Technology Integration with Teacher Educators

by

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ABSTRACT

Preservice teachers are faced with many challenges as they enter their first year of teaching. This is particularly true when dealing with future-ready skills, such as technology integration in K-12 classrooms, an area where many higher education or teaching faculty may not feel comfortable or fluent enough to support preservice teachers or to model in their own instruction.

This action research study aimed to understand how faculty develop Technological Pedagogical Content Knowledge (TPACK) in ways that will help them to enhance their instruction and model technology integration for preservice teachers. An online community was created that allowed teacher educators to interact synchronously or asynchronously to collaborate, learn, and practice new technological skills. This community served as a place for teacher educators to play with new technology and to share their ideas and practices with their peers—ideally to begin the process of developing the knowledge and fluency with technology that would allow them to better support teacher education students.

Both qualitative and quantitative data were used to explore faculty's development of TPACK. A pre-survey, retrospective pre-survey, and post-survey were administered and analyzed. Also, interviews of participants and observations of the online community were used to collect qualitative data.

The results of the study showed an increase in participants' confidence for selecting technologies to enhance their instruction after they participated in the online community. Also, the participants felt more confident using strategies that combine

content, technologies, and teaching approaches in their classrooms or other learning environments.

In Chapter 5, a discussion of the findings was presented, in which several main implications are shared for researchers who might be engaged in similar work. Also, the lessons learned from this action research are explained, as well as the limitations experienced in this study.

As I embarked on this journey, I unwittingly brought along my family and friends. Little did I know that accomplishing this type of task would greatly impact the various people in my life. Lucky for me, I have very supportive and loving family members and friends.

To my husband, who never doubted my ability to complete my doctorate—even when I doubted it. Thank you for your continuous support! I can always count on you to have our family's best interest at heart—even when the outcomes are long-term and sometimes hard to see.

To my children, I am so very proud of all your accomplishments and love that you are proud of mine, too. I tried to shelter you from feeling like you had to sacrifice anything while I was on my journey, but you were patient when I needed to work and not play. Moreover, you celebrated right along with me when I completed each milestone. My main hope is that I modeled what it is like to work hard for something you care about—without sacrificing time with the people you care most about.

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Finally, I was lucky to have amazing participants who were willing to take risks and learn new things. I learned so much from my participants and am grateful that they were willing to help me grow as a researcher and educator. Teacher educators have great influence on the development of new teachers and my participants were excellent models for what it means to be life-long learners and change agents.

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CHAPTER 1: INTRODUCTION

Preservice teachers are faced with many challenges as they enter their first year of teaching. They rely heavily on the support of their mentors, school administrators, and peers to help them master the art of teaching (Allen & Wright, 2014). Preservice teachers work to synthesize their educational experiences and apply their learning across various contexts and content. They need regular feedback, modeling, and support from their teaching faculty to implement teaching best practices during their student teaching and in their first years of teaching (Ingersoll & Strong, 2011). This is a particular challenge when dealing with future-ready skills, such as technology integration in K-12 classrooms, an area where many higher education and teaching faculty may not feel comfortable or fluent enough to support preservice teachers or to provide modeling.

Teacher educators–mentors, faculty, and university supervisors– are not always prepared to support and model new practices in technology integration for preservice teachers (Foulger, Buss, Wetzel, & Lindsey, 2015; Smith & O'Bannon, 1999). Moreover, preservice teachers may not get feedback on their technology integration or have opportunities to apply their learning from their university technology courses during their student teaching experience (Pratt & Stevenson, 2007). Pratt and Stevenson (2007) argue that preservice teachers should be assessed on their ability to integrate technology during their student teaching—not just in their educational technology courses. They noticed a gap between educational technology theory and practice when preservice teachers were only assessed in their coursework and not in the field. Therefore, teacher educators should be prepared to support preservice teachers as they integrate technology in their student teaching. This support could include modeling, feedback, and guided reflection

for the preservice teachers. Pratt and Stevenson (2007) found that providing faculty and mentors with training helped them to model technology integration for the preservice teachers. It also provided them with the information needed to give feedback to the preservice teachers about their use of technology in the classroom. Foulger et al. (2015) found that teacher educators needed support to begin modeling technology integration for preservice teachers. Through their research, they noticed that teacher educators became more positive about using technology in their instruction as they gained experience and their positive attitudes transferred to the preservice teachers with whom they worked.

This action research study addressed the broad challenge of developing support for preservice teachers around technology integration, by first supporting teaching faculty. It did so by aiming to build the capacity of teacher education faculty in a position to provide such support to teaching students pedagogical technology integration—via a faculty personal learning network aimed at technology use and integration in teacher education and practice. Mertler (2014) defines action research as research that is conducted by education practitioners in order to learn more about their own context and practice (p. 4). Action research focuses on the unique context and participants within the practitioner's everyday work. It involves cycles of research and action that include identifying a problem of practice, collecting data, and developing an action plan or intervention (Mertler, 2014). Cycles of action research are meant to inform the researcher's practice and future cycles of research.

This chapter will begin with an overview of the previous cycles of action research that led to the development of this dissertation study. Next, a description of the larger context of educational technology and the state and federal requirements related to

implementing 21st century skills in today's K-12 classrooms will be presented. Then, this chapter will examine the local context for this study—looking at the specific group of teacher educators that were included in the intervention. This will lead to a more in-depth discussion of teacher educators (e.g. university faculty, staff, administration) and the role that they play in supporting preservice teachers in learning and applying best practices related to technology integration.

Previous Cycles of Research

From Fall 2013-Fall 2017, I was a site coordinator and instructor in the Mary Lou Fulton Teachers College (MLFTC). As a site coordinator in the college of education, I worked with teacher candidates (TCs) completing their senior year residency (SYR). The SYR was a rigorous yearlong student teaching experience in which the TCs completed their last year of college coursework and student teaching in a partnering district. In my role as a site coordinator, I oversaw the TCs who are placed in one of our partner districts. I managed the TC's clinical experience with their mentor in the district, conducted walkthroughs, evaluated TC instruction, and taught ASU courses, as well as provided training for the mentor teachers.

In Fall 2015, my partner district was in the process of rapidly implementing technology in all of their K-8 schools. Through the support of the community with overrides and bonds, the district had purchased mobile devices for their students and teachers to use in the classroom. They had approximately 3,600 iPads and 1,320 Chromebooks for their 5,800 students to use. The district had made a commitment to become a one-to-one district by 2019. This would mean that there would be one technology device available for every student in the district. In addition, the district had

adopted two digitally based instructional programs for core content of reading and social studies.

In order to best prepare new teachers to work in this partner district's high-tech environment, the TCs needed to be trained to not only use technology, but to purposefully and seamlessly infuse it throughout their teaching. In order to address this problem of practice, the first cycle of action research involved collecting data about the current status of technology infusion with preservice teachers. This included exploring TCs, administrator, and mentor perceptions about technology infusion to guide future cycles of research.

The first cycle of action research had five participants. Two participants were teacher candidates in their final semester of student teaching. They were both female students in their early 20s who are placed in elementary education classrooms in a Title 1 school in the district. Participant 1 was in a fourth-grade classroom and Participant 2 was in a first-grade classroom.

Participant 3 and Participant 4 were both veteran teachers in a Title 1 dual immersion language school in the district. Participant 3 had been teaching for 30 years in a second-grade classroom. She mentored several teacher candidates and had minimal technology experience. Participant 4 had been a middle school math teacher for 15 years. She had mentored teacher candidates for over five years and had minimal technology experience.

Participant 5 was an administrator at one of the schools in the district. She had been a principal for 5 years and had experience as a middle school science teacher. Her

school site regularly hosted TCs, and she had multiple experiences observing preservice teachers in their placements.

A semi-structured one-time interview was used to collect qualitative data for the first cycle of action research. There were nine questions for the TC interview and six questions for the administrator and mentor interview. The questions focused on the ways preservice teachers utilize technology in the classroom. For example, one of the teacher candidate interview questions asked, "How do you go about choosing the technology you will use in your instruction? Please explain." The administrator and mentors interview questions were very similar to the teacher candidate questions but focused on their observations of preservice teachers using technology during instruction. For example, one of the questions asked, "To what extent do preservice teachers' use technology to teach specific content skills? Please explain." The purpose of the interview questions was to uncover the perceptions of stakeholders regarding preservice teachers' use of technology and its effectiveness. A full list of the questions can be found in Appendix E.

The analysis of the data uncovered three major themes. Technology integration was consistently perceived as being motivating and engaging for the students, effective in differentiating for students' needs, and influenced by the content being taught. All of the participants commented on the engaging nature of technology at least once in their interview. Participant 2 stated that, "I see the benefit of it [technology integration] and the kids enjoy it." "It takes back from my behavior management. I have to do less, because they are excited to get to do the iPads to do their work." In addition, one of the mentors commented that her teacher candidate, "…uses Go Noodle as a behavior

management strategy." "Motivation, differentiation, and student-to-student academic conversations [are benefits of technology integration]."

Another theme that emerged was the impact that technology integration had on the ability of preservice teachers to differentiate based on students' needs. Participant 1 stated that, "For math especially it has become really nice because they have more practice with Khan Academy and Moby Math." Moreover, Participant 4 shared that she observed her TC,

> … integrating technology in stations and creating daily quizzes to track data. It has really allowed for differentiation. I would say that is the strongest point I have seen. She has been able to create lessons and quizzes on the Chrome books to differentiate for students.

Participant 5 shared that a benefit of technology integration is that, "Now, they really do have so many different options to hit the students' interests and teach the content in different ways."

The final theme is that technology integration is influenced by the content that is being taught. Participant 1 stated that, "I will think about the objective of my unit and then I will go from there. You have to figure out what is the best fit for this technology and that is the most important question you need to ask yourself." Participant 5 reflected that, "I have seen them do a lot of their reading instruction with the iPads. I haven't seen as much with math and science. I would say there probably needs to be more training in content that is not ELA [English language arts]."

Based on the data collected in the interviews, it was evident that the stakeholders experienced technology integration to be engaging and motivating for students. This could have positive implications for student learning if it was coupled with quality content and instruction.

Another aspect of technology integration that emerged in the interviews was the ability to differentiate using technology. Considering the plethora of resources and materials available online, there is the potential to create lessons that will address the interests and needs of a variety of students. The interview that stood-out the most was the mentor who discussed her TC's use of differentiated quizzes and lessons. The mentor talked about the significant impact that the differentiated quizzes had on student growth. This was also alluded to Participant 1's comments about students having more opportunities to practice.

Through the interviews, it was clear that content played a role in what and how technology was used. Based on these data, teacher content knowledge may play a crucial role in developing Technological Pedagogical Content Knowledge (TPACK). It is important to consider the use of technology in a variety of content areas. As stated by the administrator, there may be gaps in the TC's knowledge of technology use for particular content areas such as math and science. Based on these findings, it would be important to help TCs to develop their understanding of how to use technology to enhance student learning in a variety of content areas.

These results helped to shape the second cycle of action research that focused on teacher candidates and developing their knowledge of how to integrate technology effectively across content areas. During the first semester of student teaching at MLFTC, TCs were enrolled in a student teaching course. This course was a clinical experience course that included a weekly two-hour face-to-face class and four full days of student teaching. The second cycle of action research included an intervention during the weekly face-to-face meetings in the student teaching course. As the instructor for the course, I

delivered the course content while modeling effective technology infusion—using the Technology Integration Matrix (TIM) as a guide.

The TIM organizes examples of technology infusion into a matrix that address the classroom learning environment and levels of technology use. This combination of environment and technology use helps to define the effective use of technology to impact student learning. The intervention for this cycle of action research focused on the student TIM (University of South Florida, 2019) that outlines various levels of learning students are engaging in and at what level they would be using technology to aid in their learning. The types of learning include active, collaborative, constructive, authentic, and goal directed. These are correlated with levels of technology use: entry, adoption, adaption, infusion, and transformation. The idea of the matrix is to connect the learning types and technology infusion to show the progressive power of technology infusion within the learning process. For example, if a student is actively learning about phonics while the teacher shares an instructional video that has a song about "silent e," that would be a lower level learning type and technology use. This might be appropriate for an introductory lesson on this phonics rule; however, the matrix illustrates how students should have a variety of learning experiences and that the level of learning and technology use should be used to promote rich student learning experiences. The TIM was used as a guide in the intervention to help TCs learn how to integrate technology to enhance student learning, which was a need identified in the first cycle of action research.

As the instructor for the course, I modified the course instruction to include models of technology integration and created instruction using the TIM to ensure that student activities, teacher activities, and instructional settings were provided that

maximized the use of technology to support student learning. These lessons were used to serve as models for the TCs on how to effectively infuse technology.

The use of TIM in my own instruction was beneficial for helping to better define effective technology integration for TCs and illustrate the various levels of technology implementation in the classroom. The following student quotes represented some of the outcomes of the modeling.

- "TIM was utilized in today's lesson with having us collaborate and adapt what we learned using technology tools."
- "Using TIM in the classroom is beneficial because it helps create a unique lesson for your students and it allows them to build on their twentieth century skills."
- "[We] were hitting the constructive adaptation on TIM, which helped hit higher on the TAP rubrics in presenting instructional content, as well as activities and materials because students were more engaged and in charge of what resource and activity they presented."

In this cycle of research, I found that the implementation of TIM in my coursework was beneficial; however, I wanted my intervention to include more structure for the TCs' implementation of technology integration and selection of technology to use for various content. The TIM seemed to serve more as an evaluation tool for the TCs, rather than a planning tool or resource to help the TCs develop their own knowledge related to technology integration.

The analysis of the data in the second cycle of action research uncovered three major themes. Technology integration was consistently perceived as being motivating

and engaging for the students, effective in differentiating for students' needs, and effective for enhancing instruction or providing meaningful learning experiences. All three of the participants commented on the engaging nature of technology at least once in their interview. Participant 1 stated that,

> They absolutely love it. They like reflecting and reading each other's things. You can hear them reading aloud, "Oh, so and so said, 'blah blah blah', and it's funny because great minds think alike, I also said something similar." They like it.

In addition, Participant 2 commented that "I usually just try and come up with activities I think will be really engaging and really take that thinking to the deeper level, and then I try and find activities that match with that with technology."

Another theme that emerged was the impact that technology integration had on the ability of preservice teachers to differentiate based on students' needs. Participant 3 stated that,

> I know some students don't feel comfortable with their handwriting or their spelling. Having them type it, I think they feel a little better about writing down their opinions because they don't have to worry about does it look good, is this spelled correctly, because the computer solves all that for them. I think it boosts their confidence when writing.

Also, Participant 1 shared,

> The main way that I've used [technology] is to help students have a different format of reading. They'll have the same textbook, but now they're able to read at their own pace, and they're highlighting, so we're using the McGraw Hill version of the textbooks, so that's helped them with that.

Technology-enhancing learning experiences was the final theme. All the participants talked about using technology in a way that provided students an experience that they would not have without the use of technology. For example Participants 2 and 3 talked about using virtual tours to teach content. Participant 1 used technology to promote student collaboration. She stated that, "We've also used a lot of Padlet, which

allows them [students] to comment on each other's things, and see what everybody else is writing, and also practice their typing." There were several instances throughout the interviews where the teacher candidates discussed the use of technology to enhance their content. Participant 2 stated,

> I feel comfortable like looking at my standard and then looking at my objective and seeing where I want to go and then finding activities, because I feel like there's always something out there that's been created or something that I can create using technology to deepen their understanding of the content.

One of the primary findings in this cycle of research is that the modeling of technology integration was beneficial to the participants. All three participants stated that they learned how to integrate technology during their coursework. Participant 1 stated the following in response to the question, "To what extent have you been taught how to integrate technology in your instruction:"

> I think this semester has been more heavily on technology than others I've had. I think I learned so much about how to bring it into the classroom. I guess my extent would be a large extent. It's just I've learned so much more strategies to use with them, and a lot more of apps and stuff that I can use with them.

Another finding was that the Technology Integration Matrix (TIM) might not be the appropriate tool for helping TCs to learn more about technology integration. Although it was used by two of the participants to evaluate their technology infusion, one of the participants found it very confusing and not helpful. This cycle led me to think about whether the TIM was too detailed and advanced for use by preservice teachers. It was evident that the teacher candidates needed a better planning tool for technology integration and that the TIM may not serve that purpose. Moreover, I began to realize the critical role that I played as a faculty member and how my own ability to model technology integration made an impact on my TCs' learning and technology integration.

This led me to think more about the larger context of my problem of practice and the extreme value of having teacher educators who can model and support preservice teachers with their development of TPACK. In the next section, I will outline the larger context related to technology integration and the need for faculty members who can model and support preservice teachers' development of technology integration skills.

Larger Context

Technology in K-12 Schools

In 2002, President George W. Bush signed No Child Left Behind (NCLB), which was an update to the Elementary and Secondary Education Act of 1965 signed by President Lyndon B. Johnson. NCLB called for more accountability and stricter requirements for schools in an effort to ensure that all students mastered grade-level content. It also required that students be trained to be technologically literate by eighth grade—meeting proficiency in the technology standards outlined by the U.S. Department of Education and the International Society for Technology in Education (ISTE; Learning Point Associates, 2007).

Given this, NCLB proposed that technology be used to enhance student learning in all content areas and that educators should be provided training to integrate technology into their work, curriculum, and the development of technology skills throughout education (Learning Point Associates, 2007). Soon after implementation of NCLB, schools and teacher preparation programs began to focus on improving technology access and teacher use of technology. States began to adopt or adapt the ISTE Standards for Students, and teacher preparation programs were tasked with preparing new teachers to integrate technology in the classroom. The ISTE Standards for Students outline the key

competencies that students should master by the end of high school (ISTE, 2019a). These competencies include students' ability to not only use a variety of technology tools, but also that students should be able to create, innovate, and collaborate using a plethora of technology resources and platforms.

In 2015, the United States enacted Every Student Succeeds Act (ESSA). ESSA (2015) outlines the need to provide professional development for teachers—specifically in using technology to enhance learning. Moreover, it addresses the need to provide ample access to technology in order to improve academic achievement and the digital literacy of students. In order to improve the digital literacy of students, teachers need to have the skills and ability to integrate technology into their instruction and promote student use of technology.

Technology in Higher Education

The Interstate Teacher Assessment and Support Consortium (InTASC) is a coalition of national and state organizations that have worked to create a set of standards that define the skills and competencies that teachers should be able to demonstrate across all content and grade levels (CCSSO, 2013). University teacher preparation programs are required to teach and assess these standards through their coursework and field experiences. In 2011, the InTASC standards addressed the need for teacher candidates to understand how to use a variety of technology tools and resources as strategies to support student learning, provide equitable access to information, and assess student progress. The standards addressed the need for teachers to explore new technologies and upcoming technology that could be used to enhance student learning (CCSSO, 2013). Also, the standards require that teachers instruct students how to collaborate safely and effectively

in virtual platforms and promote the use of interactive technology to engage in local or global learning.

In 2013, InTASC released a resource to illustrate the learning progressions related to the 2011 InTASC standards (CCSSO, 2013). This resource further expands the skills that teachers should have for utilizing technology in their lesson plans to increase their ability to differentiate for learners and provide options for student choice. Moreover, it called for teachers to build a virtual community to share resources to support learners (CCSSO, 2013). Universities are required to teach and assess the InTASC standards through their coursework. This means faculty should include these standards in their syllabi, and perhaps more importantly should clearly model and demonstrate these practices in their own teaching, particularly given the direct impact that modeled pedagogy has on teachers' own practices, which can lead to teaching the way that they were taught (Oleson & Hora, 2014). This a particular challenge when it comes to technology integration. Technology skills and innovations are typically taught by a select group of faculty in one or two courses that occur prior to student teaching, rather than being infused more thoroughly and cohesively through the curriculum. Borthwick and Hansen (2017) highlight the importance of ensuring that preservice teachers experience educational technology in ways that are "program-deep and program-wide" instead of isolated courses focused on technology integration. Other faculty, methods instructors, supervisors, and mentors are typically not aware of the content that is being covered in the technology courses or of the expectations for students to apply these skills in their teaching. In addition, faculty who supervise student teachers may lack the technology knowledge and skills to support or assess technology integration during student teaching.

Zhu (2008) states that, "Over the years, we have found that our faculty often do not have the time to learn technology skills and to take on the task of developing technology-based instructional materials" (p. 307). He goes on to report that technology use in higher education is relatively stagnant. Use of basic communication and productivity technology tools are most common and there is less use of interactive technologies (e.g. educational games, simulations, assessment tools, etc.). This stagnancy is clearly a problem considering that it means that teacher education students are often not working with faculty that are comfortable with their own knowledge about using technology for teaching.

Faculty are highly specialized in their unique areas of content and experts in particular subjects, but this means that they may not be trained to model and support the integration of technology or other content areas. The *2017 Inside Higher Ed Survey of Faculty Attitudes on Technology* reported that 35% of 2,360 faculty members considered themselves early adopters of new technologies (Jaschik & Lederman, 2017, p. 6). A little over half of the faculty (55%) responded that they typically adopt new technology after watching peers use it successfully (p. 25). It was not clear how often faculty had opportunities to observe their peers using technology. In my own experience as a faculty member, I rarely had the chance to view my colleagues teaching. The implications of these findings are particularly challenging because there may not be structures or professional opportunities for faculty to learn the necessary technology skills to demonstrate modeling and support for preservice teachers.

Teacher Training

Teachers need to have training and support to build their own confidence with technology and to learn to implement it in meaningful ways in their instruction (Carabine, 1999). The kinds of knowledge that are needed to teach in 21st century settings involve a unique blend of knowledge around technology, pedagogy, and content—which will be described in more detail later. Teachers are more likely to use technology in their instruction if they have experiences using it on their own. This is another reason why teacher training and support is critical to the introduction of new technology in the classroom (PR Newswire, 2016). InTASC suggests that the role of colleges of education is to ensure teacher candidates can demonstrate these technology skills (CCSSO, 2013). One might conclude then, that it is important to ensure that teacher educators have the capacity to model these practices in their instruction, resulting in their candidates' ability to enact these practices with their K-12 students.

As preservice teachers participate in methods courses and other university learning experiences, they need to see how technology can support student learning in a variety of content areas. University faculty need opportunities to experience various types of educational technology and learn how to select technology to enhance their content and student learning. Faculty need opportunities to play with new technology and practice implementing it in their instruction to promote collaboration, creativity, and productivity. These are experiences that should be offered by the university to train their faculty to teach 21st century learners. The foundation for this type of training could be focused on The International Society for Technology in Education (ISTE) Standards for Educators, which outlines best practices that can be used by teacher educators to build

their technological and pedagogical knowledge. These standards should be taught and applied by faculty to help support preservice teachers' development of technological knowledge.

