Early Career Teacher Candidate TPACK Development: Implementation of a Learning Activity Types Short Course

Daniel Mourlam
Division of Curriculum and Instruction
University of South Dakota, United States
daniel.mourlam@usd.edu

Heather Bleecker
Division of Curriculum and Instruction
University of South Dakota, United States
Heather.Bleecker@coyotes.usd.edu

Abstract: Currently, the literature contains multiple approaches to teacher candidate TPACK development. The Learning Activity Types Short Courses, which assist with scaffolding the process of combining content, pedagogy, and technologies in instruction for teacher candidates, are a recent addition to the literature. The purpose of this study was to characterize early career teacher candidate Technological Pedagogical Content Knowledge (TPACK) before and after the implementation of a Learning Activity Types Short Course in an undergraduate introductory educational technology course. Data collection occurred through a pre/post TPACK survey, as well as assessment of teacher candidate lesson plans completed before and after the Short Course. Data analysis was complete using both descriptive and inferential statistics. Findings suggest that while candidate TPACK self-efficacy remained mostly constant throughout the study, their enacted TPACK experienced a statistically significant increase.

Introduction

As society has become more digital, the knowledge required for success has evolved, necessitating an increased focus on media, information, and technology skills (Darling-Hammond, 2010; Greenhill & Petroff, 2010, Wagner, 2012). As teacher education programs have revised and enhanced curriculum to meet the needs of a changing society, preparing teacher candidates (candidates) to teach with technologies has become an imperative. The result has been a focus within teacher education to develop candidate Technological Pedagogical Content Knowledge (Mishra & Koehler, 2006; TPACK), which represents the knowledge needed to effectively teach content in specific ways using technologies.

Since the introduction of the TPACK framework (Mishra & Koehler, 2006) multiple TPACK development approaches have been examined within teacher education. Perhaps the most common context for TPACK development has been through standalone educational technology courses many institutions offer. The primary focus of these courses typically is on learning about a variety of technologies and how they can be used during instruction to assist the development of student content understandings (Chai, Koh, & Tsai, 2013). Faculty teaching these courses have a number of options that have the potential to impact candidate TPACK. Perhaps one of the more common approaches requires candidates to design and develop TPACK based instruction (An, Wilder, & Lim, 2011; Angeli & Valanides, 2013; Figg & Jaipal, 2013; Hofer & Harris, 2010; Koehler et al., 2011; Mishra & Koehler, 2006). As candidates engage in the instructional design process, they do so through one of three methods. The first method occurs through the examination of the pedagogical affordances of a technology, which ultimately leads to candidates exploring interactions among content, pedagogy, and technologies (Angeli & Valanides, 2013). A second method engages candidates in the concurrent development of their pedagogical content knowledge (PCK) and TPACK as they create technology-rich instruction (Brush & Saye, 2009; Koehler et al., 2011; Mishra & Koehler, 2006). Finally, the third method to TPACK development, however, begins with candidates first identifying learning and instructional goals, before examining how technologies can support and enhance the learning experience (Harris & Hofer, 2009; Hofer & Harris, 2016; Harris, Mishra, & Koehler, 2009, Niess, van Zee, & Gillow-Wiles, 2010). It was this final method that was the focus of this study through the use of a Learning Activity Types Short Course (short course) to support early career candidate TPACK development in an introductory educational technology course.

Learning Activity Types

Hofer and Harris (2010) developed and validated content specific learning activity types (LATs) that can serve as scaffolds for the lesson planning process in ways that support technology integration. The LATs are taxonomies of content based activities, which include a description of the activity as well as technologies that would support each activity (Harris & Hofer, 2009). When using the LATs, Hofer and Harris suggested candidates begin by identifying learning goals and considering classroom and student contextual factors that might impact instructional decisions. Then candidates should select and sequence multiple LATs, as well as formative and summative assessment strategies, and only then should decisions regarding technologies be made. They argued that by first having candidates explore content and pedagogical needs, candidates are better able to align technologies to those needs, and in the process, develop their TPACK in a more authentic way.

