 themes and 53 TPACK characteristics were

identified as a result of observing these four teachers while teaching in classrooms. Findings

indicate that using classroom observations and follow-up interviews with teachers can lend new

insight while trying to understand teachers' TPACK.

Teachers' Frequency of Exhibiting TPACK

Based on the collective coding analysis of the observation and interview data, it was found that

the TPACK knowledge domains that participants exhibited most frequently in their classrooms

were TPACK (34%), PCK (24%) and TPK (12%) (See Figure 1.1). Participants exhibited TK

(10%), TCK (9%), and PK (9%) in their teaching as well. However, the domain of CK (2%) was

observed less frequently in participants' classrooms.

<FIGURE 1.1 HERE>

Examining the two data sources (i.e., observations and interviews) separately, participants were

observed to exhibit PCK, TPACK, and PK most frequently, 30%, 23%, and 16% respectively.

However, the interview data revealed that participants most frequently *shared* reflective thoughts

and insights that aligned with TPACK (43%), PCK (18%), and TPK (13%). Thus, these four

technology-using teachers exhibited TPACK both in their actions (teaching) and their knowledge

(telling/reflecting). These teachers also frequently exhibited and shared their PCK, which

illustrates that teachers still have a keen ability to apply the pedagogical skills necessary to teach

content (Shulman, 1986). Although teachers were observed applying PK (16%) in classrooms,

this domain was rarely mentioned during the interviews (3%). Teachers' TPK was observed

(11%) and described during interviews (13%), illustrating that these technology-using teachers

were developing some expertise in this domain and were enacting that knowledge while

teaching.

One finding worth noting was that teachers' TCK (9%) was observed in classrooms and was

mentioned (9%) by teachers in follow-up interviews. Harris and Hofer (2011) have argued that

TCK definitions are inconsistent across research studies. Previous research findings indicated

that TCK was typically the domain having the lowest mean on survey responses when examining

teacher knowledge (Graham, Cox, & Velasquez, 2009; Richardson, 2009), while others reported

limited evidence or emphasis of teachers applying TCK in classrooms (Harris & Hofer, 2011;

Swan & Hofer, 2011). For the purpose of this study, TCK was defined as the "knowledge of how

technology can create new representations for specific content. It suggests that teachers

understand that, by using a specific technology, they can change the way learners practice and

understand concepts in a specific content area" (Schmidt et al., 2009-10). Several UoMs were

coded within the TCK domain in this study. For example, Candice prepared a wiki so that

students could use and add information during their social studies unit of study about the regions

of the United States. This UoM was coded as "TCK_Prepare" by both researchers during the

data analysis. Candice created a new representation (i.e., wiki) for the specific content being

taught (i.e., regions of the United States). This finding implies that teachers can be observed

using TCK, which contradicts findings from previous studies (Graham, Cox, & Velasquez, 2009;

Lux, 2010; Niess, Lee, Sadri, & Suharwoto, 2006).

TPACK Characteristics Identified

After data analysis and interpretation it was clear that particular TPACK characteristics were

both observed and described by these four technology-using teachers. Table 1.2 presents the 53

TPACK related characteristics (codes) that were identified across all seven knowledge domains.

Subsequently, 11 themes emerged from those 53 TPACK characteristics.

<TABLE 1.2 HERE>

These 11 themes were identified after closely examining the 53 TPACK related characteristics

that represented the common ground of how these four teachers exhibited their TPACK in

classrooms. "Use" was a theme identified in six of the seven TPACK knowledge domains.

Participants demonstrated not only the "Use" of technology or pedagogy for teaching (Use_TK, Use_PK) but also the "Use" of technology and/or pedagogy with content knowledge (Use_TCK, Use_PCK, Use_TPK, and Use_TPACK) in mind. The next most frequent themes observed were "Prepare" and "Match Affordance." Both were observed in five of the seven TPACK domains. Every participant was observed using technology and/or pedagogy as he/she prepared to teach content. For instance, Daniel prepared a template in Pages (a word processor) to introduce his students to the concept of persuasion. This UoM was coded "Prepare_TPACK" by each coder during the data analysis.