The ISTE 2017 Standards for Educators outline six key standards that educators should be able to demonstrate and apply in their instructional practices (ISTE, 2019b). The first standard calls for educators to regularly improve their practice and use technology to enhance student learning. This includes staying current with research and technology practices. Faculty leaders need the space and resources to work on these standards within their own practice. Although a few technology courses could cover some of these standards, it would be remiss to think that preservice teachers could master these skills void of subject-specific content, expert modeling, and ongoing feedback. For example, students could learn about technology to support collaboration within a general technology course but may miss opportunities to see ways that technology could be used specifically to support K-12 students' development of reading skills.

In an effort to make the necessary changes to enhance technology education in teacher preparation, the U.S. Department of Education, Office of Educational Technology (2016) published an update to the National Education Technology Plan, which was first implemented in 2010 (U.S. Department of Education, 2016). The publication titled *Future Ready Learning,* provides specific recommendations for teacher preparation programs and outlines their role in preparing teachers to implement technology. They argue that new teachers should leave teacher preparation programs with knowledge of the most effective technologies to use in instruction. They should be able to serve as models for veteran teachers on how to effectively use technology. In order to obtain this

outcome, teacher preparation programs need to address technology infusion in in-depth and effective ways that will adequately prepare new teachers to be leaders in technology integration.

The Council for the Accreditation of Educator Preparation (CAEP) is an organization that has been working with university teacher preparation providers to promote equity and excellence in teacher preparation since 2013 (CAEP, 2015). In 2016, CAEP accreditation standards were fully implemented and must be met in order for university teacher preparation programs to keep or obtain CAEP accreditation. Standard 1.1 of CAEP requires that programs show evidence that teacher candidates can demonstrate the competencies outlined in the InTASC standards (CAEP, 2016). Not only does it require university teacher preparation programs to implement all 10 of the InTASC standards, but it also requires that national content-specific standards be included in coursework. This means that the ISTE Standards for Educators should be taught and assessed in teacher preparation programs. Although many of these standards are addressed in technology courses, they are rarely connected to the teacher candidates' student teaching experiences. Moreover, faculty and mentors have not been trained in how to model and/or reinforce the use of technology in their courses. There is often a disconnect between the technology courses and expectations being taught to teacher candidates. Faculty do not have background and knowledge to provide support and provide feedback related to using technology to enhance instruction. Researchers in the field have been working to address this problem.

Foulger, Graziano, Schmidt-Crawford, and Slykhuis (2017) conducted a study to collaboratively develop a list of competencies needed by teacher educators to integrate

technology and support preservice teachers with their development of technological skills. An extensive process was used to work with a variety of stakeholders to codify and describe the skills, knowledge, and attitudes that are needed by teacher educators to effectively integrate technology and support preservice teachers. They developed a list of 12 competencies—each with a definition of the related criteria. Unfortunately, the competencies were not fully developed in time to use as a foundational framework in this research study; however, they were used to support the content developed in the online community. The competencies were built from several resources, including educational technology tools and frameworks, such as the ISTE standards and TPACK.

Educational Technology Frameworks

TPACK is a framework for outlining the skills and competencies and kinds of knowledge that educators need to integrate educational technology in meaningful ways to enhance student learning (Mishra & Koehler, 2006). This framework is described in detail in Chapter 2 and serves as a foundational structure for this research. Faculty and university supervisors often have strong content and pedagogical knowledge; however, they lack technological knowledge. This refers to their ability to use and explore various types of technology. Building technological knowledge requires support, modeling, and experience playing with new technology.

One challenge related to building TPACK is the rapid development of new technologies and digital tools. Mishra, Koehler, and Henriksen (2011) discuss the need for trans-disciplinary approaches to learning that challenge learners to think beyond content and promote creative and innovative thinking. One trans-disciplinary tool is "deep play." This can be described as an open-ended exploration of new ideas and

practices that might lead to solutions or a deeper understanding of a concept (Henriksen, Keenan, Richardson, & Mishra, 2015). Educators (from preservice teachers to higher education faculty) need opportunities to play with new technology. As they are developing TPACK, it is essential for faculty to become comfortable experiencing new digital tools and playing with technology to build their comfort and to prepare them for the constant fluctuation in technology resources and tools that will become available to them over time.

A major constraint to supporting faculty and university supervisors' development of technological knowledge is a lack of professional development opportunities in higher education. Conferences and research projects are typically considered professional development for faculty; however, these experiences tend to be focused primarily on the content that is already the expertise of these educators. Faculty are usually not required or encouraged to attend professional development on technology or other content that might not be a key focus of their coursework or research (Trust, Carpenter, & Krutka, 2017). Therefore, this study aimed to understand how faculty develop TPACK in ways that will help them to enhance their instruction and model technology integration for preservice teachers. An online community was created that allowed teacher educators to interact synchronously or asynchronously to collaborate, learn, and practice new technological skills. This community served as a place for teacher educators to play with new technology and to share their ideas and practices with their peers—ideally to begin the process of developing the knowledge and fluency with technology that would allow them to better support teacher education students.

Local Context

Improving Teacher Preparation

The University-School Partnerships for the Renewal of Educator Preparation National Center (US PREP) is a technical support center that provides on-the-ground assistance to university-based teacher preparation programs that are working to improve the preparation of their teacher candidates to ensure that they are classroom ready from day one. I am a Regional Transformation Support Specialist (RTSS) for US PREP and my role is to train, coach, and support university leaders and site coordinators (SC) during their transformation efforts. Site coordinators are university faculty who work directly with preservice teachers during their student teaching. They teach courses for the preservice teachers, as well as coach and evaluate them during their year-long student teaching experience. The support that I provide as an RTSS includes providing face-to-face and virtual training sessions focused on the implementation of practices and strategies to better prepare teacher candidates for the rigors of teaching.

There are seven universities partnered with US PREP. They have each committed to achieve a set of outcomes and indicators that relate to teacher candidate recruitment, quality training, and support. One of the outcomes and indicators includes the implementation of a Senior Year Residency (SYR), which includes a rigorous yearlong student teaching experience. The SYR not only increases the amount of time pre-service teachers spend teaching in the classroom, but it takes place in partnership with local K-12 school districts. As the university students complete their SYR, they take university coursework and complete their clinical training on K-12 campuses.

In order to better prepare teacher candidates for work in the classroom, each university partners with districts that will agree to provide resources and support to help train the university teacher candidates. A site coordinator (SC) from the university is assigned to each district partner. The SC serves as a liaison between the university and district partner, teaches coursework, evaluates teacher candidates, and serves as a coach for both teacher candidates and mentors. This is different that many traditional models of teacher preparation, because the SC is a full-time faculty member who not only evaluates the teacher candidates but also serves as an instructor and coach. This creates a more fluid connection between the university coursework and the expectations during student teaching. For example, SC meet with faculty to plan coursework and assignments that will better prepare teacher candidates for their clinical experience during the SYR.

Technology in Student Teaching

Site coordinators teach a student teaching course throughout the year-long residency. In this course, preservice teachers learn about and apply teaching best practices. These are assessed using two performance assessments each semester of the SYR. All of the universities working with US PREP use the same evaluation tool to assess teacher candidates' instructional competencies (NIET TAP Rubric) during the student teaching course. Although the evaluation is comprehensive and mirrors the types of evaluation tools that are used to assess in-service teachers, there is only one descriptor that addresses the use of technology during instruction. Moreover, it does not address the content or quality of the technology use. It is just mentioned as one of several possible instructional strategies that might be used to engage students in a lesson. Also, there are no assessments in the student teaching course that require students to implement

technology in their instruction. Throughout the SYR, there are no connections to the technology standards that may or may not have been taught during previous courses. This presents a clear gap in the preparation of preservice teachers and their opportunity to develop and apply TPACK. Student teaching experiences should include a connection to the theory that is taught in methods courses. Preservice teachers should be given feedback related to their ability to demonstrate the competencies taught and assessed during their coursework. Technology integration is a skill that is lacking support, feedback, and implementation in the senior year residency.

As a Regional Transformation Specialist with US PREP, I provide technical support and training for site coordinators, but this training does not include practices and strategies to model or support technology use during instruction. I have observed the site coordinators with whom I work and many of them are not comfortable with technology. They have not taught in classrooms where technology was available and rarely use technology to support their own instruction or coaching. It is evident that most site coordinators and faculty lack technological knowledge. This type of knowledge is a portion of TPACK. Technological knowledge refers to a teacher's ability to use and troubleshoot new technology. The first standard in the ISTE Standards for Educators is related to developing professional goals related to technology use in the classroom (ISTE, 2019b). This requires support from learning networks to develop new skills and ideas for technology integration. Also, the fourth standard notes the importance of collaborating with peers and co-learning with students by playing with new technology and examining its effectiveness in enhancing learning. Moreover, Foulger et al. (2017) encourage the development of program-wide professional learning systems for higher education faculty

to help build and refine their use of technology to enhance instruction. This is essential for supporting teacher educators' ability to master the Teacher Educator Technology Competencies (TETCs).

Problem of Practice

There is a clear gap between the skills that teachers are expected to demonstrate through InTASC, the TETCs, and the ISTE standards, and the knowledge and skills that teacher educators and site coordinators possess. For example, the TETCs state that, "Teacher educators will use online tools to enhance teaching and learning" (Foulger et al., 2017, p. 432). This includes using online tools to communicate, collaborate, design, and assess. Although some teacher educators utilize online tools in their instruction, most teacher educators that I have observed did not regularly use online tools to enhance their instruction or the students' learning. Often times, they were not aware of the tools that were available to them or how to use them. Moreover, teacher educators who I observed did not have opportunities to engage in professional development related to technology integration. They also lacked the confidence to play with or try new technology on their own. It was often easier to use old methods to teach content, rather than spending the time to learn a new technology tool to enhance the content.

Teacher educators need to have strong technological skills, knowledge, and attitudes in order to allow them to instruct, supervise, and model for preservice teachers during the SYR. In order for teacher candidates to effectively use technology to enhance instruction, it is imperative that teacher educators be provided training and support to build their own knowledge and capacity to use technology to enhance learning, as well as support and assess its use by teacher candidates in K-12 classrooms.

In order to address this problem, an online community was created for teacher educators focused on technology integration. This virtual space was designed to provide opportunities for site coordinators and other faculty to learn, collaborate, and share in a virtual environment to develop their TPACK. This study used mixed-methods inquiry to better understand how the online intervention supported faculty knowledge, attitudes, and beliefs around technology integration.

Research Questions

RQ #1: How and in what ways do teacher educators develop TPACK while participating in a facilitated online community focused on technology integration?

RQ #2: How do teacher educators TPACK?

RQ #3: How does facilitator and peer modeling influence teacher educators' development of TPACK?

RQ #4: How are teacher educators' attitudes and beliefs about technology integration influenced by their participation in a facilitated online community?

CHAPTER 2: THEORETICAL PERSPECTIVE AND RESEARCH GUIDING THE PROJECT

Chapter 1 set the stage for the context and issues related to this action research study and the need to further explore training site coordinators and faculty on how to use technology to enhance instruction. Chapter 2 will discuss two theoretical frameworks that were used to guide the development and implementation of this study. The first theoretical framework deals with the behaviors and skills associated with using technology in the classroom. TPACK will be defined and will serve as a foundation for examining the skills needed to effectively integrate technology in instruction. Relevant research pertaining to TPACK and teacher preparation will be outlined to provide support for the use of this theory within the context of this research.

The second theoretical framework will focus on the affective aspects of technology integration. The theory of planned behavior (TPB) will be presented as a framework for addressing the attitudes, beliefs, and perceptions related to technology integration. Since this study deals with participants who are engaged in short virtual sessions about technology integration, there is a need to develop an awareness of the participants' intentions to implement technology integration beyond this study and in their future teaching. Research including the TPB, in conjunction with technology integration, and teacher preparation will be presented as a foundation for the use of this theory.

The third construct in this chapter will focus on the use of professional learning networks and online communities as a forum for teacher professional development. This

research served as a guide for the development and usage of an online community in this study.

Technological Pedagogical Content Knowledge

TPACK is a framework developed by Mishra and Koehler (2006) to define teachers' understanding of technology integration in instruction. Using the foundational work of Shulman (1986), Mishra and Koehler expanded the theory of Pedagogical Content Knowledge (PCK) to include technology. Shulman (1986) proposed PCK as a way to define the complex relationship between teacher content and pedagogical knowledge. He challenged the trends in teacher examinations, which assessed teacher content and pedagogy separately—with an unbalanced emphasis on either set of knowledge. Shulman established PCK as a framework for investigating the combined content and pedagogy knowledge needed in order to be an effective teacher (Shulman, 1986). The TPACK framework furthers this theory by interweaving technology into seven total domains of knowledge that all intersect to form TPACK: Technological Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), and Technological Pedagogical Content Knowledge (TPACK). These domains are described in more detail below:

- Technological Knowledge (TK) refers to the knowledge of various technologies—including knowing their purpose and how to use them.
- Content Knowledge (CK) refers to understanding and demonstrating proficiency in the content that is to be taught.

- Pedagogical Knowledge (PK) includes an understanding of teaching methods and skills, such as lesson planning, classroom management, differentiation, and teaching strategies.
- Pedagogical Content Knowledge (PCK) combines both content knowledge and pedagogical knowledge to implement specific pedagogical methods to best teach content.
- Technological Content Knowledge (TCK) integrates knowledge of various technologies to be able to choose technology resources that best teach/enhance the content.
- Technological Pedagogical Knowledge (TPK) emphasizes the use of technology to enhance teaching practices and methods.
- Technological Pedagogical Content Knowledge (TPACK) is the combination of all the sets of knowledge in a tapestry of expertly woven teaching methods, content, and technology to most effectively teach any content or skill.

See Figure 1 for an illustration of the interconnected relationship between these knowledge types.

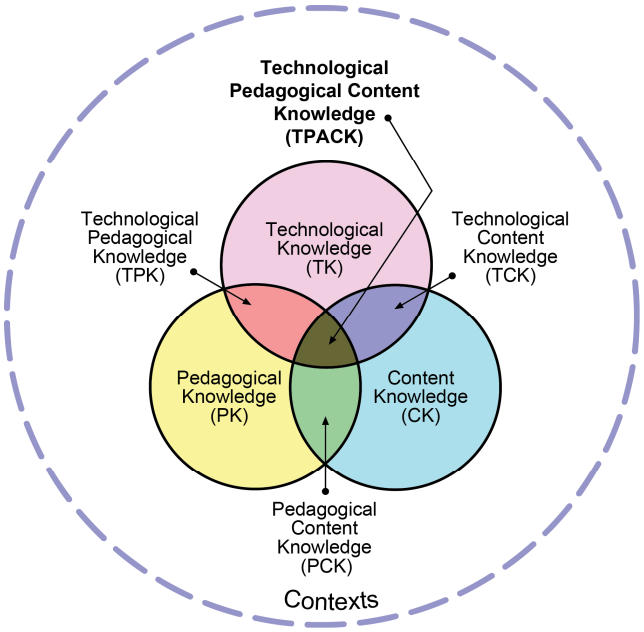

Figure 1. Technological Pedagogical Content Knowledge (TPACK). Reproduced by permission of the publisher, © 2012 by tpack.org See Appendix G.

In the quest to support site coordinators (SCs) in the development of the skills necessary to integrate technology, the TPACK framework provides detailed descriptions of the types of knowledge needed in order to effectively use technology in instruction. This can be a valuable tool for determining the skills and knowledge that SCs will need to develop in order to support their teacher candidates during the senior year residency. Schmidt et al. (2009) argue that, "TPACK is a useful frame for thinking about what knowledge teachers must have to integrate technology into teaching and how they might develop this knowledge" (p. 125). The next section of Chapter 2 will explore additional research related to TPACK and its use in teacher preparation.

Review of Supporting Scholarship

A common theme emerges in the current literature focusing on TPACK and teacher preparation. The theme outlines the importance of modeling TPACK for pre-

service teachers in a variety of contexts and throughout their coursework—not just in specific educational technology courses (Rehmat & Bailey, 2014; Chai, Koh, & Tsai, 2010; Pratt & Stevenson, 2007). This modeling includes the implementation of technology integration into the course instruction and assignments by the instructor. This type of modeling requires faculty who are working with preservice teachers to be skilled at using technology to enhance student learning.

Modeling

Rehmat and Bailey (2014) described the importance of instructor modeling of technology integration in their phenomenological study conducted in a science methods course for preservice teachers. They found through their analysis of pre- and post-survey data, lesson plans, and reflections that explicit instruction and instructor modeling of technology integration improved preservice teachers' ability to define and integrate technology in their lessons. The technology integration provided to the students in this study increased the students' technological content knowledge, as well as increased their confidence to use technology to teach science.

Although modeling of technology integration may often come from the faculty or course facilitator, in other studies the preservice teachers acted as the model for their classmates. For instance, Chai et al. (2010) implemented a series of professional development trainings focused on PK, TK and TPACK. During the sessions on PK and TK, the students researched pedagogical methods and technology resources to design activities that they presented to their peers. As the students developed their skills, they modeled these practices for each other. Survey data showed that the TK and PK of the participants increased as a result of the students' participation in these activities (Chai et

al., 2010). Therefore, instructors need to have experiences creating safe learning environments where preservice teachers explore and share new technologies with each other.

Deep play is a transdisciplinary thinking tool that can be utilized to promote creative thinking that is open-ended and focused on innovation. Mishra and Henriksen (2012) explain that creative thinking not only requires strong content knowledge, but also demands the ability to think outside typical content boundaries to synthesize and create new concepts, ideas, or products that integrate knowledge from various disciplines. Henriksen et al. (2015) argue that play "is foundational to the way that we learn and develop throughout life" (p. 5). Deep play can be used as a tool to create deeper meaning or find new products, ideas, or solutions; however, deep play might not result in any tangible outcome. Its purpose is to have fun and to explore. A playful mindset can be fostered and promoted to help faculty develop TPACK and gain comfort with technology integration, as well as a willingness to try out new things within their current content and context. Experts and peers can model their experiences and encourage each other to play with new tools and ideas. This connects to the need to create a safe place where educators can take risks and share ideas and actions that are not bound by right or wrong answers—just having fun with technology and being open to new ideas, thus, modeling deep play.

Another form of modeling represented in the literature was related to the facilitation and modeling of pedagogically focused planning and technology integration. A study conducted by Koh, Chai, and Tay (2014) analyzed three professional teacher groups and their discussions about information and communications technology (ICT) in

Singapore primary schools. Koh et al. (2014) were attempting to understand what factors influenced teachers' ability to develop TPACK. They discovered that when the majority of the teacher conversations focused on logistics and institutional factors such as schedules and paperwork, there was less evidence of the development of TPACK. They found that groups who focused more on pedagogical discussions had better development of TPACK. Koh et al. (2014) determined that pedagogy discourse improved the construction of TPACK and that organizing teams to include members who share a variety of skill sets would produce better results. This demonstrated that having a facilitator to model productive technology planning kept the group focused on pedagogy and helped the group avoid fixating on the institutional and logistical issues. This research highlights the importance of pedagogy-focused discussions about technology integration and offers implications for the design of learning experiences that strengthen instructor knowledge around teaching with technology. Providing modeling and facilitation of constructive discussions that highlight pedagogy and best practices in technology integration could support the development of TPK. Faculty need to have opportunities to discuss their use of technology to enhance instruction. They also need support learning how to plan for technology integration and how to address challenges that might arise while working with technology.

The TPACK framework can be used to help define the skills that SCs will need to develop in order to effectively integrate technology in their coursework for preservice teacher education. The review of the literature shows that training should focus on the modeling of TPACK that promotes teachers' implementation of these practices into their own teaching, as well as giving them opportunities to try out new things and gain a sense

of openness and fluency in the changeable space of technology in classrooms. These behaviors can be modeled by experts or modeled by peers. Also, it is important that faculty have time to collaborate and work together to plan their technology integration.

Context

Context is another critical component to consider when exploring the development of TPACK. Several studies highlight the impact of context, such as student backgrounds, grade levels, school structures, and technology resources, on TPACK (Rosenberg & Koehler, 2015; Kelly, 2010; Porras-Hernandez & Salinas-Amescua, 2013). Porras-Hernandez and Salinas-Amescua (2013) argue that context is a critical component that must be considered when working with the TPACK framework. Classroom contexts are impacted by school contexts, which are influenced by societal contexts, and it is important to note that these contexts can vary greatly. Therefore, they purport situating the TPACK framework within three levels of contexts: macro, meso, and micro. The macro level is defined as the overall societal or political context. Meso refers to the school or organizational context. Finally, the micro level represents the classroom and learning environment. The main characters in these contexts are defined by Porras-Hernandez and Salinas-Amescua (2013) as the teacher and student. In their study, they used the personal narratives of teachers as data and a way to promote teacher reflection. The teachers were able to share their personal narratives and learn from each other. This also helped the researchers to build an understanding of the teachers' knowledge. Therefore, in the online community developed for this study, participants who were situated in various contexts had the opportunity to share their personal experiences with each other—learning from each other and reflecting on their own practice. Contextual

references in the participants' posts were coded in order better understand the role context plays in teacher educators' development of TPACK.

In the next section of Chapter 2, I will explore the theory of planned behavior and how it can serve as a guide for predicting future behaviors.

Theory of Planned Behavior

The skills and knowledge related to effective technology integration do not account for all of the factors related to teachers' successful use of technology in the classroom. The theory of planned behavior (TPB) is a theory designed by Icek Ajzen that attempts to link beliefs to actions. TPB is a popular model for predicting intention and behavior and has been commonly used in a variety of educational research studies (Ajzen, 2011).

In this model, a person's intentions precede their behavior and refer to their desire to carry out the behavior. There are three main factors that can impact a person's intentions: attitudes (guided by their beliefs about the behavior), subjective norms (guided by the individuals' perceptions of what is socially expected), and perceived behavioral control (affected by the perceived barriers or control to complete the behavior; Ajzen, 2019). The attitudes towards a behavior, beliefs about what is acceptable behavior, and how the person perceives their control over the behavior are all direct determinants of behavioral intention (Lee, Cerreto, & Lee, 2010). This relationship is illustrated in Figure 2.