LATs have been used in a variety of ways within teacher education. Albion (2012) found the LATs were a useful resource for candidates, although additional support was needed due to their lack of knowledge and experience combining content, pedagogy, and technologies, which Hofer and Harris (2010) initially suggested for novice teachers. Figg and Jaipal (2013) leveraged the LATs during the first of a four stage TPACK-in-Practice workshop, where a LAT provided the workshop foundation, which was then built upon as candidates discussed the connections among TPACK domains, developed related technology skills, and ultimately developed their own learning experience. They found that candidates experienced an increase in their confidence after leading a TPACK-in-Practice workshop.

Building upon their work with LATs, Hofer and Harris (2016) introduced the short courses as open educational resources. These short courses were created to assist with the development of teacher TPACK using the LATs taxonomies. According to Hofer and Harris, the short courses consist of eight brief, developmental, video-based modules that begin by asking candidates to think about how they have seen digital technologies used during learning experiences, which is followed by candidate analysis of lesson plans for content goals, activities, and technologies. Candidates then explore a LATs taxonomy and consider how substituting technologies and activities in those lessons would change the overall nature of the learning experience. The short course ends with candidates creating their own lesson plan using the LATs.

Given the recency of the short courses, the goal of this study was to characterize early career candidate TPACK in an introductory educational technology course where a short course was used as part of course activities and assignments. Specifically, this study sought to answer the question, how can candidate TPACK be characterized both before and after completing a Learning Activity Types Short Course?

Technological, Pedagogical, Content Knowledge

TPACK provided the theoretical framework for this study. Building on the Shulman's (1986, 1987) conception of PCK, TPACK represents the knowledge teachers must have regarding technologies and how they dynamically interact with content and pedagogy (Mishra & Koehler, 2006). The TPACK framework for teacher knowledge consists of seven distinct and intersecting domains. These domains include the knowledge of subject-matter or content knowledge (CK), pedagogical knowledge (PK) which refers to the knowledge of teaching and learning, and technological knowledge (TK) or the knowledge and skills needed to use available digital technologies. In addition to these three domains independently, as they each intersect, new dyad knowledge domains are created, including PCK which is the knowledge of how to teach content related material, TPK or the knowledge of how to teach with technologies, and technological content knowledge (TCK), which is the knowledge of how to represent content using technologies. Finally, as all three domains overlap, TPACK emerges representing the knowledge needed to effectively teach content in specific ways using technologies (Harris & Hofer, 2009).

Methodology

Study Context

Participants were recruited from an introductory educational technology course at ABC University. The course is one of three courses required for admission to the teacher education program. ABC University is a medium-sized research university with an annual undergraduate enrollment of approximately 7,500 undergraduate students. Within the teacher education program, there are approximately 450 students enrolled annually. The primary focus of the course was on preparing early career candidates in the use of digital technologies to support teaching and learning. There were 37 candidates enrolled in the course, however three candidates did not complete all study procedures and were eliminated from analysis, resulting in a total sample of 34 candidates. Many candidates were elementary education majors (26), with six secondary, and one K12 education major. Additionally, 14 candidates were also seeking a double major in special education. Most candidates were in their sophomore year (26), with two in their freshman year and six in their junior year. Candidates were mostly female (25), aged 22 and under (30). Half of the candidates completed a field experience during the semester as well.

Learning Activity Types Short Course Implementation

The short course was implemented throughout three consecutive weeks in the course during an online unit on distance learning. During the first week, candidates completed modules one through three of the short course. They then participated in a small group online discussion where they analyzed lesson plans from the short course to identify relationships between the learning goals, activities, and technologies. Using their analyses, groups then discussed and determined what made technology integration successful during instruction. During the second week, candidates participated in modules four and five and completed a second small group discussion. In the second small group discussion, candidates individually selected one of the LATs taxonomies and classified specific activities according to the six levels of Bloom's Taxonomy. Then, as a group, candidates reviewed a lesson plan provided by their instructor and identified three alternative activity types, with associated technologies, that could be used to modify the lesson to support higher order thinking and one of the 4Cs (communication, collaboration, creativity, or critical thinking). Groups then discussed how adding, removing, and changing technologies changed the overall nature of the lesson, as well as realizations they had about content, learning activities, and technologies. During the third week, candidates completed the short course and designed and developed a lesson plan that utilized a blended, online, or global learning approach.