Although the "Prepare" theme could be explicitly observed in classrooms, the "Match Affordance" theme needed to be verified through the follow-up interviews with participants. For example, Daniel was observed incorporating the *SubText* app (space for teachers and students to have digital book discussions) into a lesson while teaching persuasive writing. Students read a persuasive piece that Daniel uploaded to *Subtext,* and then were asked to identify the key persuasive elements in the text by highlighting sentences on their iPads. Based on observation notes, both researchers documented two themes, "Prepare" and "Match Affordance" during this teaching episode. However, the "Match Affordance" theme was further verified during the follow-up interview where Daniel stated, "I used it [*Subtext*] mainly because it gives English resources on getting non-fiction. … It also has the feature of highlighting. I can see all of the kids' highlights. I can see their comments."

Likewise, the themes of "Reflect" and "Transfer" could not be easily identified by using observation data only. Several times participants demonstrated their ability to "Reflect" during

the follow-up interviews when they had the opportunity to further elaborate on what they were

teaching and why. Participants would frequently make connections between the lesson just

observed to previous lessons they had already taught. Brian was asked how his mock trial case

lesson was different from before, and he then elaborated at length on the changes that were made

this time around. This illustrates how Brian reflects upon his teaching practices and takes the

necessary steps to improve upon it from year to year.

When aligning these themes to the seven TPACK knowledge domains, it was found that

TPACK, PCK, and TK were identified with 13, 11, and 10 characteristics respectively. The TPK

domain had nine different characteristics, and PK and CK had the fewest characteristics

identified with three each. Although it was difficult to observe CK in isolation of pedagogy and

technology, there was still evidence that participants exhibited knowledge of the content that

he/she was teaching, made interdisciplinary connections, and provided accurate responses to

students' content-related questions. These findings illustrate that teachers incorporated not only

the three foundational TPACK knowledge domains (TK, PK & CK) in isolation in their teaching,

but rather the characteristics within the integrated domains of PCK, TCK and TPK and most

importantly, TPACK.

Discussion and Conclusion

The purpose of this study was to observe K-8 technology-using teachers in classrooms, with the

goal of identifying specific TPACK characteristics that were exhibited by the teachers while

teaching. In sum, the teachers exhibited 53 TPACK related characteristics (TPACK-13, PCK-11,

TK-10, TPK-9,TCK-4, PK-3, and CK-3), which then aligned with 11 specific themes. Findings

from these teachers' observations help to provide a deeper understanding of TPACK in terms of

bridging the gap between research and practice. These results provide an initial response to the

question, "*What does TPACK look like in classrooms?*" Moreover, findings also suggest that

characteristics do exist for each of the seven TPACK domains and these characteristics can be

observed in practice. Specific themes, such as "Reflect" and "Transfer," do need further

investigation while talking with teachers. Thus, this study illustrates the value of using multiple

data sources while examining teachers' TPACK.

As mentioned, surveys are commonly used to investigate the development of preservice and/or

inservice teachers' self-perceived knowledge of TPACK (e.g., Archambault & Crippen, 2009;

Koehler & Mishra, 2005; Schmidt et al., 2009-10). Using multiple data sources, such as those

used for this study, holds promise and value in terms of confirming findings from self-reported

investigations. Future research should aim to build upon self-report results by aligning key

TPACK characteristics, like those identified in this study, with items present on existing surveys.

As a result, survey items may need revising or additional items added in order to strengthen the

reliability and validity of existing instruments and their ability to measure each TPACK domain.

This study also positions us well to develop a robust classroom observation tool that lists

observable characteristics and/or codes that align with all seven TPACK domains. Such an

instrument would be extremely useful in assisting teachers, school administrators and/or teacher

educators with identifying specific TPACK domains that need attention when preparing teachers

to integrate technology.