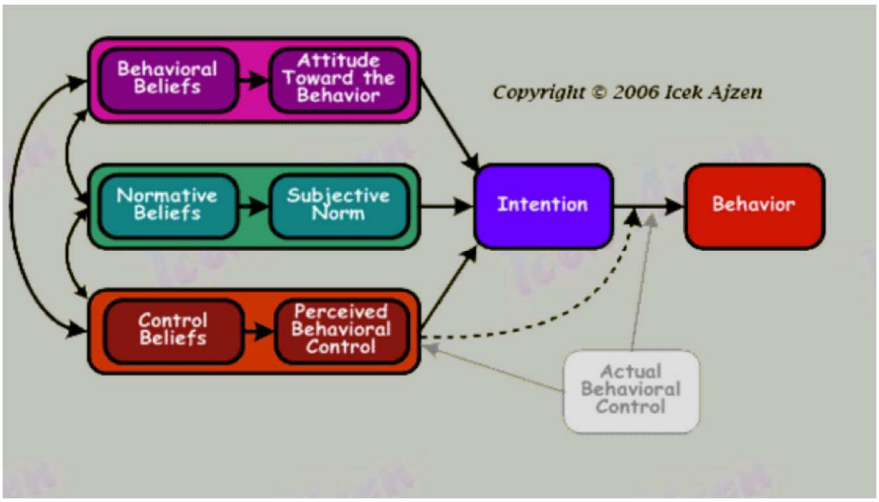

Figure 2. Theory of planned behavior diagram. Retrieved from http://people.umass.edu/aizen/tpb.diag.html (See Appendix G).

The TPB has been used to understand human behaviors and allow the researcher to predict behaviors based on the strength of the determinants (attitudes, subjective norms, and perceived behavioral control; Klöckner & Klöckner, 2011). TPB has been applied to technology integration in many studies to try to determine which factors have the most influence of teachers' intentions to use technology in their classrooms (Lee et al., 2010; Sadaf, Newby, & Ertmer, 2012; Teo & Lee 2010; Teo & Noyes, 2011; Yusop, 2015). In the next section of Chapter 2, I will examine the related literature and common themes related to the TPB, technology integration, and teacher preparation.

TPB, Technology Integration, and Teacher Preparation

In a review of the literature related to TPB, technology integration, and teacher preparation, a common theme emerged. Attitudes seem to be a significant factor in influencing teachers' intentions to use technology in their instruction. More specifically,

the technology's perceived usefulness has the most influence on teachers' positive attitudes towards integrating the technology.

Attitudes

In a study of technology use to support student-centered learning, Chen (2010) researched the factors relating to preservice teachers' use of technology. He determined that preservice teachers' feelings of efficacy in using information and communication technology (ICT) impacted their choices on how and when to use technology in their teaching. His research findings support the affective side of building technology integration skills. Preservice teachers' attitudes about their ability to integrate technology had a strong impact on their decisions to use technology. This was further supported by Al-Ruz and Khasawneh (2011) who found that instructor modeling of technology positively influenced preservice teachers' feelings of self-efficacy in regard to technology integration and their perceptions of the usefulness of technology.

Sadaf et al. (2012) found that attitudes and usefulness were significant factors in predicting preservice teachers' use of new technologies. In their study they used the decomposed theory of planned behavior (DTPB) to look more closely at the predictors of behavior in an attempt to identify aspects that had the most influence. It was identified that the perceived usefulness of the technology had a significant impact on the positive attitudes toward using the technology. In turn, attitudes were found to be the strongest indicator of the preservice teachers' intention to use technology. This is relevant to this action research study, because faculty new to technology integration will likely have the same attitudes and beliefs about technology integration as preservice teachers. For example, Foulger et al. (2015) found that faculty had attitudes of concern with learning

new technology and were hesitant to integrate technology into their coursework—just like some of their preservice teachers. These attitudes and beliefs may influence the teacher educators' future use of technology in the classroom.

In a recent study of factors that influence preservice teachers' use of Web 2.0 technology, Yusop (2015) also found that attitudes were the strongest of the three predictors (attitude, subjective norms, perceived behavioral control). This is supported by Lee et al.'s (2010) research in which they found that attitude towards creating and delivering lessons using computers was the most significant factor when analyzing the indirect and direct determinants from the TPB model. They discovered that attitude toward the behavior had the largest impact on intentions to use technology.

The research clearly shows that attitudes toward technology integration have an influence on preservice teachers' intentions to use the technology. Teo and Lee's (2010) research supports this trend; however, they also found that subjective norms were a significant predictor in their study of attitudes toward computer use. As with the other studies reviewed, perceived behavior control was not found to be a significant factor in technology integration behavior. However, Teo and Lee (2010) suggest that perceived behavioral control is significantly correlated to attitude and subjective norm. Although the research using TPB to predict technology integration overwhelmingly showed attitudes as being the strongest predictor of intended behavior, it is still important to consider the relationship between all three factors when looking at predicting behavioral intentions. That said, these theoretical foundations from TPB indicate that in terms of fostering positive attitudes and intentions toward using technology effectively and integrating it in teaching, it is important to allow for the development of positive

attitudes—as fostered by the kinds of support, communication, opportunities for learning and professional development that are the aim of the intervention in this study. In the next section of Chapter 2, I will explain a framework that will address the use of an online community to provide professional development for teacher educators.

Online Professional Development

There are a plethora of online resources for educators that are used on a regular basis by teachers at all levels. These resources often include sample lessons, videos, webinars, and other tools or experiences that support educators in a variety of contexts and content. This section will start by introducing professional learning networks (PLN) and how they are used as a form of online professional development for educators and then it will describe specific types of online communities that might be part of an individual teacher's PLN.

Professional learning networks (PLN) are a compilation of virtual learning spaces that include social media groups, online forums, and other digital collaboration spaces focused on professional learning (Krutka, Carpenter, & Trust, 2017). An educator creates his/her own PLN by connecting with a variety of online groups and digital resources that support their professional development. PLNs often include webinars, Twitter chats, and discussion forums that allow professionals to share ideas and collaborate around a variety of topics. An individual's creation of a PLN is self-driven and his/her participation could vary across the network. A key benefit of PLNs is that they can be used at the convenience of the participants and the interactions can be asynchronous or synchronous. Moreover, the participants are not limited by geography (Krutka, et al., 2017). They can

interact globally and locally through a PLN—allowing not only for flexibility but for social opportunities and a diversity of connections and resources.

There is scant research examining higher education faculty's use of PLNs as a regular form of professional development. Trust et al. (2017) found that a majority of faculty in higher education institutions use social media personally and about half of the faculty surveyed use social media professionally. Carpenter, Trust, and Krutka (2016) surveyed teachers and their use of professional learning networks. They found that PLNs were a source of support and professional growth. Teachers reported changes in their dispositions as a result of engaging in their PLN. Higher education faculty would likely experience the same types of benefits that classroom teachers reported in Carpenter et al.'s (2016) study.

Deissler, Ding, Neumann, and Kopcha (2015) studied school librarians and their use of PLNs to improve their technological skills. Similar to higher education faculty, school librarians are typically isolated. A typical school has one librarian, and they have few peers to collaborate with throughout their district. Like higher education faculty, school librarians must stay up to date on new technology and media literacy practices. There is a need for professional development, but also a lack of time, resources, and funding. Deissler et al. (2015) found that PLNs were an effective tool for school librarians to learn as well as gain fluency, experiences, and information related to technology skills and practices. Participants in their study noted that they learned about new technology devices and tools through their PLN. Moreover, they were able to access resources that helped them troubleshoot and solve problems that they had with

technology. Faculty could experience the same type of benefits by engaging in PLNs to support their development of technological knowledge.

Kelly and Antonio (2016) researched the support that teachers gain through the use of educator-focused open Facebook groups. They found that teachers are using sites to find support but are rarely engaging in reflective discussions about their teaching practices. They highlighted key elements of support and how they were or were not met through the use of online forums, such as large Facebook groups. Kelly and Antonio (2016) reported that Facebook communities served as a way for participants to share practical solutions and build relationships. They hypothesized that the small percentages of posts related to modeling and reflection were due to the open and large nature of the Facebook communities. The participants were relatively anonymous and lacked the close and trusting relationship needed to engage in reflection and in-depth sharing of teaching practices and challenges. This idea is supported by the work of Kim and Amahd (2013) where they found that trust-building was needed for successful sharing of online social-media content. Also, Lindsey (2015), in her second cycle of action research, found that using social media (specifically Edmodo) was an effective way to connect faculty members who taught the same technology-infused course, but were located on different campuses and unable to meet face-to-face. Her study also found that faculty used the social media group to ask questions and learn collaboratively.

Gareis and Nussbaum-Beach (2007) studied online mentoring for novice teachers and discovered that a majority of the participants benefited from the virtual support provided by their mentors and peers. They discovered that the content presented in the online forums consisted mainly of modeling from the mentors and shared experiences of

the participants to their peers. The content posted was balanced between mentors and participants which showed the reciprocal nature of the online mentoring community that was established. Unlike the online communities studied by Kelly and Antonio (2016), this online community was relatively small and balanced novice teachers with highly-qualified mentors. Moreover, their analysis of the online posts showed that the mentors and participants developed relationships which were represented by the large number of one-to-one posts made from novice teachers to a specific mentor. This highlights the importance of having expert participants in the online learning community. Also, there seems to be a value in having a smaller group of participants who will have opportunities to build trusting relationships. This will likely promote more reflective conversations and opportunities for mentor and peer modeling.

This literature supports the idea of using online communities to mentor and support educators in developing teaching practices and opportunities for peer collaboration and modeling. The research and theoretical frameworks outlined in this chapter were used to help shape the structure of my action research intervention. In the next chapter, I will describe my action research study and how an online community was established and studied to support higher education faculty and staff in their development of TPACK.

CHAPTER 3: METHODS

Chapter 2 outlined the theoretical underpinnings of this action research study and the research related to online professional learning. This chapter will describe the methods, research design, and instruments that were used in this mixed methods study.

Setting

The University-School Partnerships for the Renewal of Educator Preparation National Center (US PREP) is a technical support center that provides on-the-ground assistance to university-based teacher preparation programs which are working to advance the learning of their teacher candidates in order to ensure that they are classroom ready from "day one." There are seven universities partnered with US PREP and they are located in Texas, Louisiana, Tennessee, Kansas, and Mississippi. Although the university partners are spread-out geographically across the United States, US PREP uses virtual meeting spaces and travels on-site to engage the partners in professional development and collaboration.

In this study, Facebook was used as a virtual space to conduct the research and intervention. A private Facebook page was created to allow site coordinators and faculty from across universities to participate in learning about and collaborating around technology integration in instruction–all aimed at improving their TPACK and influencing attitudes, and thus behavior, with regard to technology and teaching and learning. Facebook was chosen as a platform because a majority of possible participants were already engaged in using this social media outlet for personal and work-related activities. Although many possible participants also had a Twitter account, the platform can be more difficult to use for posting large amounts of content due to the 280-character

limitation. Furthermore, it was not feasible to use a work-related social platform, such as Blackboard or Office 360 due to faculty being spread across a variety of institutions.

Participants

The participants of this study were 12 faculty volunteers from three universities. The participants' ages ranged from 35 to 64 years old. All of the participants were engaged in teacher preparation and either taught coursework, provided professional development to site coordinators and/or faculty, or served in an administration role in a teacher preparation program. The researcher invited site coordinators and faculty from across seven universities in the US PREP Coalition, as well as site coordinators from one university outside of the coalition. The invitation was sent to 20 possible participants. Given the time commitments and the benefits and also given a sense of the local context, it was anticipated that approximately 10-15 people would volunteer to be participants in the study and that they would have a wide range of experience with technology integration. This was accurate in that three participants had between 13-15 years of teaching experience and nine participants had over 16 years of teaching experience. Based on their survey responses, seven participants had minimal experience with technology integration, while three had some and two had ample experience integrating technology in their coursework or instruction. A majority of the participants were unfamiliar with the ISTE Standards for Educators and had minimal experience with the standards. Several of the participants had experience integrating technology in their coursework and supervising students in their implementation of technology integration; however, it was unclear if they explicitly made connection to the ISTE Standards for Educators, ISTE Standards for Students, or InTASC standards.

Role of the Researcher

This research study was designed as practical action research (Mills, 2011). Mills (2011) refers to "practical action research" as research that is focused on answering questions related specifically to one's context and/or to bring about change (p. 7). Therefore, as the researcher I played an active role, implementing the intervention and completing the data collection to improve my practice as a Regional Transformation Specialist. The research was focused on implementing change in order to facilitate opportunities for site coordinators and teacher educators to develop and apply their TPACK. As the researcher in this intervention, my role involved collecting data and reflecting on my local practice as a participant observer. I was also the facilitator of the online community and was involved throughout the research and data collection process.

Intervention

The intervention was created based on the research and theoretical framing presented in Chapter 2 around the use of PLNs and online communities to support teacher professional development around TPACK, as well as aiming to change attitudes and behaviors in alignment with the theory of planned behavior. Using a virtual space for the intervention was essential for the setting and context of this research study. The participants were spread across different institutions in various states and had a variety of schedules that would not allow for face-to-face or regular synchronous meeting times.

An online community allowed all the participants to engage in professional development through a virtual format that was synchronous and asynchronous. Moreover, it allowed for experts to join to share content and expertise that might otherwise be unavailable in a traditional professional development setting. One expert

was invited to facilitate a webinar and provided additional resources throughout the course of the intervention. Her participation added to the facilitation of the group, but she was not counted as an active participant in the data collection.

Using modeling by the facilitator and peers, this intervention helped to provide a clear illustration of technology integration and will gave opportunities for participants to discuss common examples. Moreover, the instruction provided in this intervention was enhanced by purposeful and meaningful uses of technology to collaborate. The benefits of technology integration were experienced by the site coordinators through their participation in the online community and the intervention modeled how to create a more collaborative, creative, and transformative learning environment.

Appendix H outlines the overall structure, procedures, and content of the intervention during each phase.

Phase 1

At the beginning of Phase 1, I established the closed Facebook page and posted an introduction to the group, including the purpose, expectations, and norms of the group. An email was sent to invite teacher educators to join the community. The email included the introduction and details about the content that would be covered during the intervention. Teacher educators were asked to attend an invitation webinar to learn more about the online community and how they can volunteer to be participants in the study.

The purpose of the online community was communicated to the prospective participants as a support system in helping them to develop the knowledge and skills necessary to create more collaborative, creative, and transformative learning environments, which will help them to model and support pre-service teachers in their

use of technology in K-12 classrooms. The group members were asked to participate weekly in the group by watching the webinars, posting ideas or reflections, and/or commenting on other members' posts. The value of the online community would come from the active participation of the members, so everyone was encouraged to engage with the group as often as possible during the intervention. The following norms were introduced during the invitation were later posted in the online community introduction:

- Participate regularly to share your ideas with others. The value of the online community will come from the active participation of all the members.
- Be willing to be vulnerable and work outside of your comfort zone with technology. Respect that other community members are being vulnerable and will need encouragement and support.
- Respect the privacy of the online community and do not share or post material to other sites or share with people outside of the group.
- Be conscious of the limits of written communication and think carefully about posts that are made to members of the community. Also, assume the best when reading the comments and posts of participants in the community.
- Direct specific questions or concerns about the online community to the facilitator through a private message or email.
- Have fun and enjoy sharing and learning with teacher educators from across the country!

At the end of Phase 1, participant signatures were collected, and they were invited to join the closed Facebook page via email or a Facebook invitation.

Phase 2

Phase 2 began with a kick-off webinar that was recorded for participants who could not join live. Participants were introduced to the major goals of the online community and the TPACK framework to aid participants in thinking about levels of technology use. Participants were given multiple examples of technology integration at various levels and were encouraged to create goals related to technology integration that stretched them beyond their current technology use. During the session, the facilitator highlighted the connections to InTASC standards and state requirements for technology integration. Also, information about the TETCs were provided. Participants were asked to reflect on their current practices and set goals for their integration of technology. The facilitator posted resources and questions that to prompt further discussion after the webinar.

The next part of Phase 2 included a webinar led by Dr. LeeAnn Lindsey, a member of the core team that developed the ISTE Standards for Educators in 2017. She joined as a guest speaker to share the new ISTE Standards for Educators and the ISTE Standards for students and discussed how to model and/or use the ISTE standards in instruction. Participants were encouraged to discuss the benefits and challenges of using the ISTE Standards for Educators. Resources and videos that supported the group's application of their new learning were shared. Participants were encouraged to set goals for their exploration of new technology and pedagogical approaches and also to research ways in which technology is being used to enhance student learning.

Phase 3

In Phase 3, participants were guided to explore new technology and collaborate to use technology to create engaging and authentic learning experiences. This connects to ISTE Educator Standard 4: Collaborator and ISTE Student Standard 1: Empowered Learner. The facilitator modeled creating a collaborative environment where teacher educators could work together to plan and explore ways to leverage technology in their instruction. Phase 3 began with a screencast (pre-recorded) that outlined the exploration task for the week. Participants were asked play with a tool or technology resource. They were asked to try the new tool in their instruction and share an artifact about the new technology resource that they used. The participants were asked to share what went well or what did not go well. In the second part of Phase 3, participants collaborated with their peers to examine ways that new technology helped or did not help in their instruction. Throughout Phase 3, the facilitator posted additional examples and resources to keep the collaboration active.

Phase 3 continued with a deep look at ISTE Educator Standard 4: Collaborator. The participants were encouraged to look for ways to engage their students in collaboration about technology tools or use a collaborative technology tool for their students to share ideas about course content. The facilitator posted links to various virtual platforms for teacher educators to use to promote collaboration in their instruction and coursework.

The next portion of Phase 3 focused on using technology to enhance specific content. The participants were encouraged to play with new technology that enhances specific content areas. A post was made by the facilitator for each of the four major

content areas (math, language arts, science, and social studies) and participants were asked to share other resources and technology tools that could be used to enhance content instruction and student learning.

The final webinar in Phase 3 presented ways to use technology to assess student learning and prompt students to reflect on their learning. This webinar made connections to ISTE Standard 7: Analyst where educators are encouraged to find a variety of ways to engage students in demonstrating their learning. Participants were asked to share tools and reflections representing their use of technology to assess students or aid in student reflection on learning. For example, the facilitator posted resources such as online portfolios, Flipgrid, Kahoot!, and other online assessment tools.

Phase 4

The final posts in the online community focused on the participants and their experiences in the online group. Participants were asked to share resources, tools, and ideas that were prompted by their engagement in the online community. They were also encouraged to share ways in which they plan to use technology to enhance their instruction and student learning in the future.

Phase 4 concluded with the facilitator asking for volunteers to participate in interviews. Six participants were selected from the community based on observable participation in order to get a more varied sampling of experiences. The identified participants were contacted via email to set up a virtual meeting time for the interview. All the participants were sent the link to the pre-intervention and post-intervention retrospective survey via email.

Evaluation and Instruments

This action research study was a mixed methods study. Ivankova (2015) explains the benefits of using both quantitative and qualitative data to gain a deeper insight into a particular problem or answer complex questions. "Mixed methods research capitalizes on the fact that qualitative and quantitative research approaches are complementary in nature" (Ivankova, 2015, p. 4). In this study, data was collected from both qualitative and quantitative sources in order to better understand teacher educators' development of TPACK and their attitudes and beliefs about technology integration. The next section will outline the measures that were used in this action research project.

Instruments and Data Analysis

There were multiple measures used to help answer the research questions in this study. The first section will outline the qualitative measures that were used, and the final section will discuss the quantitative measures.

Qualitative Measures

There were two qualitative measures that were used in this action research study. The first measure was the observation and analysis of posts, artifacts, and reflections from the online community. The second measure was interviews conducted with six of the online community participants.

Observation (See Appendix D). Participant observation was used to collect data from the online group. The closed Facebook page only included individuals who consented to be part of the research study. I participated in the online group, while recording observations of the online participants, which included posts, interactions, and

other online behaviors. A copy of all the posts and comments in the Facebook community was saved to allow for data analysis and coding.

I also typed field notes that include reflections on my experience and research process in a password protected Word document. All of the observations that were collected or referenced in the Word document were reviewed and hand-coded using descriptive coding.

Coding. Saldaña (2013) explains that descriptive coding can be used to help categorize and label qualitative data, especially large quantities of a variety of data (pp. 71, 292). The following codes were selected in alignment with the TPACK framework and the research questions of this study to help organize the observational data.

Context (C): references to or evidence of macro (societal or political context), meso (school or organizational context), or micro (classroom and learning environment).

Technological Knowledge (TK): references to or evidence of the participants' knowledge of various technologies—including knowing their purpose and how to use them.

Content Knowledge (CK): references to or evidence of the participants' understanding and demonstrating proficiency in the content that is to be taught.

Pedagogical Knowledge (PK): references to or evidence of the participants' understanding of teaching methods and skills, such as lesson planning, classroom management, differentiation, and teaching strategies.

Pedagogical Content Knowledge (PCK): references to or evidence of the participants' combination of both content knowledge and pedagogical knowledge to implement specific pedagogical methods to best teach content.

Technological Content Knowledge (TCK): references to or evidence of the participants' integration of knowledge of various technologies to be able to choose technology resources that best teach/enhance the content.

Technological Pedagogical Knowledge (TPK): references to or evidence of the participants' ability to emphasize the use of technology to enhance teaching practices and methods.

Technological Pedagogical Content Knowledge (TPACK): references to or evidence of the participants' ability to combine of all the sets of knowledge in a tapestry of expertly woven teaching methods, content, and technology to most effectively teach any content or skill.

Attitudes Teacher Educator (A-T): references to or evidence of the teacher educators' attitudes about using technology to enhance instruction.

Attitudes Student Teacher (A-S): references to or evidence of the student teachers' attitudes about using technology to enhance instruction.

Behaviors Teacher Educator (B-T): references to or evidence of the participants' behaviors related to using technology to enhance instruction.

Behaviors Student Teacher (B-S): references to or evidence of the student teachers' behaviors related to using technology to enhance instruction.

Play (P): references to or evidence of the participants' playing with new technology.

Once the data was coded, it was manually categorized into sections in a password protected Word document. Considering the large amounts of data that were collected in the online community, descriptive coding helped to categorize the data into basic topics

for further analysis. Saldaña (2013) provides examples of how descriptive coding can help determine changes in participants over time. This was helpful for answering the questions presented in this research study.