Data Collection and Analysis

A TPACK survey (Pamuk, Ergun, Cakir, & Yilmaz, 2013) was used to determine candidate self-efficacy (Schunk, 1984) of their knowledge, before and after the use of the short course. The survey was administered at the start of the course and then again after completing the short course and lesson plan assignment. The survey consisted of 37 four-point Likert-type questions ranging from strongly disagree (1) to strongly agree (4). Survey items aligned to the seven TPACK domains and were not changed from the original instrument published by Pamuk et al. that underwent both content and construct validity testing. The original instrument had an internal consistency for individual TPACK domains ranging from .759 to .916 with an alpha of .950 for the entire instrument. Candidate survey responses were analyzed using descriptive and inferential statistics, specifically means, standard deviations, and a paired samples t-test.

In addition to examining candidate perceptions of their knowledge, candidate lesson plans created before and after the short course were also analyzed to determine any observable changes in the enactment of their TPACK. The Technology Integration Assessment Rubric (Harris, Grandgenett, & Hofer, 2010) was used to assess candidate lesson plans. The rubric consists of four criteria aligned to TCK, TPK, and TPACK. Two researchers with deep knowledge of the TPACK framework and teaching with technologies independently scored lesson plans. To calibrate researcher interpretation of the rubric, researchers scored three lesson plans from another educational technology course not included in this study. During calibration, researchers independently scored one lesson plan and then shared and discussed their results, repeating this process for the final two lesson plans. To assist with independent scoring of candidate lesson plans, the researchers collaboratively selected exemplars for each criterion (see Table 1). Researchers then independently scored candidate lesson plans, met to compare results, and negotiated any differences (Creswell, 2008). Lesson plan data was then analyzed using descriptive and inferential statistics, specifically mean scores, standard deviations, and a paired samples t-test.

Criteria	Definition	Example
Curriculum Goals and Technologies	Technologies selected for use in the instructional plan are <u>strongly aligned</u> with one or more curriculum goals.	Content: "CCSS.Math.Content.K.G.B.5: Model shapes in the world by building shapes from components (e.g., sticks and clay balls) and drawing shapes." Technology: "Geoboard iPad app, iPads or iPods"
Instructional Strategies and Technologies	Technology use <u>optimally supports</u> instructional strategies.	"I will explain that over the course of the next few days, we will be using the school iPads to explore a new app called Geoboard. I will model on one of the iPads on what the app looks like and where it will be located on the iPads. Then I will open the app and model how to use it."

Technology Selections	Technology selection(s) are exemplary, given curriculum goals(s) and instructional strategies.	Content: "CCSS.Math.Content.K.G.B.5: Model shapes in the world by building shapes from components (e.g., sticks and clay balls) and drawing shapes." Technology: "Geoboard iPad app, iPads or iPods" Instructional Activities: "I will model," "[Students will] explore and record the shapes that they are making"
Fit	Content, instructional strategies, and technology fit together strongly within the instructional plan.	"Students will be able to use an iPad to explore the Geoboard app to create different shapes"

Table 1. *Candidate TPACK Scoring Criteria and Examples*

Findings

Candidate TPACK Self-Efficacy

This study sought to characterize candidate TPACK before and after completing a Learning Activity Types Short Course in an introductory educational technology teacher education course. Analysis of candidate pretest survey responses indicated they agreed or nearly agreed with each of the TPACK domains, with means ranging from 2.99 to 3.29 (see Table 2). Candidate responses, therefore indicated that at the start of the course they believed they had the knowledge and skills related to each of the TPACK domains. After the completion of the short course, discussions, and lesson plan assignment that required candidates to create a blended, online or global learning experience, candidates completed the TPACK survey again. On the posttest survey, candidate responses remained at the agree level on the scale for each of the TPACK domains, with means ranging from 3.01 to 3.26. A paired samples t-test was used to determine if there were any statistically significant mean score differences from pre to post and there were none, with p-values all above .05.