In sum, a case study approach was used to better understand teachers' TPACK by observing exemplary teachers who were using technology as an integral part of their teaching practices. All participants were observed applying their knowledge of each TPACK domain while teaching, which then led to the identification of specific characteristics that were aligned to the seven domains. These findings offer a possible next step in developing a more systematic approach for assessing teachers' TPACK. Triangulating data from multiple sources is appears promising as researchers continue to refine and improve the existing research approaches being used to measure TPACK.

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Table 1.1

Description of Teacher Participants

Name (pseudonym)	Degree(s)	Years Taught	Grade Levels Taught	Access to Technology
Alice	BS & MEd	39	2	25 station computer lab
Brian	BS & MS	15	5, 8	25 station computer lab & classroom set iPads
Candice	BA & MEd	13	3, 4	Laptop Cart
Daniel	BS	1	5	1:1 iPad Program

Table 1.2

TPACK Themes and Characteristics Identified

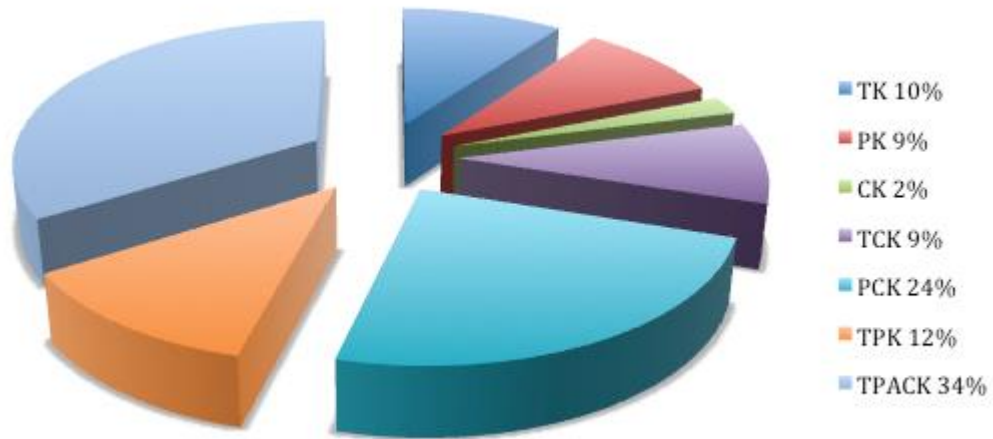| Themes (Occurrence in TPACK domains)	Definition of Themes	TPACK Domains (# of Characteristics Identified)						
		TK (10)	PK (3)	CK (3)	TCK (4)	PCK (11)	TPK (9)	TPACK (13)
Use (6)	Teacher demonstrates the ability to use technology and/or pedagogy for content teaching	√	√		√	√	√	√
Match Affordance (5)	Teacher selects technology and/or pedagogy to match the teaching/learning objectives.	√			√	√	√	√
Prepare (5)	Teacher demonstrates the ability to use technology and/or pedagogy to prepare for content teaching.	√			√	√	√	√
Collaborate (4)	Teacher collaborates with others to use technology and/or pedagogy for content teaching.	√	√			√		√
Engage (4)	Teacher uses technology and/or pedagogy to engage students in content learning.	√				√	√	√
Learner Centered (4)	Teacher uses technology and/or pedagogy to create student-centered environment for content learning.		√			√	√	√
Reflect (4)	Teacher reflects on his/her use of technology and/or pedagogy for content teaching.	√				√	√	√
Troubleshoot (3)	Teacher demonstrates the ability to troubleshoot.	√			√		√	
Connect (3)	Teacher uses technology and/or pedagogy to connect students' learning to others.					√	√	√
Assess (2)	Teacher uses technology and/or pedagogy to assess student learning.					√		√
Transfer (1)	Teacher demonstrates the ability to help students transfer technology knowledge from one context to another.	√						
Others	Teacher demonstrates the ability to integrate technology and/or pedagogy into content teaching, e.g., teacher exhibits CK, coordinate technology, and scaffold content learning.	√ √		√ √ √		√ √	√	√ √ √ √

Figure 1. Frequency of TPACK Related Codes