Post-intervention interviews (see Appendix C). The overarching purpose of the interviews was to gather information about the experience of the teacher educators in the online community, their attitudes and beliefs about technology integration, and their perceptions of TPACK development. The interviews took place after the intervention.

Six teacher educators were selected from the online community to participate in one-on-one interviews. The participants were selected using maximal variation sampling. Creswell (2015) describes this type of purposeful sampling as a way to get a variety of perspectives from participants. A particular trait or set of characteristics is used to select participants that differ (Creswell, 2015, pp. 205-206). In this study, participants were selected based on their differences in observable engagement in the online community. An equal number of participants were chosen from groups that were organized by the number of observable interactions in the online group. Number of posts, involvement in the webinars, and number of likes or comments were used to categorize the participants by their engagement. Two participants from each category were selected to participate in the interviews. Table 1 presents details related to the six participants who were interviewed.

Table 1

Interview Participants' Engagement in the Online Community

Participants	Comments	Likes	Original Posts	Webinar Participation	Total Observable Interactions
Veronica	10	13	2	0	25
Gwen	11	5	3	2	21
Joslyn	4	8	1	0	13
Sara	5	0	0	0	5
Diana	2	2	0	1	5
Audrey	0	0	0	0	0

The interviews were conducted using the recruitment consent form and introduction located in Appendix C. The interviewer set-up interview times with each of the participants. The interviews took place in a virtual meeting space, OfficeSuite HD Meeting. The interviews started with the introduction and presentation of the recruitment consent form. After the participant gave verbal consent, the interviewer recorded the complete interview. The interviewer used semi-structured interview questions (see Appendix C) and asked follow-up questions, as needed. The interviews lasted approximately 30-40 minutes. The introduction was used to inform interviewees about participation and confidentiality.

The audio-recordings were transcribed and coded to uncover emerging themes, patterns, and contrasts. A holistic approach to coding the data was used, looking for recurring words, phrases, or perceptions related to the participants' attitudes and beliefs about technology integration and their TPACK development (Saldaña, 2013, p. 165).

Open coding was used to identify words, phrases, or concepts salient in the data. Rossman and Rallis (2017) state that, "Holistic analysis is especially useful when you want to capture a person's experience in a setting" (p. 232). The coding of the data was intended to capture the participants' attitudes and beliefs about technology integration and their TPACK development.

In the first stage of coding, I looked for meaning units and then hand-coded each meaning unit. Throughout the coding process, I reviewed the codes to ensure consistency. Once the first two participants are coded, I used axial coding to create categories—looking for the words, phrases, or concepts that were most salient. After creating categories, I reviewed the data to make sure that all of the codes are represented appropriately through the axial coding. I shared the coding with a colleague to review and look for consistency and any unforeseen bias. Rossman and Rallis (2017) encourage researchers to use colleagues or peers as critical friends to help improve the quality of the research and expand upon one's thinking (pp. 53-54). Next, I continued the process with the remaining participants. The codes and axial codes were compared and combined to ensure that the categories are consistent with all the data. These were then categorized into themes, which are the larger meaning units developed based on the patterns found in the codes. A chart was created to list the themes and the components of the theme. These theme-related components consisted of the axial codes that were combined and categorized to generate the theme. Then, assertions were made based on the themes and theme-related components. The assertions are beliefs that the researcher developed based on the overall theme and theme-related components.

Quantitative Measures

In addition to the session posts, comments, and reflections, a survey was used to measure the participants' overall TPACK and attitudes and beliefs about technology integration. The survey was sent to participants via email using Qualtrics.

Survey (See Appendix B). The pre- and post-survey consisted of 72 items compiled from a Sadaf, Newby, and Ertmer (2012) survey intended to measure attitudes towards technology infusion and a Schmidt et al. (2009) survey intended to help determine teacher educators' levels of TPACK. Six of the survey items were selected from the attitudes section of the Sadaf et al. (2012) survey. "Web 2.0 technologies" was replaced with "integrating technology" to modify the items to match this action research project. There were 48 items included from the Schmidt et al. (2009) survey. Four items were added to gather perceptions about playing with technology and seven open-ended questions were asked to ascertain information about the participants' contexts and experiences related to integrating technology. Finally, seven demographic questions were asked at the end of the survey. The majority of the questions were assessed on a 4-point Likert scale ranging from *strongly agree* to *strongly disagree* (see Appendix B for survey).

A pre-survey was administered to the participants prior to the start of the online community. However, due to a survey design error which missed the creation of a participant identification code, I was unable to link pre and post survey results. Due to the length of the survey and the time needed for participants to complete the items, I decided to not re-administer the pre-survey. Instead, I chose to use a retrospective pre-

survey at the end of the intervention to gather pre- and post- perceptions from the participants.

Although the data from the original pre-survey could not be linked to the participants' post-survey results, the data from the pre-survey is included in Chapter 4 to give a better picture of the participants' pre-intervention perceptions using the aggregate data.

The data from the surveys was scored using summed scores for nine constructs: Beliefs, Play, TK, CK, PK, PCK, TCK, TPK, and TPACK. These constructs were created in SPSS by combining questions from the sections already labeled in the original Sadaf et al. (2012) and a Schmidt et al. (2009) surveys. The items were organized by topic in order to develop the nine constructs. The constructs are listed in Table 2, along with the survey items that were combined to create each construct in SPSS. Individual survey items can be seen in Appendix B. The data was analyzed using IBM SPSS Statistics for Windows to find trends and outcomes that point to relevant results and implications in the data using descriptive statistics. A *t*-test statistics matrix was created and used to analyze the statistical difference between the nine constructs.

Reliability Data for Retrospective Survey

This section will detail the reliability of the survey. Fraenkel and Wallen (2005) state that, "Reliability refers to the consistency of the scores obtained-how consistent they are for each individual from one administration of an instrument to another and from one set of items to another" (p. 160). In order to look at reliability, Cronbach's Alpha was calculated using IBM SPSS Statistics for each construct (Beliefs, Play, TK, CK, PK,

PCK, TCK, TPK, and TPACK) and, then, for the overall survey. The results are presented in Table 2 and discussed further below:

Table 2

Teacher Educator Beliefs and Technological Pedagogical Content Knowledge

Construct	Within Construct Item Numbers	Retrospective Pre-Coefficient Alpha Estimate of Reliability	Post-Coefficient Alpha Estimate of Reliability
Construct 1: Beliefs about Technology	1 - 6	.812	.638
Construct 2: Beliefs about Playing with Technology	7 - 10	.644	.701
All of Beliefs	1 - 10	.817	.812
Construct 3: Technology Knowledge	18 - 24	.949	.874
Math Content Knowledge	25 - 28	.994	.988
Social Studies Content Knowledge	29 - 31	.950	.922
Science Content Knowledge	32 - 34	.985	.966
Literacy Content Knowledge	35 - 37	1.000	.984
Construct 4: Content Knowledge	25 - 37	.969	.911
Construct 5: Pedagogical Knowledge	38 - 44	.942	.911
Construct 6: Pedagogical Content Knowledge	45 - 48	.715	.544
Construct 7: Technological Content Knowledge	49 - 52	.878	.734
Construct 8: Technological Pedagogical Knowledge	53 - 57	.981	.907
Construct 9: Technological Pedagogical Content Knowledge	58 - 65	.972	.904
All Constructs	1-10, 18-65	.959	.943
All Constructs	1-10, 18-65	Both pre- and post- items .973	

Note: n = 11.

The overall coefficient alpha estimate of reliability for the post-survey was .943; however, there were a few constructs that had low scores that indicated there could be issues with reliability in the items. For example, in the post-survey Construct 1: Beliefs about Technology and Construct 6: Pedagogical Content Knowledge scored .638 and .544 respectively. This was particularly interesting because the data collected in the pre-retrospective survey was .812 for Beliefs about Technology. Moreover, Pedagogical Content Knowledge scored a .715 in the pre-survey. This demonstrated that there were inconsistencies in reliability for those constructs. Although there were a few items that were possibly less reliable, the construct scores maintained a good internal consistency.

Overall, the survey had a coefficient alpha estimate of reliability that was .959 for the pre-retrospective items and .943 for the post-retrospective items, which is considered to be an acceptable level of reliability. Also, when both pre- and post- items were combined the coefficient alpha estimate of reliability was .973. The repetitive nature of the TPACK survey items could be responsible for this; however, each item measures a slightly different piece of knowledge that is necessary for measuring the TPACK framework.

Threats to validity. In addition to the threats mentioned above, several additional procedures were used to reduce these threats. Reducing the threats to validity of this study were achieved through the collection of multiple sources of data and careful comparison of these data during analysis for triangulation. Rossman and Rallis (2017) argue that using multiple data points provides a better understanding of what is being studied and promotes looking at issues from a broader perspective (pp. 54-55). Understanding my own biases and how they may affect a study's results is critical to the

validity of the study. Rossman and Rallis (2017) discuss the importance of considering assumptions and how they can influence the interpretation of data (p. 25). To decrease bias, I disclosed my role to my participants and triangulated the data.

CHAPTER 4: DATA ANALYSIS AND RESULTS

In Chapter 4, I review the analysis and results of the qualitative and quantitative data from this action research study. The study was guided by the following research questions:

RQ #1: How and in what ways do teacher educators develop TPACK while participating in a facilitated online community focused on technology integration?

RQ #2: How do teacher educators utilize play as they develop TPACK?

RQ #3: How does facilitator and peer modeling influence teacher educators' development of TPACK?

RQ #4: How are teacher educators' attitudes and beliefs about technology integration influenced by their participation in a facilitated online community?

The results are organized according to research question, with the quantitative data being presented first for each question, followed by the qualitative data.

Comparison of Pre-Survey Results to the Retrospective Pre-Survey Results

Since the original pre-survey that was administered for this study did not include the question to code participant responses, the results of the pre-survey were not able to be matched to the post-survey results. Therefore, this section will present a comparison of the mean scores from the original pre-survey to the mean scores of the retrospective pre-survey for each of the nine constructs to highlight any similarities or differences between these data. These results are presented to better illustrate the perceptions of the participants prior to participating in the online community. The mean scores were calculated by adding the response values for each item in the construct and then dividing the sum by the total number of responses for the items in the construct. The following

response values were used to calculate the mean scores: S*trongly Agree* = 4, Agree = 3, *Disagree* = 2, and *Strongly Disagree* = 1. It should be noted that the pre-survey had responses from all 12 participants and the retrospective survey had responses from only 11 of the 12 participants.

Table 3

Pre-Survey Mean Scores and Retrospective Pre-Survey Mean Scores

Construct	Within Construct Item Numbers	Pre-Survey Mean Score	Retrospective Pre-Survey Mean Score
Construct 1: Beliefs about Technology	1 - 6	3.44	3.22
Construct 2: Beliefs about Playing with Technology	7 - 10	3.42	3.18
All of Beliefs	1 - 10	3.43	3.21
Construct 3: Technology Knowledge	18 - 24	2.48	2.33
Math Content Knowledge	25 - 28	2.92	2.84
Social Studies Content Knowledge	29 - 31	2.61	2.54
Science Content Knowledge	32 - 34	2.77	2.69
Literacy Content Knowledge	35 - 37	3.25	3.27
Construct 4: Content Knowledge	25 - 37	2.89	2.83
Construct 5: Pedagogical Knowledge	38 - 44	3.45	3.42
Construct 6: Pedagogical Content Knowledge	45 - 48	2.87	3.27
Construct 7: Technological Content Knowledge	49 - 52	2.42	2.40
Construct 8: Technological Pedagogical Knowledge	53 - 57	2.73	2.41
Construct 9: Technological Pedagogical Content Knowledge	58 - 65	2.59	2.53
All Constructs	1 - 10, 18 - 65	2.91	2.75

Note. n = 12 for pre-survey and n = 11 for retrospective pre-survey.

The mean scores show that participants had fairly consistent responses between the pre-survey and the retrospective pre-survey. Although there are slight differences in the means of the various constructs, the overall construct means show that the participants'

perceptions about their ability, beliefs, and skills prior to the intervention stayed fairly consistent across both measures. Therefore, I made the decision to present the remaining results using the retrospective pre-survey results. Although several constructs had slightly higher mean scores on the pre-survey, I made the decision to use the retrospective pre-survey results that included the paired responses of 11 of the 12 participants. This would ensure that the same 11 participants' responses were being compared in the final data. Moreover, the retrospective pre-survey allowed the participants to respond to the items with a similar frame of reference and understanding of the overall concepts, helping to avoid participants' possible overestimation of their abilities and skills prior to their experience in the intervention.

Data Collection Summary

In this section, the quantitative and qualitative data collected in the study is organized according to the research questions. The retrospective survey, post-survey, observations of the online community, and post-intervention interviews are intended to triangulate to help answer the research questions. Therefore, portions of all these data will be presented in the following research question sections.

Quantitative Data for RQ #1 on Participants' Development of TPACK

> Research Question #1: How and in what ways do teacher educators develop TPACK while participating in a facilitated online community focused on technology integration?

Table 4 displays the response frequencies for three items related to TPACK prior to participation in the online community. To calculate the response frequencies the following tables, the total number of response types (e.g. *Strongly Agree, Agree, Disagree,* and *Strongly Disagree*) for each item was divided by the total number of

responses in all the response types for each item. This calculation shows the percentage of response types for each item. The survey prompts in Table 4 focus on the participants' perceptions of their ability to select and use technology to enhance their instruction prior to the intervention.

Table 4

Retrospective Pre-Intervention Response Frequencies for Items 62, 63, and 65

Item	Strongly Agree	Agree	Disagree	Strongly Disagree
Item 62. I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn.	18.2%	27.3%	45.5%	9.1%
Item 63. I can use strategies that combine content, technologies, and teaching approaches that I learned about in professional development opportunities in my classroom.	9.1%	36.4%	45.5%	9.1%
Item 65. I can choose technologies that enhance the content for a lesson.	18.2%	36.4%	36.4%	9.1%

Note. n = 11.

The frequencies show that participants had fairly low confidence in their ability to select and use technologies to enhance their teaching before participating in the online community. In fact, 45.5% of the participants disagreed that they were able to select technologies to enhance what they taught, how they taught, and what students learned (Item 62). The same percentage of participants disagreed that they could use strategies

that combine content, technologies, and teaching approaches that they learned about in professional development opportunities in their classroom (Item 63). Table 4 displays the response frequency for eight items within the TPACK section of the retrospective survey. This information details the perceptions of the participants after participating in the online community related to TPACK and their ability to use content, technology, and teaching approaches appropriately.

Table 5 displays the response frequency for eight items within TPACK section of the retrospective survey. This information details the perceptions of the participants after participating in the online community related to TPACK and their ability to use content, technology, and teaching approaches appropriately.

Table 5

Technological Pedagogical Content Knowledge Post-Intervention Survey Response Frequencies (TPACK)

Item	Strongly Agree	Agree	Disagree	Strongly Disagree
Item 58. I can teach lessons that appropriately combine literacy, technologies, and teaching approaches.	36.4%	45.5%	18.2%	0%
Item 59. I can teach lessons that appropriately combine mathematics, technologies, and teaching approaches.	0%	90.9%	9.1%	0%
Item 60. I can teach lessons that appropriately combine science, technologies, and teaching approaches.	0%	81.8%	18.2%	0%
Item 61. I can teach lessons that appropriately combine social studies, technologies, and teacher approaches	9.1%	72.7%	18.2%	0%
Item 62. I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn.	36.4%	54.5%	9.1%	0%
Item 63. I can use strategies that combine content, technologies, and teaching approaches that I learned about in professional development opportunities in my classroom.	36.4%	63.6%	0%	0%
Item 64. I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my place of work, school and/or district.	27.3%	36.4%	36.4%	0%
Item 65. I can choose technologies that enhance the content for a lesson.	45.5%	45.5%	9.1%	0%

After their participation in the online community, the survey response frequencies of the TPACK section of the survey show that participants felt the most confident about choosing technologies to enhance the content of a lesson (Item 65). A majority of the participants strongly agree (45.5%) or agree (45.5%) with this item, which is closely followed by their responses to Item 63. This item indicates that participants are confident about their ability to use strategies that combine content, technologies, and teaching approaches that they learned from professional development opportunities. All of the participants strongly agree (36.4%) or agree (63.6%) with this item. The responses to Item 62 also illustrate the participants' confidence with selecting technology that enhances what they teach, how they teach, and what students learn. Only one participant disagreed with this item and the rest strongly agree (36.4%) or agree (54.5%). These items suggest that a majority of participants feel confident in selecting and using technology in their lessons after participation in the intervention. Comparing these specific items from before and after participation on the intervention demonstrate a change in the participants' perceptions related to selecting and using technology to enhance instruction. It is evident that the participants felt more strongly about their abilities to integrate technology after they engaged in the online community. Moreover, only a small percentage felt that they could not choose technologies that enhance the content for a lesson. There was a definite shift in the participants' feelings about their ability to choose and combine strategies and technologies to enhance their content after participating in the intervention.

In the next section, the descriptive statistics will be presented for the retrospective survey items related to participants' development of TPACK. The responses to the

survey items were translated into numerical form in order to calculate the mean for the items within the various sub-constructs. Responses for *strongly agree* were coded as four, *agree* was coded as three, *disagree* was coded as two, and *strongly disagree* was coded as one. In the following tables, the mean score was calculated for each item by finding the sum of the responses for each item and dividing it by the total number of responses. Then, the difference in the means was calculated by subtracting one mean from the other and finding the absolute value of the difference. These calculations were done using IBM SPSS Statistics for Windows and are displayed in Table 6.

Table 6

Technological Pedagogical Content Knowledge Survey Descriptive Statistics (TPACK)

Item	Retrospective Pre-Survey Mean	Post-Intervention Mean	Difference in Means
Item 63. I can use strategies that combine content, technologies, and teaching approaches that I learned about in professional development opportunities in my classroom.	2.45	3.36	.91
Item 65. I can choose technologies that enhance the content for a lesson.	2.64	3.36	.72
Item 62. I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn.	2.55	3.27	.72
Item 58. I can teach lessons that appropriately combine literacy, technologies, and teaching approaches.	2.64	3.18	.54
Item 61. I can teach lessons that appropriately combine social studies, technologies, and teaching approaches.	2.45	2.91	.46
Item 59. I can teach lessons that appropriately combine mathematics, technologies, and teaching approaches.	2.55	2.91	.36
Item 64. I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at my place of work, school and/or district.	2.45	2.91	.46
Item 60. I can teach lessons that appropriately combine science, technologies, and teaching approaches.	2.55	2.82	.27

Note. n = 11.

The mean scores for the majority of the items show similar results to Tables 3 and 4. After participation in the online community, the participants believe that they can select technologies and use strategies to enhance their lessons (Items 62, 63, and 65). Participants are less confident in their ability to teach lessons that combine appropriate sub-specific content, technologies, and teaching approaches, and these responses stayed fairly consistent between the pre- and post-intervention items. In response to Item 64, participants do not feel confident providing leadership to help others learn to use content, technologies, and teaching approaches in their workplace. Overall, these data suggest that participants gained confidence in using strategies and choosing technology to enhance the content and instruction after participating in the online community.

In the next section, descriptive statistics will be shared for the nine constructs in the survey. Specific constructs related to the participants' development of TPACK will be highlighted. Table 7 presents the descriptive statistics for the overall constructs on the pre-retrospective and post-intervention survey. In the following tables, the mean score was calculated for each construct by finding the sum of the responses for all the items within the construct and dividing it by the total number of responses in the construct. Then, the difference between the construct means was calculated by subtracting one mean score from the other and finding the absolute value of the difference.

Table 7

Descriptive Statistics of Each Overall Construct

Item	Retrospective Pre-Survey Mean	Post-Intervention Mean	Difference in Means
Construct 1: Beliefs about Technology	3.22	3.61	.39
Construct 2: Beliefs about Playing with Technology	3.18	3.86	.68
Construct 3: Technological Knowledge	2.33	2.98	.65
Construct 4: Content Knowledge	2.83	2.97	.14
Construct 5: Pedagogical Knowledge	3.42	3.67	.25
Construct 6: Pedagogical Content Knowledge	3.27	3.38	.11
Construct 7: Technological Content Knowledge	2.40	2.95	.55
Construct 8: Technological Pedagogical Knowledge	2.41	3.16	.75
Construct 9: Technological Pedagogical	2.53	3.09	.56

Note. n = 11.

These data indicate that participants have stronger beliefs about their abilities in each of the nine constructs after the intervention. However, the differences between the means of the pre- and post- of Construct 4 and Construct 6 were very small. Considering the participants were all veteran teachers with at least 13 years of experience in education, it could be assumed that their content knowledge and pedagogical knowledge were already well established. This is supported by further data illustrating that each participant perceived themselves as very strong in at least one content area. Also,

Construct 5 and Construct 6 had the highest mean score on the pre- and post- surveys, with very little change between the two. Since the participants had ample years of experience in education and were all teacher educators, it is not surprising that they would have strong confidence in their pedagogical skills.

There were larger differences between pre- and post- survey means *in Constructs 2, 3, and 8.* This illustrates that the intervention was successful in positively impacting the participants' perceptions of their ability to implement various aspects of technology integration and their beliefs about playing with technology. In particular, the participants' perceptions of their Technological Pedagogical Content Knowledge (Construct 9) changed from a mean of 2.53 on the pre- to a mean of 3.09 on the post-intervention items. These data show that participants gained confidence in selecting appropriate technologies and strategies to teach various content and enhance student learning. Also, the participants' perceptions of their Technological Pedagogical Knowledge (Construct 8) changed. They became more confident in their ability to use technology to enhance their teaching practices and methods. They, also, have a stronger understanding of how to integrate their knowledge of various technologies to choose technology resources that best teach/enhance the content (Construct 7). Moreover, the mean score for Construct 3: Technological Knowledge increased from 2.33 to 2.98, which illustrates growth in the participants' knowledge of various technologies and how to use them. These data address research question #1 by reflecting the ways that the participants' development of TPACK increased through their participation in the online community.

Qualitative Data for RQ #1 on Participants' Development of TPACK

Qualitative data related to how and in what ways teacher educators develop TPACK while participating in a facilitated online community will be presented using data collected from the online community observations and post-intervention interviews. Table 8 presents the themes, theme-related components, and assertions that relate to the participants' development of TPACK through their participation in the online community. The themes are the larger meaning units developed based on the patterns found in the codes. The theme-related components consist of the axial codes that were combined and categorized to generate the theme. Then, the assertions illustrate the facts and/or beliefs developed by the researcher based on the themes and theme-related components.