	Pretest		Posttest			
	Mean	SD	Mean	SD	df	P
TK	3.07	0.482	3.10	0.603	33	0.764
CK	3.11	0.391	3.01	0.534	33	0.346
PK	3.29	0.449	3.26	0.620	33	0.748
PCK	3.09	0.379	3.03	0.547	33	0.489
TPK	2.99	0.399	3.14	0.541	33	0.153
TCK	3.18	0.470	3.20	0.386	33	0.893
TPACK	3.07	0.386	3.15	0.578	33	0.420

Notes: N = 34, Statistical Significance P ≤ .05, Cronbach's Alpha: Pre: .943, Post: .983

Table 2. *TPACK Pre/Post Survey Descriptive and Inferential Statistics*

Candidate Enacted TPACK

To more holistically understand candidate TPACK, candidate lesson plans were analyzed. Analysis of candidates' lesson plans completed before the short course indicated candidates demonstrated proficiency on only the Curriculum Goals and Technologies (TCK) criterion (see Table 3). The remaining criteria were all below, but nearing proficiency on the rubric. This indicated that candidates had room for growth in their ability to apply their knowledge through lesson planning, specifically related to their TPK and TPACK, as well as their TCK, although to a lesser degree. Candidate lesson plans were again assessed after the completion of the short course. On the second lesson plan, mean scores were all above a three on the rubric, and in some cases nearing a four, the top of the scale. A paired samples t-test was used to determine if the changes in mean scores from pre to post were statistically significant. For each of the four rubric criteria there were statistically significant differences at a p-value less than or equal to .05.

	Pretest		Posttest			
	Mean	SD	Mean	SD	df	P

Curriculum Goals & Technologies (TCK)	3.15	0.821	3.74	0.511	33	0.002*
Instructional Strategies & Technologies (TPK)	2.91	0.965	3.50	0.615	33	0.003*
Technology Selection(s) (TPACK)	2.74	0.864	3.32	0.727	33	0.005*
"Fit" (TPACK)	2.76	0.923	3.53	0.662	33	< 0.000*

Notes: N = 34, * Statistical Significance $P \leq .05$

Table 3. *TPACK Pre/Post Lesson Plan Descriptive and Inferential Statistics*

Discussion

The focus of this study was to characterize candidate TPACK before and after the completion of a Learning Activity Types Short Course used in an introductory educational technology course for early career teacher education candidates. Findings from this study paint a peculiar picture for understanding candidate knowledge. According to TPACK survey findings, candidates began and ended the study believing they had the knowledge and skills related to each of the TPACK domains. While there were some small differences in mean scores across each of the seven domains, none of these differences were statistically significant. This appears to indicate that course activities, which included the use of the short course, likely made minimal changes to candidate self-efficacy related to each of the seven TPACK domains.

However, when examining candidate ability to enact or demonstrate their knowledge through lesson planning at the start of the study, there were areas requiring additional growth. Specifically, these areas included their ability to combine instructional strategies and technology, select technologies that were compatible with curriculum goals and instructional strategies, as well as fit content, instructional strategies, and technology strongly together within the lesson plan. At the end of the study, candidate ability to use their knowledge had increased at a statistically significant level for each of the four areas measured. This suggests that after participating in course activities, which included the short course, candidate ability to effectively combine content, pedagogy, and technologies in their lesson plans had improved. The question that emerges, is when measuring candidate knowledge, which is more important, their self-efficacy or observable performance? The likely answer is both, as there is value in having teachers that not only think they can teach with technologies, but in fact can do so effectively in observable ways.

The differences in how candidate TPACK self-efficacy and enacted TPACK changed in this study demonstrates the complexity of the knowledge needed to teach with technologies. While self-efficacy focuses more on one's own assessment of their capacity to complete a task (Schunk, 1984), which in this study was the candidate's judgement of their capacity to perform tasks in each of the seven TPACK domains, enacted TPACK constitutes an observable phenomenon. Simply put, candidates may or may not believe in their ability to develop TPACK based instruction, but still be able to create instruction that effectively combines content, pedagogy, and technologies. This begs the question, is there a relationship between candidate TPACK self-efficacy and their enacted TPACK? The answer to this question would prove very useful for teacher educators seeking to not only help improve candidate instruction, but also their self-assessments of their knowledge and abilities. As such, teacher educators and researchers must keep both phenomena in mind when designing and evaluating TPACK development opportunities to ensure a more holistic understanding of candidate TPACK.

Study findings suggest the use of the Learning Activity Types Short Course may assist with candidate TPACK development. However, it can be said with no certainty the degree to which the short course impacted candidate TPACK; only that their observable knowledge increased in this particular case. Therefore, it is recommended additional research be conducted on the implementation of the short courses to better understand not only how best to use these resources, but the extent to which it assists with candidate knowledge development.

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