Table 8

Themes, Theme-Related Components, and Assertions

Themes	Theme-Related Components	Assertions
Creating personal goals or commitments to integrate technology	Participants created personal goals, plans, or made commitments to implementing or integrating technology. Participants referenced personal accountability to implementing new learning.	Participants set personal goals, plans and commitments to integrate technology and viewed their participation in the group as a form of accountability.
Using technology to enhance content and instruction	Participants used new technology to enhance current curriculum or regular activities as a result of participation in the group. Participants' familiarity with content allowed for focusing on technology integration.	Participants in the online community used new technology to enhance their content and instruction.
Participation in the online group depended on various factors	Participation in the group was encouraged by easy access to a user-friendly group platform. Participation depended on whether the content was relevant to participants' role or work context.	Participation in the online group was encouraged by easy access to the platform, personal connections to and relevance to the participants' context.

Creating Personal Goals or Commitments to Integrate Technology

Participants set personal goals, plans, and commitments to integrate technology and viewed their participation in the group as a way to stay accountable. Responses from the post-intervention interviews were used to support the two theme-related

components (a) participants created personal goals and plans or made commitments to implementing or integrating technology, and (b) participants referenced personal accountability to implementing new learning.

Participants created personal goals and plans or made commitments to implementing or integrating technology. Four of the six interview participants talked about their commitments, plans, or goals to integrate technology while participating in the online group. Five of the six participants discussed how the online group benefited them and helped them to gain new ideas for integrating technology. Audrey did not benefit from the group but shared how her lack of participation was a missed opportunity, "I had every intention [of participating], but I wasn't able to put it into practice." Audrey also stated, "I should have paid more attention [to the online community], it was my short sightedness and it was me not engaging at the level I could have." Audrey had no observable interactions in the online group but expressed that she viewed a few posts and had a colleague who participated, so she was aware of some of the content that was being shared in the online group. However, she felt that it was not relevant to her current role. Audrey said, "I didn't feel at the moment it was something that I could use right away." She was the only participant out of the 11 who responded to the survey that did not teach a course or facilitate professional development in a teacher preparation program. Audrey has been working in education for 17 years and most of that time has been spent working as an instructor and leader in a university college of education program that graduates approximately 400 teacher candidates a year. Audrey describes herself as being interested in technology integration, but not competent at using technology to enhance her instruction. She liked the idea of joining the group to learn more about technology

but found that her role in leadership did not lend itself to playing with and integrating technology.

Sara has been in education for 25 years. She is currently a math instructor and leader at a relatively large university. She has been in higher education for 10 years and through her interview it became clear that she was very invested in learning more about technology integration. In her interview she elaborated on the work she had done while participating in the online community. Although she had a small amount of observable participation in the online group (5 total interactions), she shared the goals and plans she made for herself during the intervention. Sara said the following:

> I did read every post and make a goal for myself that every time a certain piece of technology was suggested, I at least looked at every piece of technology that was suggested, and then made a note to myself of how I thought I might use it, even if that note was, "I have no idea how I'm going to use this, but I'm going to come back around to it later and look at it again."

Sara also stated that, "I had to make an active goal of engagement. Engage in this, commit to looking at every suggestion, commit to at least thinking about how you might use everything." She shared that her participation in the group helped prompt a mind shift that she shared with her group of college students in her class, "What I told them was my personal professional goal for this year is to use technology better."

Participants referenced personal accountability to implementing new learning. Veronica was one of the most observably active participants in the online group (25 total observable interactions). She has been teaching for 20 years and spent 10 of those years working as a clinical assistant professor in a university college of education program that graduates over 1,000 teacher candidates a year. She has been engaged with technology integration projects in the past and would consider herself

knowledgeable about various technologies. In the interview, she talked about how the online group caused her to hold herself accountable to integrating technology,

> I saw the other posts, I thought, "Okay, I need to step up to this. I know what my goals are. I know what my intent is. This is another layer of accountability for me, and I can share with this safe environment."

Veronica felt that the online group benefited her in several ways. She stated that, "It [participation in the online community] gave me more confidence. It inspired me. And honestly, it was fun, fun trying these new things, and exciting to see how these tools enriched the lessons."

Diana observably interacted in the online group five times. She has worked in higher education for over five years and has been in education for close to 12 years. She describes herself as being comfortable with technology integration and has had opportunities to be engaged in technology integration projects in her former role as a site coordinator at a relatively large university. She stated that, "I think of it as a responsibility to integrate [technology] as much as possible in comfortable ways that don't stress people out." She used the online community as a resource for trying the ideas on her own. She stated that, "I tend to be very open-minded and willing to try new things." She expressed how she used ideas from the group and implemented them in her own context.

Using Technology to Enhance Content and Instruction.

Participants in the online community used new technology to enhance their content and instruction. Responses from the post-intervention interviews and online community observations were combined to support the two theme-related components (a) participants used new technology to enhance current curriculum or regular activities as a

result of participation in the group, and (b) participants' familiarity with content allowed for focusing on technology integration.

Participants used new technology to enhance current curriculum or regular activities as a result of participation in the group. Throughout the online community, participants posted or commented on content referencing new technology that they were using to enhance their instruction. For example, Diana posted, "Loved your webinar on using Piktochart a few weeks ago! I used it to create some infographics for a recent session I facilitated at our national conference." Also, Gwen posted pictures of her students using https://app.edu.buncee.com/ to develop student-centered activities for their instruction. Gwen is an enthusiastic site coordinator who has been working in education for 21 years. She has been employed by a college of education for over 13 years and works closely with teacher candidates during their full year of student teaching. She is eager to learn new things to implement in her coursework and expressed her excitement about engaging in the online community to find new resources and tools to use in her instruction.

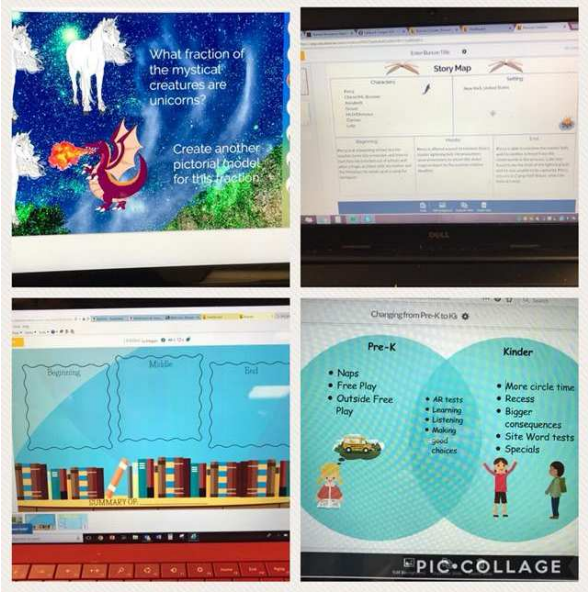

Figure 3. Examples of student work from PT 2 Facebook post.

Seven of the twelve participants referred to using technology that they learned about from the online community in their open-ended responses to the survey. Three additional participants referenced their intentions to implement technology they learned about from the online community. One participant shared, "I have begun using Socrative and Mentimeter as formative assessment tools. Also, Kahoot. Also, my students are using Google Docs to collaboratively complete homework and other assignments." Another explained, "I learned about new tech tools to integrate in my instruction. One of the them helped me to create additional artifacts to support my instruction beyond the presentation." Also, a participant shared that, "I have been using new tools. In addition, for the first time, I have been using SAMR to frame how and why technology is integrated into my lessons." Finally, another participant stated that, "I use the technologies I learned in my courses on a regular basis."

Participants' familiarity with content allowed for focusing on technology integration. All twelve participants in the study had more than 13 years of experience in education, with nine having more than 16 years of experience. Although their perceived ability across the content areas was moderate with a mean score of 2.97 in Construct 4: Content Knowledge, all but one of the 11 respondents had a particular content area in which they strongly agreed with their ability to choose strategies and approaches to effectively teach that specific content. For example, six of the eleven participants strongly agreed with their ability to teach literacy, while only one of the same six strongly agreed with their ability to teach math content.

Veronica expressed that,

> It's content that I am familiar with, and I can anticipate potential challenges, or anticipate potential ways I might need to scaffold, or potential ways I might need to enrich. So that helps me think about new technology tools I've never used before that can be the vehicle for that.

Moreover, one of the higher scoring constructs on the pre- and post-intervention section of the survey was Construct 6: Pedagogical Content Knowledge with a mean score of 3.27 and 3.38 respectively. This supports the notion that the participants are comfortable combining both content knowledge and pedagogical knowledge to implement specific pedagogical methods to best teach content. Sara explained that as she previewed the posts on the online community, "Lots of times, it would be an English teacher or history teacher or something I didn't teach, but I could still see what they did and think, 'Could I use this in my class?'" As a math instructor, she shared that her content and curriculum drive her instruction; however, she was looking for ways that technology could enhance her course. She shared that she would "…grab on to the [technology ideas] that solve a problem that I have." The online community was

designed to help teacher educators share and gain ideas for technology integration, and at the beginning of the group, it was made clear that not every participant was engaged in teaching the same content. Therefore, many of the resources that were shared at the beginning of intervention were tools that could be used across different content areas.

Participation in the Online Group Depended on Various Factors

Participation in the online group was encouraged by easy access to the platform and relevance to the participants' context. Responses from the post-intervention interviews and open-ended responses to the survey questions were combined to support the two theme-related components (a) participation in the group was encouraged by easy access to a user-friendly group platform and (b) participation depended on whether the content was relevant to participants' role or work context.

Participation in the group was encouraged by easy access to a user-friendly group platform. All six of the participants who were interviewed referenced their ability to access the online community as a factor in their participation. Diana stated that, "I would pick and choose things that seemed interesting or like, 'Oh, I'm going to just look at that really quick.'" She would access the online community as prompted by email notifications and explained that she only opened the notifications that seemed the most relevant. Although her observable interaction in the group were minimal (5 interactions), she stated in her interview that, "I felt more like a passive observer of what was happening in the group. I truly did use it more of a resource versus true interaction." This seemed to be a trend for those participants who were not already actively using social media platforms to interact or collaborate. For example, Audrey was unfamiliar with Facebook prior to the start of the online group and ended-up having no observable

interactions in the group. Conversely, Veronica described herself as being extremely active on social media for personal and work-related reasons in her interview. She was also the participant with the most observable interaction in the online group. This trend was also evident with Gwen and Joslyn who were avid Facebook users and subsequently had ample observable interactions in the community. Josyln is a 25-year education veteran and has been working in higher education for the past 15 years. She is currently a site coordinator in a university program that has a yearlong student teaching experience. She was eager to share in her interview that the connection to Facebook allowed her to view the online community content easily and during her regular social media activity. She was able to get new ideas to implement in her instruction, without having to go to a different website or resource.

Audrey stated that one of the reasons for her lack of participation (0 observable interactions) was her inexperience using Facebook. She referenced her regular use of other social media accounts and how she feels comfortable engaging online, but her lack of familiarity with Facebook made it difficult for her to engage in the online community. She explained that,

> I feel like if I used Facebook a lot and I had a Facebook account that I regularly used, it would've been more natural for me, but it was just hard for me to kind of even know what to do. Even though you had the webinar and all that kind of stuff, it's just not a regular thing that I engage in.

Joslyn noted that the regular posts encouraged her use of technology and were easy to access from her phone. She said the following:

> Your new ideas that you posted were things I could think about at times that I wasn't necessarily sitting down on my computer. I'm looking on my phone, and it pops up, and I'm like, "Oh, that's a great idea!" I guess how it impacted me is I definitely use technology more now than I did a year ago. I think that comes from seeing it frequently on my feed and getting ideas that other teachers are posting.

> It was often on my phone while I'm waiting for my kids. I would see it on my feed and think, "That's something I could add this week." So, it was easy.

Gwen expressed a similar sentiment,

> Using Facebook was convenient, because we are busy. We're all in different time zones even, I mean it's almost impossible for us to have a common time. It was like just in time instruction. Like I could go use it tomorrow.

Sara also stated that,

> I think a community like the one you had is a better approach than other things I've seen, because I can go there when it's just in time training. If I have a need right then, I can go to that community. An ongoing, active social media community gives you the just in time ideas and then also a place to go and ask the question the moment you have the question.

Of the 12 participants in the study, nine were regular Facebook users prior to participating in the online community. Those same nine participants self-reported interacting in the online community at least once a week. Four of the nine self-reported viewing or interacting with the group 2-3 times per week, one selected 4-6 times per week, and two stated they viewed posts or interacted in the group daily. Of the three that did not use Facebook prior to the online community, one did not interact at all and two stated that they viewed posts once a week. This supports the idea that participants who were more familiar with the platform tended to view or interact more in the online community.

Participation depended on whether the content was relevant to participants' role or work context. Five of the six participants who were interviewed were engaged in teaching or facilitating training in higher education. All five referenced the value of being in an online community with people in similar roles. Diana shared that,

> There's a lot of teacher educators in this particular group. I think it was nice to have. I think that is rare. I think that was helpful to me as far as finding things that I am looking for to support the work that I'm doing.

One of the participants stated that, "I learned about what others were doing in the same field." It was evident that the similar roles of the participants produced discussions and content that was more relevant to the group. Sara stated, "There's somebody that I already trust their opinion. They're already telling me [the technology idea] is cool and they're giving me a specific idea of how it can be used." Conversely, Audrey spoke about her role as a faculty administrator and how the content in the online community was not as relevant to her day-to-day context. She pointed out that, "I wasn't teaching a class. It was one of those things where it just didn't feel at the moment that it was something that I could use right away." Therefore, Audrey's participation was impacted by the relevance of the content to her context—perhaps suggesting that such an intervention is most useful for teacher educators who can use the ideas in a "just in time" type of approach. Gwen expressed that, "It would have been totally different had it been people that had the same job. Then we could talk about it later. Having a thinking partner to talk to is important."

In reviewing the online observation codes, there were 23 references to context. Micro contexts, which are defined as classroom and learning environments, were referenced in 16 of the 23 context codes (Porras-Hernandez & Salinas-Amescua, 2013). For instance, a participant shared that, "My TCs use Kahoot regularly in their classrooms–all levels. The students love it. I've used it as a review in my own classes." Joslyn explained, "In my literacy class, one TC used PosterMyWall to incorporate writing into her guided reading group. The second graders and TC made the 'poster' interactively!"

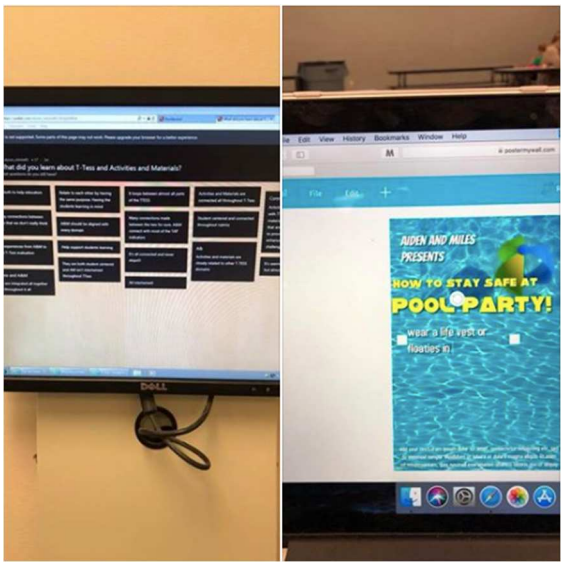

Figure 4. Online group post sharing Padlet and PosterMyWall student examples.

References to context were one of the most frequently coded pre-selected categories for the online community observations. In these references, the participants mentioned specific grade levels, subject areas, and/or other micro context factors. Moreover, the micro contexts tended to be similar, such as university classrooms or observing teacher candidates in K-12 classrooms.

Throughout this section the quantitative and qualitative data helped to support the ways that teacher educators developed TPACK through participating in the online community. In the next section, the quantitative and qualitative data related to how teacher educators utilized play as they developed TPACK in the online community will be presented.

Quantitative Data for RQ #2 on Participants' Use of Play

Research Question #2: How do teacher educators utilize play as they develop TPACK? Quantitative data related to the participants' use of play will be presented and then followed by the qualitative data to answer this research question.

Table 9 shows the data collected from the pre-intervention retrospective and post-intervention survey. Twelve participants responded to the survey, yet only eleven answered the questions in all the constructs. Earlier data was presented to illustrate the participants' increase in confidence related to Construct 9: Technological Pedagogical Content Knowledge. This demonstrates that participants felt their ability to weave teaching methods, content, and technology to most effectively teach any content or skill improved. Participants also had a change in perception related to Construct 2: Beliefs about Playing with Technology. The mean score increased from 3.18 to 3.86 in this construct.

Table 9

Descriptive Statistics of Construct 2 and Construct 9

Construct	Retrospective Pre-Survey Mean	Post-Intervention Survey Mean	Difference in Means
Construct 2: Beliefs about Playing with Technology	3.18	3.86	0.68
Construct 9: Technological Pedagogical Content Knowledge	2.53	3.09	0.56

Note. n = 11.

These data represent a change in perceptions related to the participants' beliefs about playing with technology. It also shows an increase in the participants' confidence to weave technology, content, and pedagogy together to teach a variety of content.

Table 10 shows the descriptive statistics for the items within Construct 2: Beliefs about Playing with Technology. The mean scores on the post-intervention survey responses show that a majority of participants agree or strongly agree that play is valuable in learning about new technology. These data also represent a change in the participants' beliefs about playing with technology after participating in the intervention.

Table 10

Beliefs about Playing with Technology Survey Response Descriptive Statistics

Item	Retrospective Pre-Survey Mean	Post-Intervention Survey Mean	Difference in Means
Item 7. I feel that playing with technology is a fun way to learn.	3.18	3.82	.64
Item 8. I feel that playing with new technology helps me become better at using technology in my instruction.	3.27	3.91	.64
Item 9. I feel that listening to my peers' experiences of playing with technology helps me improve my technological knowledge.	3.09	3.91	.82
Item 10. I feel that my students should have opportunities to play with new technology during their coursework.	3.18	3.82	.64

Qualitative Data for RQ #2 on Participants' Use of Play

Qualitative data related to how teacher educators utilize play as they develop TPACK while participating in a facilitated online community will be presented using data collected from the online community observations, post-intervention interviews, and open-ended responses from the survey. Table 11 presents the themes, theme-related

components, and assertions that relate to the participants' use of play in the online community.

Table 11

Themes, Theme-Related Components, and Assertions Related to Play

Themes	Theme-Related Components	Assertions
Playing with new technology	Participants reference trying, playing with, or investigating new technologies. Testing out or playing with new tools was something participants recommend other teacher educators do when learning to integrate technology.	Playing with new technology was a foundation for technology integration implementation.

Playing with New Technology

Playing with new technology was a foundation for technology integration implementation. Responses from the post-intervention interviews, open-ended responses to the survey questions, and online community observations were combined to support the two theme-related components (a) participants reference trying, playing with, or investigating new technologies and (b) testing out or playing with new tools was something participants recommend other teacher educators do when learning to integrate technology.

Participants reference trying, playing with, or investigating new technologies. All six of the participants who were interviewed talked about trying, playing with, or investigating technology in some way. Often times, they equated playing with technology as taking a risk. Sara explained to her college students that,

> I'm going to try to use a lot of technology in here, and easily half of it is probably going to fail because I'm so new at it, but it's important to me that you try to incorporate it. You just have to see that it's not ever going to get incorporated if I won't risk failing at it.

Veronica shared that the online community, "…gave me more confidence. It inspired me. And honestly, it was fun, fun trying these new things, and exciting to see how these tools that were shared are relatively simple tools to implement and how they enriched the lessons." Even Audrey, who did not have any observable interactions in the online group shared how she was prompted to play with new technology. She stated that, "I did play with Flipgrid through seeing it on the thread, I didn't do the Flipgrid activity through the community, but I did go look at it on my own and play with it." Gwen explained that, "I would learn about the new stuff through your learning community, and then I would practice with it and use it in my classes." In the open-ended responses of the survey, one of the participants shared that, "I'm really excited about a few websites and trying new things." Another participant said, "[The online community] allowed me to feel okay about trying something new and trying to integrate it in [instruction] and I feel a little less scared and overwhelmed."

The online community observations revealed only eight references to participants' playing with new technology; however, these instances gave explicit examples of technology that participants tried as a result of their interaction in the group. For example, one of the participants posted a screencast that she created as a response to a post asking the participants to share a new tool they played with during the week. "Screencasting is tough!" was the beginning of the post that linked to her screencast video introduction to NEWSELA. Although she found playing with the new technology challenging, she

received encouragement from the group for trying and sharing the new tools. A participant responded, “Yay! Great job! Your screencast was so smooth!”

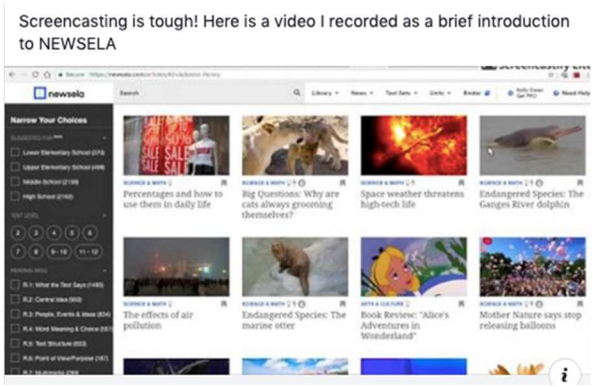

Figure 5. Example of participant post about Screencasting and NEWSELA.

> In a later post, a participant shared an experience trying Pear Deck.
>
> I am so excited to work with Pear Deck. I followed your instructions and found it to be very easy to set up and add slides. Thanks also for mentioning how to use with early grades as I will be working with another early childhood group in the fall and need to be able to offer them options.

This type of post was similar to the other participants’ references to playing with new technology. Often times, the comments were short and in response to recommended technology that was posted to the group. For instance, when dotstorming.com was shared, one participant commented on not being able to access the group dotstorming board, but then another participant helped by sharing her success with opening and playing with it. She later stated, “I tried it! Pretty cool!!”

Not only did the participants talk about trying new technology as a result of the online community, but they also recommended this as a strategy for other people wanting to learn about technology integration. Throughout the intervention, the participants were

asked to play with new technology and share about their experiences. It can be assumed that their experiences playing with new technology had an impact on their own perceptions related to technology integration. It impacted them so much that they would recommend playing with technology to others who want to improve their technology integration skills.

Testing out or playing with new tools was something participants recommend other teacher educators do when learning to integrate technology. In the open-ended portion of the retrospective survey, participants were asked what advice they would give to other teacher educators who might be interested in technology integration. Ten of the twelve respondents encouraged teacher educators to play with, try, or experiment with new technology and/or ideas. The following are some of the participants' advice:

> "Try it and just see what happens. Play with it and give it a chance."
>
> "Pick something and focus on using that one thing until you get comfortable with it. Just go for it and try!"
>
> "Join a community of people also trying to integrate or increase integration of technology, and treat it like a book study, or PLC. In other words, hold yourself accountable for trying new things, ask questions, and share experiences."
>
> "Experiment! Try new things."
>
> "Do not be intimidated by the vast choices! Just listen to others, play with applications, and learn from students as well. You don't have to know everything!"

"Be open-minded and try new tech. It is important to model taking risks for teacher candidates."

"Don't be afraid. Learn one at a time and try it."

It is evident that the participants valued taking time to try new technology as a way to begin learning about technology integration. These qualitative data suggest that participants think there is a need to play with and try new technology when attempting to integrate technology.

Quantitative Data for RQ #3 on Facilitator and Peer Modeling

Research Question #3: How does facilitator and peer modeling influence teacher educators' development of TPACK? Quantitative data related to how facilitator and peer modeling influenced teacher educators' development of TPACK will be presented and then followed by the qualitative data to answer this research question. Table 12 shows responses for one item on the survey related to learning from peers.

Table 12

Item 9 Descriptive Statistics

Item	Retrospective Pre-Intervention Mean	Post-Intervention Survey Mean	Difference in Means
Item 9. I feel that listening to my peers' experiences of playing with technology helps me improve my technological knowledge.	3.09	3.91	.82

Note. n = 11.

This item demonstrates that participants learn from the experiences of their peers. This is supported by the comments made in the post-intervention interviews as well as open-ended responses in the survey. One of the participants stated that,

> The resources that were discussed and shown in this group helped me to see how to integrate technology in a variety of subjects and for many purposes. It was great to see the suggestions from the facilitator and any of the other participants.

Another participant shared that, "I learned from the modeling and conversations with the collaborative group." A third participant commented, "I learned about what others are doing in the same field."

Qualitative Data for RQ #3 on Facilitator and Peer Modeling

Qualitative data related to how facilitator and peer modeling influence teacher educators' development of TPACK will be presented in this section. Table 13 presents the themes, theme-related components, and assertions that relate to facilitator and peer modeling in the online community.

Table 13

Themes, Theme-Related Components, and Assertions Related to Facilitator and Peer Modeling

Themes	Theme-Related Components	Assertions
Learning from the modeling of others	Participants referenced technology being modeled by the facilitator, peers, and students. Participants modeled the use of technology to students and mentors.	Modeling played a role in participants' learning and application of their learning.

Note. n = 11.

Learning From the Modeling of Others

Modeling played a role in participants' learning and application of their learning. Responses from the post-intervention interviews and open-ended responses to the survey questions were combined to support the two theme-related components (a) participants referenced technology being modeled by the facilitator, peers, and students and (b) participants modeled the use of technology to students and mentors.

Participants referenced technology being modeled by the facilitator, peers and students. Several of the participants who were interviewed shared their experiences learning from the modeling of the facilitator, peers, and students. Veronica stated that, "The thing I found surprising and interesting, was how much I connected to and enjoyed seeing everyone's posts and seeing different experiences shared, different tools shared, and people sharing their successes and challenges." Joslyn talked about how seeing the facilitator's posts were an example and she would say, "Oh, I could use that in my sessions!" She went on to say that, "Other teachers showing how they used [technology] definitely caused me to be more consistent with technology use." Diana shared that the online community allowed her access to different people's ideas. She shared that, "I learned from the initial post from what people would put out there." In addition, a participant commented on the survey that,

> The resources that were discussed and shown in this group helped me to see how to integrate technology in a variety of subjects and for many purposes. It was great to see the suggestions from the facilitator and any of the other participants.

Finally, another participant shared, "I learned from modeling and conversations in the collaborative group."

Participants also discussed learning from their students. Sara talked about gaining more information about Flipgrid from her students. She explained that, "By having the students use it, I learned more about Flipgrid because they did something that I thought was cool and I asked them how they did it." Veronica shared an experience where she and the students had trouble with a technology tool she used in her instruction. She said, "The students and I worked together to figure out what the issue was so we can get that problem resolved, and that's a collaborative problem-solving opportunity that's very important life skills—especially as an educator." Gwen talked about how the students in her class were modeling for the mentor teachers, "They were making Piktocharts for the mentors."

Participants modeled the use of technology to students and mentors. Not only did participants learn from the modeling of others, they also shared their experiences modeling technology for students and mentors. Sara told her students, "Y'all are going to get to see me mess a lot of things up, but also have a lot of discoveries using technology. It's a mind shift." Joslyn expressed, "I think it has helped them for me to be a model without teaching a technology class. My objective isn't technology, but they're getting to see how I use that, those materials in just regular teaching." She went on to say, "I see it is helping them as teachers, because they're finding more authentic ways of incorporating technology." Gwen talked about using technology in her mentor trainings. She said that,

> I saw my mentor teachers writing down Padlet and the Mentimeter, so that they could use it on their own. I feel like modeling technology is one way that I can help improve student achievement in school through my mentor teacher meetings. I introduce them to new technology and then they can use it in their classrooms.

The quantitative and qualitative data suggests that modeling was a component of value in the online community. Rehmat and Bailey (2014) described the importance of

instructor modeling of technology integration and that it helped to improve preservice teachers' ability to define and integrate technology in their own lessons. It is clear that modeling also played a role in teacher educators' development of TPACK as they participated in the intervention. The participants not only learned from the experiences of their students and peers, they also saw value in modeling the use of technology to various stakeholders. For example, in one of the participant's advice to other teacher educators she shared, "Join a community of people also trying to integrate or increase integration of technology, and treat it like a book study or PLC. In other words, hold yourself accountable for trying new things, ask questions, and share experiences." This advice suggests that the participant found value in collaborating and learning from peers. This is consistent with the research related to modeling and technology integration. Chai et al. (2010) implemented a series of professional development trainings focused on PK, TK and TPACK. During the sessions on PK and TK, the students modeled for their peers. This resulted in learning for not only the students who modeled the instruction, but also their peers who learned from the modeling. Therefore, the online community was able to create a space where teacher educators could see models of technology integration and share their learning with each other. In the next section, data related to the participants' attitudes and beliefs about technology integration will be presented.

Quantitative Data for RQ #4 Participants' Beliefs about Technology

Research Question #4: How are teacher educators' attitudes and beliefs about technology integration influenced by their participation in a facilitated online community? Quantitative data related to the participants' beliefs about technology integration will be presented and then followed by the qualitative data to answer this

research question. Table 14 shows the mean scores for the items *in* Construct 1: Beliefs about Technology. Item 2 had an increase in mean score, which shows that participants' feelings changed regarding how easy integrating technology would be in their future instruction. In addition, the change in mean scores on Item 6 shows that more participants agree or strongly agree with the statement that the advantages of integrating technology outweigh the disadvantages of not infusing technology.

Table 14

Beliefs about Technology Survey Response Descriptive Statistics

Item	Retrospective Pre-Intervention Survey Mean	Post-Intervention Survey Mean	Difference in Means
Item 1. I feel that integrating technology in instruction is a good idea.	3.45	3.70	.25
Item 2. I feel that it will be easy to integrate technology in my future instruction.	2.91	3.50	.59
Item 3. I feel that integrating technology in my instruction will help students to learn more about the content.	3.27	3.70	.43
Item 4. I feel that integrating technology will improve my students' satisfaction with the course.	3.45	3.80	.35
Item 5. I feel that integrating technology will improve students' grades.	3.00	3.10	.10
Item 6. The advantages of integrating technology outweigh the disadvantages of not infusing technology.	3.27	3.90	.63

Note. n = 11.

Table 15

Descriptive Statistics of Construct 1

Construct	Retrospective Pre-Intervention Survey Mean	Post-Intervention Survey Mean	Difference in Means
Construct 1: Beliefs about Technology	3.22	3.61	.39

Note. n = 11.

Qualitative Data for RQ #4 Participants' Beliefs about Technology

Qualitative data related to how teacher educators' attitudes and beliefs about technology integration were influenced by their participation in a facilitated online community will be presented using data collected from the online community observations and post-intervention interviews. Table 16 presents the themes, theme-related components, and assertions that relate to participants' attitudes and beliefs.

Table 16

Themes, Theme-Related Components, and Assertions Related to Beliefs about Technology

Themes	Theme-Related Components	Assertions
Creating personal goals or commitments to integrate technology	Participants created personal goals, plans, or made commitments to implementing or integrating technology.	Participants set personal goals, plans and commitments to integrate technology and viewed their participation in the group as a form of accountability.

Note. n = 11.

Change in Beliefs About Technology Integration

Participants' mindsets and beliefs were impacted by their participation in the online community. Responses from the post-intervention interviews and open-ended responses to the survey questions were combined to support the two theme-related components: (a) participants referenced a change in beliefs about technology, and (b) participants referenced confidence and willingness to persevere over technology challenges as needed skills for technology integration.

Participants referenced a change in beliefs about technology and how it could be used. In the open-ended survey responses, participants reference their change in beliefs about technology integration. Much of this focused on positive shifts in belief, such as for one participant who said that after her participation in the online community, "I feel a little less scared and overwhelmed." Another participant stated, "I had a small shift in awareness that working with technology shouldn't be feared, because the great variety of resources far outweigh the time and learning curve in learning the new information." Moreover, participants talked about their change in attitudes and beliefs during the post-intervention interviews. Sara exclaimed that, "I was the worst. I used technology in that I projected a PowerPoint. I don't even consider that innovative anymore, because it's so standard." She went on to say that she had a mind shift,

> Before, my philosophy of technology use has always been that we shouldn't be spending time in math class on using technology for the sake of technology. Now I'm thinking, what is the technology that can make this content more accessible to students?

Gwen stated that, "My whole teaching has shifted this semester. I think you just opened my eyes to, like I didn't have to do the leg work and it's not that hard."

In the online community observations, there were 20 references to participants' attitudes. Nineteen of the references were related to the participants' own attitudes and one reference was related to their students' attitudes. Some of the attitudes were positive; such as, "I had fun making the Piktochart," and

> We used some fun technology today! In my teacher candidate class, we used Padlet as a reflective exit slip tool based on what we had discussed. Then we looked at various posts and provided feedback to each other. They loved seeing the responses and it helped me to see what was learned!

However, some of the references were not reflective of all positive feelings or beliefs, but in some cases reflected some uncertainty about their own confidence, such as "Ok, somehow I feel very behind. I just watched [the webinar] though and great job. I really like the pace of this and it's great background info." In the online community the participants seemed to freely share references to their attitudes. Of the 98 codes marked in the online observations, 24 referenced the participants' attitudes towards technology integration or technology content shared in the group. This was the most frequently marked code out of the 11 pre-selected online community observation coding categories.

Participants referenced confidence and willingness to persevere over technology challenges as needed skills for technology integration. Beliefs in the value of technology changed, but not without participants experiencing struggles using technology. Participants shared their experiences with technology failures but talked about them more as opportunities for learning—rather than barriers to technology integration. For example, Diana explains, "I tend to be very open-minded and willing to try new things. I'm also willing to make mistakes along the way. It doesn't stress me out." Veronica shared that, "I've had technology fail, but I also want to embrace that as an opportunity to model that it's okay, that we don't want a technology fail to stop us

from trying new technology." In the open-ended survey responses, a participant stated, "I think we need to get over being scared and just dig in." Participants in the interviews discussed the value of modeling risk-taking and dealing with technology failures in front of their students. Sara told her students, "Some of [the technology] will work really well. Some of it is going to be frustrating. You have to be willing to have it fail in front of other people."

Participants' mindsets and beliefs changed through their participation in the online community as evidenced by the quantitative and qualitative data. Although each participant was impacted in different ways, there was a common trend that participants believe there are advantages to integrating technology. Also, when asked whether their participation in the online community had an impact on them as a teacher educator, 11 of the 12 responded in the affirmative. In the affirmative responses, three references were made to a change in beliefs, four references were made to an increase in ideas, two references were made regarding motivation and encouragement that was gained from the group, and four references were made to specific skills that were learned. Overall, the majority of participants had experiences in the online group that supported them as a teacher educator.

Chapter 4 provided an overview of the qualitative and quantitative data as it related to each of the research questions. Overall, the participants had an increase in their confidence to select, combine, and use technology to enhance their instruction. They were able to use the online community as a vehicle to learn from their peers and share ideas. Although participation varied based on the participants' comfort level with the online platform, the majority of participants were able to gain new ideas, tools, and

resources to integrate technology to enhance their instruction and content. Seven out of 12 participants referenced learning from the group and implementing their learning in some way. In Chapter 5, a discussion is presented related to these overall findings and recommendations will be shared for further research.

CHAPTER 5: DISCUSSION

The purpose of this study was to explore how teacher educators develop TPACK while participating in an online community focused on technology integration. The TPACK framework was used in this action research dissertation as a guide in the development of the online community content, as well as data collection. In the first section of this chapter, a summary of the quantitative and qualitative data will be presented for each of the research questions. The next section will provide a discussion of the overall findings in relation to the theoretical perspectives used to design the study. Then, a section describing the limitations of the study will be presented. Finally, the implications for practice and further research will be explored.

Summary of Results

In Chapter 4, qualitative and quantitative data were shared for each of the research questions in this action research study. In this section, a summary of those results will be presented.

The first research question explored how teacher educators develop TPACK while participating in a facilitated online community focused on technology integration. The quantitative data showed an increase in participants' confidence for selecting technologies to enhance their instruction after they participated in the online community. Also, the participants felt more confident using strategies that combine content, technologies, and teaching approaches in their classrooms or other learning environments. In addition, participants felt that they had gained knowledge of various technologies and how to use them after participating in the online community. Complementing this quantitative data, and in order to understand how the online

community helped participants to develop TPACK, the qualitative data illustrates several key aspects of the community that impacted the participants' learning. Firstly, participants felt an accountability to set goals and implement new learning because of their interaction in the online group. The participants shared how they made personal goals to participate in the online community and to try out new technology. They also pointed out how the online community prompted them to use technology to enhance their instruction. The participants talked about and posted examples of technology and how they used them in their context. It was evident from the quantitative data and qualitative data that the participants had strong content knowledge in at least one content area and were comfortable with selecting content strategies prior to the intervention, but they gained confidence in selecting technology to support their instruction and content after participation in the online group. Specifically, they were able to start thinking about ways to enhance their content with technology as a result of their learning in the online community. Moreover, participants were able to develop TPACK in the online community if it was easy to access, relevant, and if it fit into their already established routines—suggesting that convenience or access and practicality of application are essential to supporting teachers in development of TPACK. The participants who regularly engaged with Facebook prior to joining the online community felt that their participation was encouraged by the regular notifications and easy access to the content. They did not feel like it was just another task to complete, but rather that it was something that fit naturally into their daily online activities as Facebook was a regularly-used platform for most of the participants.

The second research question focused on how teacher educators utilized play as they developed TPACK in the online community. The quantitative data illustrated that the participants' beliefs about playing with technology changed. After participating in the online community, a majority of participants agreed or strongly agreed that playing with new technology helped them to become better at using technology in their instruction. They also felt that listening to their peers' experiences of playing with technology helped them to improve their technological knowledge. The qualitative data supports these findings. The majority of participants encouraged other teacher educators to try, experiment, and/or play with technology in order to learn about technology integration. Moreover, they talked about their own experiences playing with new technology in order to help them decide how it could be used to enhance their instruction.

The third research question addressed how facilitator and peer modeling influenced teacher educators' development of TPACK. The quantitative data showed that participants felt that within the online community, listening to their peers' experiences helped them to improve their technological knowledge. The qualitative data further emphasized how the participants learned from each other's posts in the online community. They referenced how they took ideas that other participants shared and tried them in their own context. They also talked about how the facilitators' posts prompted them to try new technology tools to enhance what they were already planning to teach in their coursework. Many of the online community posts were examples or models of what others were doing with technology. These models encouraged participants to try technology in their own context and with their own content, which proved critical for real-world application in learning. Furthermore, the participants shared how their

modeling of technology integration for their teacher candidates and mentors seemed to have an impact on their use of technology in their own classrooms.

The fourth research question examined how teacher educators' attitudes and beliefs about technology integration were influenced by their participation in the online community. The quantitative data illustrated that the participants' beliefs about technology integration changed after their participation in the online community. In particular, they felt more strongly that the advantages of integrating technology outweighed the disadvantages. They also felt more strongly that integrating technology in their instruction would help their students to learn more about the content. For example, Joslyn talked about her use of an interactive chart where students could share their area of strength and area of weakness from their most recent formal observation. The students were able to see who had strengths that could support them, and this led to the students connecting and collaborating to support each other. She stated that,

> I'm thinking that it enhanced their learning because they got to see right there. It wasn't an exit slip, that they turned in on a piece of paper. They got to see, "Oh, I'm not the only one missing modeling."

Gwen shared how she used Padlet to allow her students to share ideas and resources. Her students were spread-out across multiple locations and Padlet created a space where their work could be seen by the group and they could share ideas outside of a normal classroom setting. Veronica explained how she used Pear Deck during her course instruction. "I loved the interaction and how engaging it was. I was able to use the features in Pear Deck to do formative assessments throughout the instruction. It was really fantastic!" She felt that the on-the-spot assessments were a great way to use

technology to quickly and accurately gauge student learning in the lesson and provide support as needed.

These changes in beliefs were supported by the qualitative data, which highlighted the impact that the online community had on the attitudes and beliefs of the participants. Several of the participants talked about how they had a shift in thinking or an added awareness about technology integration after participating in the group. Also, comments in the online community reflected positive attitudes towards technology integration.

Another attitude and belief that was impacted was the participants' confidence and willingness to persevere over technology challenges. Several of the participants shared how their mindsets towards using technology changed, because they were no longer afraid to fail or make mistakes with technology integration. They seemed more willing to try technology even if there was a possibility that it might not work as they had planned—a connection that aligns well with their increase in interest or willingness to play or learn through experimentation and trying new things.

This summary of the data presented in Chapter 4 demonstrates how the quantitative and qualitative data collected in the study triangulate to help answer the research questions. In the next section, a discussion of the outcomes related to the theoretical perspectives will be presented.

Discussion of Outcomes Related to Theoretical Perspectives

In Chapter 2, the theoretical perspectives and constructs that guided this action research study were outlined in detail. In this section, a discussion of the findings is presented in relation to those theoretical perspectives and constructs.

Technological Pedagogical Content Knowledge (TPACK)

TPACK was used as a foundation for the planning and implementation of the intervention. Research related to TPACK suggests that modeling is an important factor in the development of technological knowledge. This theme in the research suggests modeling TPACK for pre-service teachers in a variety of contexts and throughout their coursework, not just in specific educational technology courses is valuable (Rehmat & Bailey, 2014; Chai et al., 2010; Pratt & Stevenson, 2007). Modeling for pre-service teachers includes the implementation of technology integration by the instructor into the course lessons and assignments. In this study, modeling was used in the online community to support teacher educators' development of TPACK. The quantitative and qualitative data presented in Chapter 4 demonstrate that modeling played a role in the participants' development of TPACK. The participants agreed that peer modeling was helpful in improving their technological knowledge. Watching their peers eased their own fears about technology integration. For example, a participant stated, "It allowed me to feel okay about trying something new and trying to integration it in my coursework. I feel a little less scared and overwhelmed." Another participant shared that, "It was a safe, collaborative forum that never felt evaluative or like one more thing to do. I thought, 'Oh, this is how one of my peeps did it, and I can do this, too.'" Participants commented about how they learned from what other participants shared about their technology integration. They valued learning from others' experiences, models, and examples. Koh et al. (2014) determined that pedagogy discourse improved the construction of TPACK and organizing teams to include members who share a variety of skill sets would produce better results. Also, they found that having a facilitator to model productive technology

planning kept the group focused on pedagogy and finding solutions to challenges that might arise. The facilitator role in the online community was designed to help support productive technology integration and planning. Veronica explained, "It was a professional growth development opportunity. It was an opportunity to engage, to become a more effective practitioner, and that is always very motivating to me." Joslyn stated, "I thought it was a great experience. I loved it being as convenient as seeing, through Facebook, pictures about what other teachers or site coordinators are using and what their perspectives are."

Another key aspect in the research related to TPACK is the use of play to support the development of technological knowledge. Henriksen et al. (2015) argue that play "is foundational to the way that we learn and develop throughout life" (p. 5). Deep play can be used as a tool to create deeper meaning or find new products, ideas, or solutions; however, deep play might not result in any tangible outcome. Its purpose is to have fun, try new things, and to explore. The online community was designed to allow for a safe and collaborative environment where participants could learn, play, and share ideas freely and without evaluation or judgement. Many of the facilitator prompts encouraged the participants to play with something new and share their experience, whether it was positive, neutral, or negative. The qualitative and quantitative data support the idea that play is critical to TPACK development. In particular, 10 out of 12 participants gave advice for other teacher educators to play, try, or experiment with new technology if they wanted to learn more about technology integration. The quantitative data also represents that a majority of participants valued playing with technology as a way to improve their use of technology.

Theory of Planned Behavior (TPB)

The literature related to TPB, technology integration, and teacher preparation, has a common theme. Attitudes are seen to be a significant factor in influencing teachers' intentions to use technology in their instruction. More specifically, the technology's perceived usefulness has the most influence on teachers' positive attitudes towards integrating the technology. Sadaf et al. (2012) found that the perceived usefulness of the technology had a significant impact on the positive attitudes toward using the technology. In turn, attitudes were found to be the strongest indicator of the preservice teachers' intention to use technology.

In this action research study, observations of the online community were used to identify attitudes towards technology integration. The attitudes coded in the online community were often positive. Furthermore, the quantitative data showed a difference between the pre-intervention and post-intervention survey responses related to the participants' beliefs/attitudes about technology integration. A majority of the participants agreed that integrating technology in instruction was a good idea and that it would help their students learn more about the content and improve their satisfaction in the course. Gwen and Joslyn talked about how their use of technology allowed students to collaborate outside of the classroom. They used technology tools that gave students the opportunity to share resources and connect to support each other in their learning. Sara shared how her use of technology was engaging for the students and allowed her to make better use of her instructional time. Several participants referenced their use of technology and intentions to use technology based on their participation in the online community. For example, one participant shared that, "I've really enjoyed participating

in this group, and it have motivated me to reach out to collaborate more with my colleagues, and to learn new tools for engagement, formative assessment, and managing student behavior." Another participant said, "I was excited to become aware of amazing tools available and hear about as well as apply them to my practice." Since most participants had positive attitudes towards integrating technology as demonstrated by the post-intervention survey, it is hopeful that they will follow through with those intentions. Based on TPB, the participants' increase in Technological Knowledge and positive attitudes towards technology integration would indicate that they might be more likely to follow through with using technology to enhance instruction in the future.

Professional Learning Networks (PLNs)

A PLN is a compilation of virtual learning spaces that include social media groups, online forums, and other digital collaboration spaces focused on professional learning. Carpenter et al. (2016) surveyed teachers and their use of professional learning Networks. They found that PLNs were a source of support and professional growth. Teachers reported changes in their dispositions as a result of engaging in their PLN. Also, Deissler et al. (2015) found that PLNs were an effective tool for school librarians to learn and gain fluency, experiences, and information related to technology skills and practices. Participants in their study noted that they learned about new technology devices and tools through their PLN. In addition, Gareis and Nussbaum-Beach (2007) discovered that participants benefited from virtual support provided by mentors and peers in online forums consisting mainly of modeling from the mentors and shared experiences of the participants to their peers.

In the online community designed for this study, I modeled technology integration for the participants through the webinars, screencasts, and other posted content. The participants also shared their own use of technology and provided videos, images, and narratives to describe the technology they were using to enhance instruction. The participants shared that the use of a familiar social media platform helped them to interact more often and with ease. It seemed like a natural way for participants to communicate, share, and collaborate if they were already using the medium for socializing and/or learning. In the post-intervention survey, 11 out of 12 participants responded that their participation in the online group positively impacted them as a teacher educator. The majority of them clarified that it benefited them by providing ideas and improved their attitude towards technology integration. Others cited that it provided them motivation and encouragement to integrate technology. These findings align with the research related to PLNs and their ability to support people in learning about technology.

As demonstrated in this section, the results of the study aligned to the theoretical perspectives and constructs that helped to shape the research. It is evident that prior research was beneficial in helping to design the intervention for this action research dissertation. In the next section, a discussion of limitations in the study will be presented.

Limitations

There were several factors that could be considered limitations in this study. As a participant in the action research study, I was in consistent contact with the participants as a facilitator of the online community. The Hawthorne effect (Smith & Glass, 1987) could have impacted the results of the study. For example, the participants were interviewed about the online community by me; therefore, they might have been less

likely to be honest in their responses. This could have impacted the overall outcomes. Moreover, the participants were selected from universities where I worked or had relationships with the faculty. Therefore, my prior interactions with the participants could have impacted their participation and/or commitment to the study.

Another limitation was the use of a retrospective survey. The study implemented a pre-intervention and post-intervention set of items for the participants to answer. This model is not true to the typical structure of a retrospective assessment. Due to time limitations and the length of the survey, the retrospective portion of the survey was presented in parallel with the post-intervention items and not given separate from the post-survey. This could have impacted the participants' responses. Moreover, the validity of retrospective surveys is not agreed upon by all researchers.

Implications

This action research study has implications for practice and future research. These implications will be addressed in this section. First, the implications for practice with be presented, followed by the implications for future research.

Implications for Practice

The results of this study suggest implications for future practice. There are several main implications that will be described in this section: (a) connect across various platforms and keep the structure of the online community basic and easy to follow, (b) personal and job-related connections in the online group help to build accountability and relevance, and (c) online content should include relatively quick tasks that promote application such as including short videos, and be adaptable to a variety of content areas.

The first implication for practice is that the platform for the online community should be familiar, easy to access, and part of the participants' typical online routine. In order to make the online community accessible to more participants, it should be connected across various platforms. In this study, only one platform was utilized in order to keep the group private and the participants anonymous. In future practice, it would be advantageous to post links to content on Twitter and Instagram, as well as Facebook. Posting the content across platforms would allow users like Audrey to engage using their already established social media routines. Moreover, if someone is considering using a school or work-related platform (e.g. Edmodo or Blackboard), they might contemplate whether the platform is regularly accessed by all the participants and part of their daily routine. It was discovered that participants engaged in the community similarly to how they already engage in those types of collaborative online platforms. Therefore, if the group does not currently engage in using a social, school, or work-related social platform on a regular basis, it may be more challenging to involve the participants in viewing, sharing, and posting content.

The second implication for future practice is that there should be personal and job-related connections in the online group to help build accountability and relevance. In this study, it became evident that having participants in similar roles helped to build relevance in the content of the online group. For example, participants shared how hearing from other teacher educators helped them to better understand how to use technology tools in their own context. They also seemed to trust the advice of their peers over things they might have heard from other sources. Sara stated the following:

> I get ads for technology on my Twitter all the time. I pretty much scroll right by those because for me to engage with that, I'm going to have to find out if it is any good or how I could use it. If someone in the group suggested a technology and showed how they used it, then half the battle of just seeing the Twitter ad is done for me, because here is somebody that I already trust and their opinion. They're already telling me it's cool and they're giving me an idea specifically of how I can use it.

Having some type of job-related or personal connection to the individuals in the group made a difference. In two of the interviews, participants commented on not wanting to let people in the group down by not participating or sharing ideas. Also, several participants set personal goals and expressed a sense of accountability to the group. This was likely a result of the participants me or other people in the online community. In future practice, it would be beneficial to engage the whole group together at least once before the online learning began. This could be through a virtual meeting space or in-person if the project context allowed. A kick-off webinar was provided at the beginning of this project, but only one of the participants attended. However, 16 views of the kick-off webinar video were recorded by YouTube. This indicates that several of the participants watched at least a portion of the video at some point. Since the group already had familiarity with each other this did not seem to be a problem, but if there was a new group of people, it would be important to consider how the group could be connected in some way. Posting personal introduction videos would be a good way to build community or doing a Facebook live video stream where people could chat during the video might be a way to connect the group more personally. Creating personal connections and grouping individuals with similar roles are things that should be considered in future work with creating online communities.

The third implication for future practice is that the online content should include quick tasks and short videos as well as being adaptable to a variety of content areas. In the interviews, participants talked about how the online community provided "just in time" professional development. They referred to seeing quick posts or watching the webinars and getting ideas to use in their own practice. In reviewing the online community content, it was noted that the one-hour webinars were viewed by most participants; however, it is unclear how much of the video they watched or if some of the views were participants watching the video multiple times from different devices. Joslyn shared in her interview that she was never able to join a webinar and suggested that shorter webinars might have been better or easier to join. Gwen gave a similar suggestion in her interview. She expressed that people might be intimidated by longer webinars and that short videos might be more accessible and enticing to users. Therefore, it would be beneficial to host shorter 20-minute webinars focused primarily on participant collaboration and post instructive content in 5 to 10-minute short videos.

In future work with online communities, it is critical to remember that the content needs to be easy to access, quick, and adaptable. Gwen went on to share in her interview that the resources were easy to use and could be connected to a variety of content. She said, "I think you showed us real examples and started basic enough that anybody could use it. You didn't have to be a technology guru to figure it out." The resources that were presented could be used across content areas and allowed participants to think about how they could use it in their own setting. The facilitation of the online community focused on providing a variety of tools and resources for the group to play with, as well as regular requests for participants to share their thoughts, ideas, and examples of technology use.

The facilitator encouraged participation through comments, likes, and example posts. Also, new learning was provided through the online webinars. The webinars focused on technology integration frameworks (TPACK, TETCs, ISTE standards, and SAMR) and gave introductions to a variety of tools that could be used to enhance instruction. Participants were given opportunities to try the tools and resources during the webinars. Not only did this model technology integration, but it also gave the participants the opportunity to apply their learning.

Implications for Future Research

There are two implications for future research suggested from the results of this study. One recommendation would be to delve more deeply into the Teacher Educator Technology Competencies (TETCs). Another recommendation would be to conduct another cycle of research including a wider variety of teacher educators.

The first implication for future research is to consider the use of TETCs, a new resource created in 2017. The TETCs are a set of skills, knowledge, and attitudes needed by teacher educators to effectively integrate technology and prepare pre-service teachers for technology integration. Foulger et al. (2017) conducted a study to collaboratively develop the TETCs through an extensive process that included a variety of stakeholders. Through a clearly designed process, 12 teacher educator technology competencies were developed that each include related criteria. The following is a list of the TETCs:

1. Teacher educators will design instruction that utilizes content-specific technologies to enhance teaching and learning.
2. Teacher educators will incorporate pedagogical approaches that prepare teacher candidates to effectively use technology
3. Teacher educators will support the development of the knowledge, skills, and attitudes of teacher candidates as related to teaching with technology in their content area.

4. Teacher educators will use online tools to enhance teaching and learning.
5. Teacher educators will use technology to differentiate instruction to meet diverse learning needs.
6. Teacher educators will use appropriate technology tools for assessment.
7. Teacher educators will use effective strategies for teaching online and/or blended/hybrid learning environments.
8. Teacher educators will use technology to connect globally with a variety of regions and cultures.
9. Teacher educators will address the legal, ethical, and socially-responsible use of technology in education..
10. Teacher educators will engage in ongoing professional development and networking activities to improve the integration of technology in teaching.
11. Teacher educators will engage in leadership and advocacy for using technology.
12. Teacher educators will apply basic troubleshooting skills to resolve technology issues. (Foulger et al., 2017, pp. 432-433)

The online community in this study addressed several of these competencies; however, there were only a few explicit connections made to the TETCs. They were shared via a webinar and discussed; however, they could have been used as a framework for the development of the community and data collection. For example, teacher educators in the online community focused on Competency 4 (Teacher educators will use online tools to enhance teaching and learning competencies throughout the intervention). In future research, it would be interesting to use the competencies as a framework to support teacher educators in their development of technology integration skills. Also, a survey could be created to measure participants' perceptions related to their implementation of the competencies. This would serve as a helpful guide for teacher educators and professional development facilitators in future research similar to this study.

Another implication for further research would be to expand the participants included in the online community. This study included mostly teacher educators who were serving in roles that were closely connected to teacher candidates in the student

teaching experience—typically the final semester of a teacher preparation program. It would be beneficial to expand the participants and include more methods instructors and other faculty who work with teacher educators. It would be of interest to see how the various roles would impact the content shared in the community. Although it is important to make sure the roles are common enough to maintain relevance, there is a possibility that expanding the types of teacher educators could help to produce more examples and broader thinking for the group. Furthermore, mentor teachers who work with teacher candidates during their student teaching are also teacher educators. It would be intriguing to see the impact of including mentor teachers in the discussion and learning. Considering mentor teachers spend considerable time with teacher candidates, it would be advantageous to include them in professional development related to the TETCs and/or TPACK.

Critical Challenges

Although the overall results of the intervention were positive, there are key challenges that should be addressed. The first challenge was that the facilitation of the online community was extremely time intensive. The group was most active when specific examples of technology integration were shared by the participants; however, these were prompted by the facilitator examples and content. In order to keep the group participating, at least one post per week by the facilitator was required. Also, the facilitator needed to comment on each of the participants' posts in order to encourage them to continue sharing. Moreover, the webinars took planning and time to facilitate. Although may participants did not join the webinars synchronously, there is evidence that participants viewed the webinars at a later time. Also, participants cited using resources

that were shared during the webinars. This would indicate that providing new learning through webinars or videos is helpful to participants, but these take time to plan and present.

Another challenge is the limitations of using one social media platform and the potential challenges of trying to post across platforms. Although it would be recommended that the online group be assessible across various social media platforms, this would require additional time and support by the facilitator. Limiting the group to Facebook excluded some of the participants who were not familiar with the platform. Therefore, finding a platform that is easy to use and accessible to a variety of people is a challenge.

Finally, creating a group that is specialized for a particular type of educator was named as a benefit across multiple interviews; however, this might be difficult to maintain over time. Limiting the group to teacher educators, working with pre-service teachers, allowed the participants to easily share with peers in relevant and meaningful ways. Yet, the participant pool was small. Having a large group of people would likely expand the ideas, resources, and tools that would be shared, but it might be difficult to build a large group that can remain specialized. The content might become less relevant if it expanded to all teacher educators—including those that work with veteran teachers. Or the pool of participants might remain small if the group only caters to teacher educators and not teachers in general.

Conclusion

Pre-service teachers are tasked with teaching in 21st century school environments. Principals are looking for teacher candidates who have a variety of teaching skills—

including the ability to use technology to enhance instruction. Therefore, teacher educators need opportunities to learn technology integration skills in order to model for teacher candidates and offer them opportunities to apply technology in their instruction. This study focused on creating an online community to investigate how teacher educators develop TPACK, while participating in a virtual community. The results showed that teacher educators' TPACK and beliefs were impacted by participating in online learning focused on technology integration. Participants shared ideas and learned from the modeling and examples of their peers in the online community. They valued opportunities to play with new technology and were encouraged by the resources shared by the facilitator and other group members. All six of the participants who were interviewed said that they would participate if the online community continued after the study. They found the resources, modeling, and ideas to be beneficial and worth the time it took to engage with the group. Moreover, the roles of the participants were similar enough to make the content relevant to the majority of the community members, which encouraged their participation and implementation of the ideas gained from the group.

The intervention created in this action research project was a great start in thinking about how to provide meaningful, relevant, and timely professional development for teacher educators. Considering the nature of higher education and the lack of structured professional development for teacher educators, this online community was an appropriate alternative to face-to-face training. The synchronous and asynchronous collaboration that could occur using a social media platform seemed to be an asset to the group and encouraged participation. In the future, spreading the content across various platforms would reach more participants and provide information to members engaging

in other social media outlets. It makes sense to maximize social media resources to provide learning communities for faculty who are spread across the nation but are willing and eager to learn and collaborate with others to improve their practice.

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APPENDIX A

RECRUITMENT AND CONSENT LETTER

Dear Teacher Educator:

My name is Lynda Scott and I am a doctoral student in the Mary Lou Fulton Teachers College (MLFTC) at Arizona State University (ASU). I am working under the direction of Dr. Henriksen, a faculty member in MLFTC. We are conducting a research study on teacher educators' development of technology integration skills. The purpose of this online community and survey collection is to better understand the current situation with respect to teacher educators' ability to use technology to enhance their instruction in various content areas and teacher educators' attitudes and beliefs about the use technology to enhance their instruction in various content areas.

We are asking for your help, which will involve your participation in a 12-week online community. Participation in the online community will take approximately 1-2 hours a week over the next 12 weeks. Part of the participation in the community will include a 72-item survey concerning your knowledge, competency, attitudes and beliefs related technology integration. We anticipate that the survey will take 30-45 minutes.

Your participation in this study is voluntary. If you choose not to participate or withdraw from the study at any time, there will be no penalty whatsoever. You must be 18 years of age or older to participate. Due to the group nature of this project, all posted comments and interactions in the online community will be seen by others and; therefore, are not confidential. However, we will not share identifiable data with anyone outside of the online community.

Responses to survey items or interview questions outside of the online community will be anonymous. Results from this study may be used in reports, presentations, or publications but your name will not be used.

The benefit to participation is the opportunity for you to reflect your attitudes and beliefs about the use of technology and its integration across content areas. Your survey responses will also inform future research questions related to teacher educators' beliefs and attitudes towards technology integration. Thus, there is potential to enhance the experiences of your colleagues and students. There are no foreseeable risks or discomforts to your participation.

If you have any questions concerning the research study, please contact the research team – Danah Henriksen at Danah.Henriksen@asu.edu or Lynda Scott at Lynda.Scott@asu.edu or 602-

Lynda Scott, Doctoral Student
Danah Henriksen, Assistant Professor

If you have any questions about your rights as a participant in this research, or if you feel

you have been placed at risk, you can contact the Chair of Human Subjects Institutional Review Board through the ASU Office of Research Integrity and Assurance at (480) 965-6788.

Consent

Your signature below indicates that you have decided to volunteer as a research participant for this study, and that you have read and understood the information provided above. You will be given a signed and dated copy of this form to keep, along with any other printed materials deemed necessary by the study researchers.

Subject's Name (print)		Date:
Subject's Signature:	_____	_____
Researcher's Signature:	_____	Date: _____

APPENDIX B

SURVEY

As part of our study related to teacher educators' use of technology, we would like to ask about your knowledge, attitudes and beliefs related to technology integration. Since there are varying definitions of technology, for the purpose of this study we will define technology as digital devices, tools, and resources. Examples of technology would be iPads, cell phones, presentation software (e.g. Prezi, PowerPoint, Google Slides, etc...), social media sites, digital productivity tools, etc...

If you are not currently teaching coursework, you can consider professional development trainings as your lessons/instruction and participants/attendees as your students.

Your responses are anonymous and all data collected will remain secure and confidential. Your participation in this survey is voluntary. If you choose not to participate or withdraw from the survey at any time, there will be no penalty whatsoever. You must be 18 years of age or older to participate. Your responses will be confidential. Anonymous results from this study may be used in reports, presentations, or publications but your name will not be used.

The survey should take about 30-35 minutes to complete.

We value your input.

If you have any questions concerning the research study, please contact the research team – Danah Henriksen at Danah.Henriksen@asu.edu or Lynda Scott at Lynda.Scott@asu.edu or 602-332-1692.

Theory of Planned Behavior Section

The first six items of this survey are modified from Sadaf et al (2012) and are intended to measure attitudes towards technology infusion. The survey items were selected from the attitudes section of the survey. "Web 2.0 technologies" was replaced with "integrating technology" to modify the items to match this action research project. Several items were added at the end of the survey to collect additional information from the participants.

For each statement, choose the response that best fits your feelings BEFORE participating in the online group and AFTER participating in the online group.

	BEFORE participating in the online group:				AFTER participating in the online group:			
	Strongly Agree	Agree	Disagree	Strongly Disagree	Strongly Agree	Agree	Disagree	Strongly Disagree
I feel that playing with technology is a fun way to learn.	○	○	○	○	○	○	○	○
I feel that playing with new technology helps me become better at using technology in my instruction.	○	○	○	○	○	○	○	○
I feel that listening to my peers' experiences of playing with technology helps me improve my technological knowledge.	○	○	○	○	○	○	○	○
I feel that my students should have opportunities to play with new technology during their coursework.	○	○	○	○	○	○	○	○

Describe your context (e.g. teaching environment, classroom setting, school or organization, and societal or political contexts).

Describe your students or the people you train/instruct (e.g. various characteristics, beliefs, general attitudes, and behaviors related to technology integration).

Describe your experiences related to integrating technology in your instruction PRIOR to participating in the online group.

Describe your experiences related to integrating technology in your instruction AFTER participating in the online group.

Did your participation in the online group have an impact on you as a teacher educator? Why or why not?

Based on your experience in the online group, what advice would you have for other teacher educators who might be interested in technology integration?

Please share any additional comments or suggestions below:

Math Content Knowledge

For each statement, choose the response that best fits your feelings BEFORE participating in the online group and AFTER participating in the online group.

	BEFORE participating in the online group:				AFTER participating in the online group:			
	Strongly Agree	Agree	Disagree	Strongly Disagree	Strongly Agree	Agree	Disagree	Strongly Disagree
I know how to solve my own technical problems.	○	○	○	○	○	○	○	○
I can learn technology easily.	○	○	○	○	○	○	○	○
I keep up with important new technologies.	○	○	○	○	○	○	○	○
I frequently play around with technology.	○	○	○	○	○	○	○	○
I know about a lot of different technologies.	○	○	○	○	○	○	○	○
I have the technical skills I need to use technology.	○	○	○	○	○	○	○	○
I have had sufficient opportunities to work with different technologies.	○	○	○	○	○	○	○	○

Math Content Knowledge

For each statement, choose the response that best fits your feelings BEFORE participating in the online group and AFTER participating in the online group.

	BEFORE participating in the online group:				AFTER participating in the online group:			
	Strongly Agree	Agree	Disagree	Strongly Disagree	Strongly Agree	Agree	Disagree	Strongly Disagree
I have sufficient knowledge about mathematics.	○	○	○	○	○	○	○	○
I can use a mathematical way of thinking.	○	○	○	○	○	○	○	○
I have various ways and strategies of developing my understanding of mathematics.	○	○	○	○	○	○	○	○
I have sufficient knowledge about mathematics.	○	○	○	○	○	○	○	○

Social Studies Content Knowledge

For each statement, choose the response that best fits your feelings BEFORE participating in the online group and AFTER participating in the online group.

	BEFORE participating in the online group:				AFTER participating in the online group:			
	Strongly Agree	Agree	Disagree	Strongly Disagree	Strongly Agree	Agree	Disagree	Strongly Disagree
I have sufficient knowledge about social studies.	○	○	○	○	○	○	○	○
I can use a historical way of thinking.	○	○	○	○	○	○	○	○
I have various ways and strategies of developing my understanding of social studies.	○	○	○	○	○	○	○	○

Science Content Knowledge

For each statement, choose the response that best fits your feelings BEFORE participating in the online group and AFTER participating in the online group.

	BEFORE participating in the online group:				AFTER participating in the online group:			
	Strongly Agree	Agree	Disagree	Strongly Disagree	Strongly Agree	Agree	Disagree	Strongly Disagree
I have sufficient knowledge about science.	○	○	○	○	○	○	○	○
I can use a scientific way of thinking.	○	○	○	○	○	○	○	○
I have various ways and strategies of developing my understanding of science.	○	○	○	○	○	○	○	○

Literacy Content Knowledge

For each statement, choose the response that best fits your feelings BEFORE participating in the online group and AFTER participating in the online group.

	BEFORE participating in the online group:				AFTER participating in the online group:			
	Strongly Agree	Agree	Disagree	Strongly Disagree	Strongly Agree	Agree	Disagree	Strongly Disagree
I have sufficient knowledge about literacy.	○	○	○	○	○	○	○	○
I can use a literary way of thinking.	○	○	○	○	○	○	○	○
I have various ways and strategies of developing my understanding of literacy.	○	○	○	○	○	○	○	○

Pedagogical Knowledge

For each statement, choose the response that best fits your feelings BEFORE participating in the online group and AFTER participating in the online group.

	BEFORE participating in the online group:				AFTER participating in the online group:			
	Strongly Agree	Agree	Disagree	Strongly Disagree	Strongly Agree	Agree	Disagree	Strongly Disagree
I know how to assess student performance in a classroom.	○	○	○	○	○	○	○	○
I can adapt my teaching based upon what students currently understand or do not understand.	○	○	○	○	○	○	○	○
I can adapt my teaching style to different learners.	○	○	○	○	○	○	○	○
I can assess student learning in multiple ways.	○	○	○	○	○	○	○	○
I can use a wide range of teaching approaches in a classroom setting.	○	○	○	○	○	○	○	○
I am familiar with common student understandings and misconceptions.	○	○	○	○	○	○	○	○
I know how to organize and maintain classroom management.	○	○	○	○	○	○	○	○

Pedagogical Content Knowledge

For each statement, choose the response that best fits your feelings BEFORE participating in the online group and AFTER participating in the online group.

	BEFORE participating in the online group:				AFTER participating in the online group:			
	Strongly Agree	Agree	Disagree	Strongly Disagree	Strongly Agree	Agree	Disagree	Strongly Disagree
I can select effective teaching approaches to guide student thinking and learning in mathematics.	○	○	○	○	○	○	○	○
I can select effective teaching approaches to guide student thinking and learning in literacy.	○	○	○	○	○	○	○	○
I can select effective teaching approaches to guide student thinking and learning in science.	○	○	○	○	○	○	○	○
I can select effective teaching approaches to guide student thinking and learning in social studies.	○	○	○	○	○	○	○	○

Technological Content Knowledge

For each statement, choose the response that best fits your feelings BEFORE participating in the online group and AFTER participating in the online group.

	BEFORE participating in the online group:				AFTER participating in the online group:			
	Strongly Agree	Agree	Disagree	Strongly Disagree	Strongly Agree	Agree	Disagree	Strongly Disagree
I know about technologies that I can use for understanding and doing mathematics.	○	○	○	○	○	○	○	○
I know about technologies that I can use for understanding and doing literacy.	○	○	○	○	○	○	○	○
I know about technologies that I can use for understanding and doing science.	○	○	○	○	○	○	○	○
I know about technologies that I can use for understanding and doing social studies.	○	○	○	○	○	○	○	○

Technological Pedagogical Knowledge

For each statement, choose the response that best fits your feelings BEFORE participating in the online group and AFTER participating in the online group.

	BEFORE participating in the online group:				AFTER participating in the online group:			
	Strongly Agree	Agree	Disagree	Strongly Disagree	Strongly Agree	Agree	Disagree	Strongly Disagree
I can choose technologies that enhance the teaching approaches for a lesson.	○	○	○	○	○	○	○	○
I can choose technologies that enhance students' learning for a lesson.	○	○	○	○	○	○	○	○
Professional development opportunities provided during my time in education have helped me to think more deeply about how technology could influence the teaching approaches I use in my classroom.	○	○	○	○	○	○	○	○
I am thinking critically about how to use technology in my classroom.	○	○	○	○	○	○	○	○
I can adapt the use of the technologies that I am learning about to different teaching activities.	○	○	○	○	○	○	○	○

Technological Pedagogical Content Knowledge

For each statement, choose the response that best fits your feelings BEFORE participating in the online group and AFTER participating in the online group.

	BEFORE participating in the online group:				AFTER participating in the online group:			
	Strongly Agree	Agree	Disagree	Strongly Disagree	Strongly Agree	Agree	Disagree	Strongly Disagree
I can teach lessons that appropriately combine literacy, technologies, and teaching approaches.	○	○	○	○	○	○	○	○
I can teach lessons that appropriately combine mathematics, technologies, and teaching approaches.	○	○	○	○	○	○	○	○
I can teach lessons that appropriately combine science, technologies, and teaching approaches.	○	○	○	○	○	○	○	○
I can teach lessons that appropriately combine social studies, technologies, and teaching approaches.	○	○	○	○	○	○	○	○
I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn.	○	○	○	○	○	○	○	○
I can use strategies that combine content, technologies, and teaching approaches that I learned about in professional development opportunities in my classroom.	○	○	○	○	○	○	○	○
I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at my place of work, school and/or district.	○	○	○	○	○	○	○	○
I can choose technologies that enhance the content for a lesson.	○	○	○	○	○	○	○	○

Please provide the following demographic information:

What is your gender?

- ○ Male
- ○ Female
- ○ Other

What is your age?

- ◯ 18-24 years old
- ◯ 25-34 years old
- ◯ 35-44 years old
- ◯ 45-54 years old
- ◯ 55-64 years old
- ◯ 65 years or older

How long have you worked in education?

- ◯ Less than one year
- ◯ 1-3 years
- ◯ 4-6 years
- ◯ 7-9 years
- ◯ 10-12 years
- ◯ 13-15 years
- ◯ 16 years or more

Do you have opportunities to observe student teachers' instruction during their student teaching experience?

- ◯ Yes
- ◯ No
- ◯ Other

Do you teach a course or courses in a teacher preparation program?

- ◯ Yes
- ◯ No
- ◯ Other

Did you regularly use Facebook prior to participating in the online group?

- ◯ Yes
- ◯ No
- ◯ Other

How often did you view posts or interact in the online group?

- ◯ Daily
- ◯ 4-6 times a week
- ◯ 2-3 times a week
- ◯ Once a week
- ◯ Never
- ◯ Other

Thank you for your participation in this survey!

If you have any questions concerning the research study, please contact the research team – Danah Henriksen at Danah.Henriksen@asu.edu or Lynda Scott at Lynda.Scott@asu.edu or 602-332-1692.

If you have any questions about your rights as a participant in this research, or if you feel you have been placed at risk, you can contact the Chair of Human Subjects Institutional Review Board through the ASU Office of Research Integrity and Assurance at (480) 965-6788.

APPENDIX C

RECRUITMENT/CONSENT FORM AND INTERVIEW QUESTIONS

Dear Online Community Participant:

My name is Lynda Scott and I am a doctoral student in the Mary Lou Fulton Teachers College (MLFTC) at Arizona State University (ASU). I am working under the direction of Dr. Henriksen, a faculty member in MLFTC. We are conducting a research study on teacher educators' development of technology integration skills. The purpose of this interview is to better understand teacher educators' experiences developing Technological Pedagogical Knowledge (TPACK) and their participation in the online community focused on technology integration.

We are asking for your help, which will involve your participation in an interview concerning your knowledge, experiences, attitudes, and beliefs about technology integration and best practices to facilitate learning in online communities. I anticipate this interview to take 30-40 minutes. I would like to audio record this interview. The interview will not be recorded without your permission. Please let me know if you do not want the interview to be recorded; you also can change your mind after the interview starts, just let me know.

Only the research team will have access to the recordings. The recordings will be deleted immediately after being transcribed and any published quotes will be anonymous. To protect your identity, please refrain from using names or other identifying information during the interview.

Your participation in this study is voluntary. If you choose not to participate or withdraw from the study at any time, there will be no penalty whatsoever. You must be 18 years of age or older to participate.

The benefit to participation is the opportunity for you to reflect on and think more about your knowledge, experiences, attitudes, and beliefs about technology integration. Interview responses will also inform future work around teacher educators' development of TPACK. Thus, there is potential to enhance the experiences of our colleagues and students. There are no foreseeable risks or discomforts to your participation.

Your responses will be confidential. Results from this study may be used in reports, presentations, or publications but your name will not be used.

If you have any questions concerning the research study, please contact the research team – Danah Henriksen at Danah.Henriksen@asu.edu or Lynda Scott at Lynda.Scott@asu.edu or 602-332-1692.

Thank you,

Lynda Scott, Doctoral Student
Danah Henriksen, Assistant Professor

If you have any questions about your rights as a participant in this research, or if you feel you have been placed at risk, you can contact the Chair of Human Subjects Institutional Review Board through the ASU Office of Research Integrity and Assurance at (480) 965-6788.

Online Community Participant Interview Questions:

1. Describe your experience participating in the online community.

2. Where did you get ideas for technology integration before the online community?

3. Has your experience in the online community impacted your use of technology? Why or why not?

4. In what ways have you utilized technology in your instruction since your involvement in the online community? Can you give a specific example?

5. Has your use of technology changed as a result of your participation in the online community? Why or why not?

6. Did your experiences "playing" with new technology impact your skills, attitudes, beliefs or knowledge related the technology integration? Why or why not?

7. How do you go about choosing the technology you will use in your instruction? Please explain.
    a. Follow-up questions: What kind of decision-making process do you use when choosing technology to use in your instruction? What criteria do you use for selecting technology to use in your lessons?

8. Do you feel confident in your ability to choose technologies to teach specific content areas? Please explain.

9. In what ways has your use of technology enhanced your instruction and teaching quality? Can you give a specific example?

10. In what ways has your use of technology inhibited your instruction and teaching quality? Can you give a specific example?

11. How has the use of technology had an impact on students' learning experiences during a lesson? Can you give a specific example?

12. Will you continue to use technology in your instruction? Why or why not?
    a. If yes: Can you give a specific example of how you would like to use technology in your instruction in the future?

13. What types of tools, resources, and/or professional development do you need to help you successfully integrate technology in your instruction?

APPENDIX D

ONLINE COMMUNITY OBSERVATION

The observations will be reviewed and coded using the following categories:

Context (C)	references to or evidence of macro, meso, or micro context • Macro – societal or political context • Meso – school or organizational context • Micro – classroom and learning environment
Technological Knowledge (TK)	references to or evidence of the participants' knowledge of various technologies—including knowing their purpose and how to use them.
Content Knowledge (CK)	references to or evidence of the participants' understanding and demonstrating proficiency in the content that is to be taught.
Pedagogical Knowledge PK)	references to or evidence of the participants' understanding of teaching methods and skills, such as lesson planning, classroom management, differentiation, and teaching strategies
Pedagogical Content Knowledge (PCK)	references to or evidence of the participants' combination of both content knowledge and pedagogical knowledge to implement specific pedagogical methods to best teach content
Technological Content Knowledge (TCK)	references to or evidence of the participants' integration of knowledge of various technologies to be able to choose technology resources that best teach/enhance the content
Technological Pedagogical Knowledge (TPK)	references to or evidence of the participants' ability to emphasize the use of technology to enhance teaching practices and methods
Technological Pedagogical Content Knowledge (TPACK)	references to or evidence of the participants' ability to combine of all the sets of knowledge in a tapestry of expertly woven teaching methods, content, and technology to most effectively teach any content or skill
Attitudes	references to or evidence of the teacher educators'

(A-T) Teacher Educator (A-S) Student Teacher	attitudes about using technology to enhance instruction references to or evidence of the student teachers' attitudes about using technology to enhance instruction
Behaviors (B-T) Teacher Educator (B-S) Student Teacher	references to or evidence of the participants' behaviors related to using technology to enhance instruction references to or evidence of the student teachers' behaviors related to using technology to enhance instruction
Play (P)	references to or evidence of the participants' playing with new technology

APPENDIX E

ADMINISTRATOR AND MENTOR QUESTIONS

Mentor and Administrator Questions:

1. In what ways have you seen pre-service teachers utilize technology in their instruction? Can you give a concrete specific example?

2. To what extent does pre-service teachers' use technology enhance their instruction and teaching quality? Please explain.

3. To what extent do pre-service teachers' use technology to teach specific content skills? Please explain.

4. How does the use of technology have an impact on students' learning experiences during a lesson? Please explain

5. Have you ever used the Technology Integration Matrix? If so, what were your experiences with it? Can you give a concrete specific example?

6. To what extent you think pre-service teachers are taught how to integrate technology in a way that improves their instruction quality and student learning experiences? Please explain.

Pre-Service Teacher Questions:

1. In what ways have you utilized technology in your instruction?
2. How do you go about choosing the technology you will use in your instruction? Please explain.

3. In what ways has your use of technology enhanced your instruction and teaching quality? Can you give a specific example? Can you remember a specific instance?
4. In what ways has your use of technology inhibited your instruction and teaching quality? Can you give a specific example?

5. Does the use of technology have an impact on students' learning experiences during a lesson? Why or why not? How do you know?

6. Have you ever used the Technology Integration Matrix? If so, what were your experiences with it? Can you give a concrete specific example?

7. To what extent have you been taught how to integrate technology in a way that improves your instruction quality and student learning experiences? Please explain.

8. Do you feel confident in your ability to choose technologies to teach specific content areas? Please explain.

9. In what ways do you imagine you will use technology in your instruction in the future?

APPENDIX F

RECRUITMENT/CONSENT FORM

Dear Colleagues and Pre-Service Teachers:

My name is Lynda Scott and I am a doctoral student in the Mary Lou Fulton Teachers College (MLFTC) at Arizona State University (ASU). I am working under the direction of Dr. Michelle Jordan, a faculty member in MLFTC. We are conducting a research study on pre-service teachers' use of technology and best practices to facilitate experiential learning. The purpose of this interview is to better understand the current situation with respect to pre-service teachers' ability to use technology effectively to enhance their instruction and student learning experiences.

We are asking for your help, which will involve your participation in an interview concerning your knowledge, experiences, attitudes, and beliefs about pre-service teachers' use of technology and best practices to facilitate experiential learning. We anticipate this interview to take 20 minutes total. I would like to audio record this interview. The interview will not be recorded without your permission. Please let me know if you do not want the interview to be recorded; you also can change your mind after the interview starts, just let me know.

Only the research team will have access to the recordings. The recordings will be deleted immediately after being transcribed and any published quotes will be anonymous. To protect your identity, please refrain from using names or other identifying information during the interview.

Your participation in this study is voluntary. If you choose not to participate or withdraw from the study at any time, there will be no penalty whatsoever. You must be 18 years of age or older to participate.

The benefit to participation is the opportunity for you to reflect on and think more about the use of technology and best practices to facilitate experiential learning. Interview responses will also inform future iterations of the study. Thus, there is potential to enhance the experiences of our students/parents/clients. There are no foreseeable risks or discomforts to your participation.

Your responses will be confidential. Results from this study may be used in reports, presentations, or publications but your name will not be used.

If you have any questions concerning the research study, please contact the research team – Michelle Jordan at michelle.e.jordan@asu or (480) 965-9663 or Lynda Scott at Lynda.Scott@asu.edu or 602-332-1692.

Thank you,

Lynda Scott, Doctoral Student
Michelle Jordan, Assistant Professor

Please let me know if you wish to be part of the study by verbally indicating your consent.

If you have any questions about your rights as a participant in this research, or if you feel you have been placed at risk, you can contact the Chair of Human Subjects Institutional Review Board through the ASU Office of Research Integrity and Assurance at (480) 965-6788.

APPENDIX G

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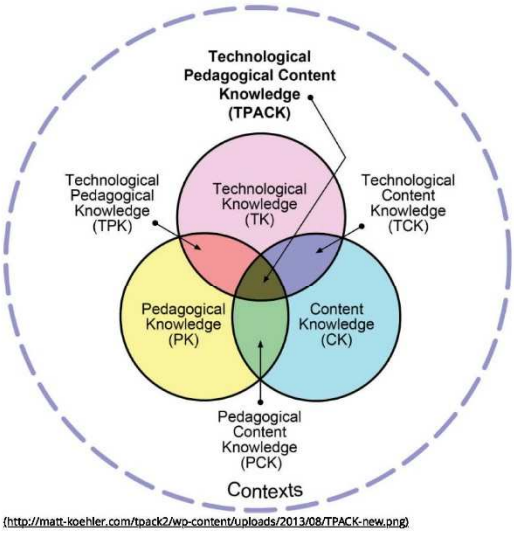

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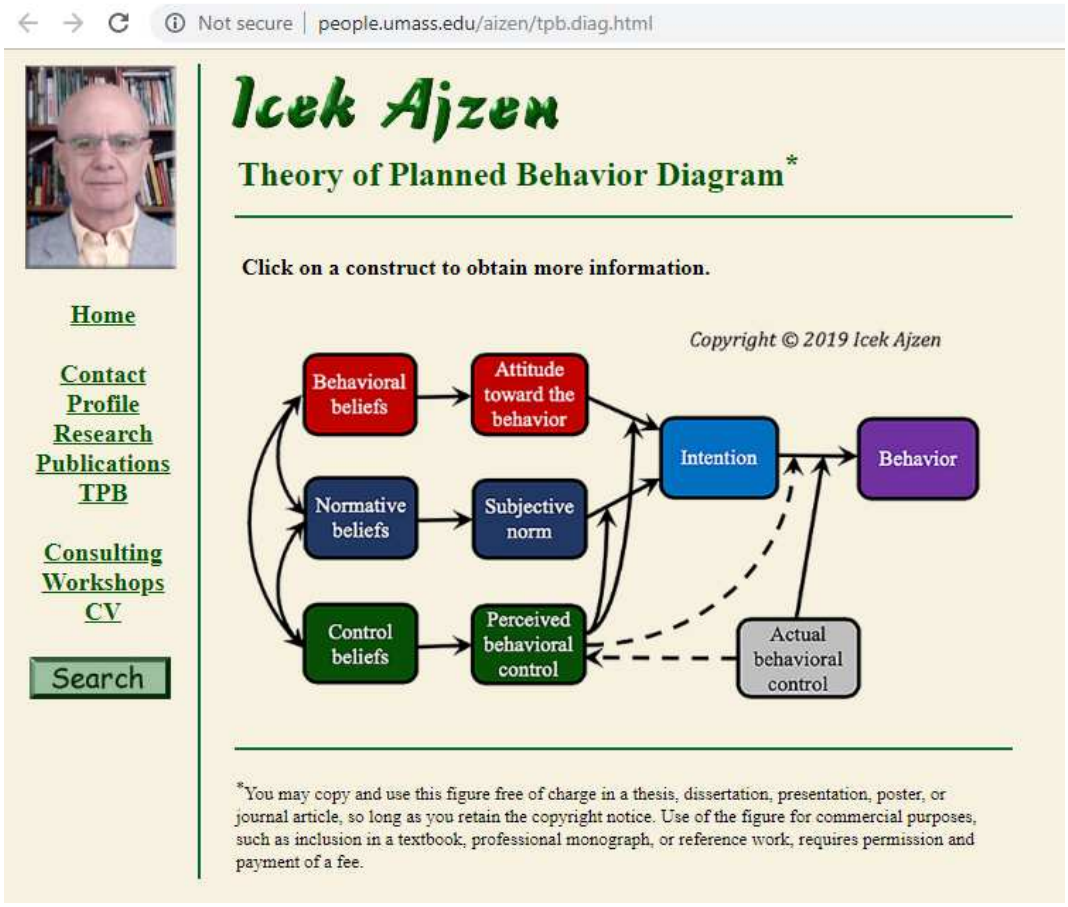

APPENDIX H

TIMELINE OF EACH PHASE

Phase 1: Implementation

Action	Timeframe in 2018
An online community was created using a closed Facebook page and linked out to unlisted YouTube videos and other resources that supported the group.	February 14th
Three initial entries were added to the page for starter content: Introduction to the group including the purpose, expectations, and norms	February 14th
Invitations to the online community and participation in the study were sent via email. A webinar was scheduled to share the purpose of the study and formally invite interested participants.	February 15th - March 13th
Invitation webinar	March 16th
Follow-up and collection of all participant signatures	March 16th- March 26th

Phase 2: Introduction

Action	Timeframe in 2018
Invitations to planned webinars were posted to the group	March 26th
Poll on participant feeling related to learning about technology integration was posted to the group	March 26th
Poll on participants' favorite interactive technology application, device, or online program that they use in their instruction and presentations	March 28th
Kick-off webinar event (recorded): Participants were introduced to the major goals of the online community and the TPACK framework to aid participants in thinking about levels of technology use. Participants were given multiple examples of technology integration at various levels and were encouraged to create goals related to technology integration that stretched them beyond their current technology use.	March 30th
Posts asking participants to reflect on the content from the kick-off webinar	March 30th and 31st
Poll to determine if any webinar dates and times should be modified for more synchronous participation.	April 1st
Introduction to ISTE Standards (recorded): A guest speaker presented on the ISTE Standards and what skills, knowledge, and dispositions that are needed in order for students to be able to use technology effectively. Participants were given opportunities to apply their learning by examining video examples of technology integration and discussing the ISTE Standards that were addressed.	April 4th
Posts asking participants to reflect on the content from the ISTE Standards webinar	April 4th-April 6th

Phase 3: Exploration

Action	Timeframe in 2018
Playing with Technology Part 1: 1. Playing with technology introduction screencast (pre-recorded) and connection to ISTE Standard 4: Collaborator, as well as student ISTE Standard 1: Empowered Learner 2. The facilitator posted a model example with a description of a new technology tool and how it could be used in instruction. 3. Participants were asked to share an artifact about a new technology resource/tool that they used in their instruction or training to enhance the content. This was a two-week session and the facilitator posted additional examples and resources to keep the collaboration active and maintained an ongoing discussion and sharing of ideas and artifacts over the time period.	April 16th - April 27th
Playing with Technology Part 2: 1. Deep Dive into ISTE Standard 4: Collaborator Webinar-- participants were introduced to ideas for using collaborative tools to expand students' learning. The facilitator conducted a webinar on technology tools and resources to promote collaboration in the classroom. The participants were given opportunities to collaborate during the webinar using the various tools. 2. Participants were asked to play with one of the modeled tools or find a new collaborative tool to play with and share their experience or artifacts with the group in the coming week.	April 30th
Posts asking participants to reflect on the content from the collaboration tools/resources webinar and encouragement to post new tools used by participants	April 30th- May 4th
Using Technology to Enhance Content: 1. The facilitator posted resources related to each main content area represented in the TPACK framework. Over the course of three weeks, four specific content area posts were made to the group by the facilitator (approximately one every 5-6 days). Participants were encouraged to find, play with, and add resources and technology tools to the specific content area discussions.	May 7th – May 24th

Deep Dive into ISTE Standard 7: Analyst Webinar: 1. The facilitator presented ways to use technology to assess student learning and to help students reflect on their learning 2. The facilitator modeled technology within the webinar that could be used to assess student learning.	June 6th
Posts of specific tools for assessing students were posted to the group. Participants were asked to play with new tools and post their reflections.	June 6th – June 21st

Phase 4: Reflection

Action	Timeframe in 2018
Final Webinar and Reflection Session: 1. The facilitator posted asking participants to share their reflections and any new tools, resources, or content that they found useful and/or plan to use in the future. 2. Participants were contacted to participate in interviews 3. Participants were provided with the link to the survey	June 24th – July 12th
Interviews	July-September
Survey Results Collected	July-September