Online Professional Development’s Effect on Teachers’ Technology Self-Efficacy and Continuance Intention to Use Pear Deck

Katherine Shirley Degar

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ONLINE PROFESSIONAL DEVELOPMENT’S EFFECT ON TEACHERS’ TECHNOLOGY SELF-EFFICACY AND CONTINUANCE INTENTION TO USE PEAR DECK

by

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DEDICATION

I dedicate this dissertation to my parents and to my two amazing sons, Lincoln and Kain. I owe a tremendous thank you to my entire family for supporting me throughout my educational journey.

To my “bubbas”, thank you for your endless patience as I have worked towards my degree; I know how much time together we sacrificed. I hope I have shown you what can happen with some hard work and grit, regardless of past mistakes. Never stop learning and growing!

From the very bottom of my heart, I would like to thank my parents, Rick and Sharon, who have supported me in any way I needed throughout this process. From endless hours of childcare so that I could write, to feeding me dinner, to cheering me on when I was tired, the support you provided was truly priceless.
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I am grateful for the teachers who participated in my research. Being on the tail end of COVID-19 added stress to everyone’s plate, but these teachers were still willing to help me and support my dream. I appreciate all my friends and colleagues who cheered me on during the past few years. Marika, you have been so patient as my time has been limited with school. I cannot wait to celebrate with you!

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Finally, to the Professional Development Fellowship and its liaison, Dr. Currin, a sincere thank you. I can easily say I would not have been able to complete this degree without the financial support of the PDS Fellowship. Dr. Currin has always been a cheerleader in the background and a huge support when I needed help. Thank you for allowing me, who at one time did not even know if I would ever graduate college, the opportunity to prove to myself that I could achieve my dream.
ABSTRACT

Districts and schools are spending millions of dollars on technology, training, and professional development each year; however, a disconnect between technology use and good pedagogy remains. The one-shot, sit-and-get professional development model has not provided North Lake Intermediate School’s teachers the necessary skills and knowledge to prepare students for the 21st century through the use of innovative technologies. The purpose of this action research study was to investigate how a TPACK-focused online professional development experience influenced teachers’ development of technology self-efficacy and intention to integrate the technology tool, Pear Deck, and measure changes in their attitudes toward Pear Deck.

The innovation in this study was a TPACK-focused, online, asynchronous professional development. Participants had access to optional pre-learning material and discussion forums, an asynchronous professional development presentation, and personalized feedback reports in response to their reflection questions. A convergent mixed-methods design yielded supplementary sources of data: quantitative data gathered through a modified TAM pre and post survey and lesson plans and qualitative data from teacher reflections and semi-structured interviews. Analyzing and converging interview data revealed the impact of online teacher professional development on intermediate teachers’ technology self-efficacy, changes in attitudes toward Pear Deck, and continuance intentions to integrate Pear Deck. Implications from this study include providing asynchronous TPACK-focused online professional development to positively
impacts teachers’ technology self-efficacy, attitudes toward Pear Deck, and continuance intentions. However, further studies should be done to address how external barriers may be overcome.
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CHAPTER 1

INTRODUCTION

National Context

Integration of instructional technology is becoming more prevalent across the United States. Pre-pandemic, on average, over 70% of public school students reported using a device at school (OECD, 2015), and 65% of public school teachers reported using digital learning tools every day to teach (Gallup, 2019). At the middle school level, 40% of students received their own device to use in school (Gallup, 2019). Since the start of the Coronavirus (COVID-19) pandemic, 94% of public schools now provide students, K through 12, with a digital device (Kuykendall, 2022).

This increase in instructional technology use has coincided with districts’ spending hundreds of thousands of dollars on devices for students and teachers. For example, in 2013, Los Angeles Unified School District spent over thirty million dollars for a 3-year contract with Apple to provide iPads for students (Molnar, 2017). To support equitable access to educational technology nationwide, Congress passed the Every Student Succeeds Act (ESSA, 2015), which provides up to $1.65 billion annually through grants. The goal of ESSA is to promote active learning using instructional technology tools and strategies that deepen students’ knowledge (Mesecar, 2015). Although districts may only use 15% of the funds for devices and technology infrastructure, up to 60% can apply to training, professional development, and outside coaches (Center for Digital Education, 2017). However, despite this funding and support, there is a disconnect
between having technology in the classroom and using it in ways that enhance student learning (Burch & Mohammed, 2019; Kopcha, 2012; Lisenbee, 2016; McKnight et al., 2016). When the COVID-19 pandemic hit in 2020 causing schools to shift to virtual models, the government stepped in with the Elementary and Secondary School Emergency Relief (ESSER) fund. The three phases of ESSER provided $189.5 billion dollars to schools (Albanese, 2022). While the due date for fund allocation for the second and third phases has not passed yet, based on current data collected by the National Conference of State Legislatures (Reid, 2022), technology accounts for approximately 10% of spending or around $19 billion dollars. This allowed for low-technology districts to quickly adopt new technologies as shown by the aforementioned 24% jump in devices in schools.

The National Educational Technology Plan (U.S. Department of Education, 2017) addressed a growing divide in the use of devices across the country. Even though technology is more accessible, some students use technology in innovative ways that transform their learning and increase their 21st-century skills while others merely replace paper with a digital tool (Hohlfeld et al., 2008). To be effective, technology should be an integral and cohesive part of instruction rather than a separate piece (Okojie et al., 2005), as in the technological pedagogical content knowledge (TPACK) framework, which helps teachers consider how content, pedagogy, and technology intersect to use technology effectively (Koehler & Mishra, 2009). However, some teachers lack the necessary digital pedagogies to combine innovative technology with effective classroom practices (Prestridge & Tondeur, 2015). Such teachers need support and training to help them incorporate technology in a meaningful way (Bingimlas, 2019; Ertmer, 1999).
Traditional sit-and-get or one-shot workshop instructional technology professional development models are ineffective in supporting teachers in shifting their pedagogical practices with integrating technology (Albion et al., 2015; Cifuentes et al., 2011; Gulamhussein, 2013; Hanover Research, 2014; Mouza, 2002; So, 2012). Short-term professional development experiences do not help teachers overcome barriers to change, such as negative attitudes or low self-efficacy. To be effective, professional development should last at least 20 hours, include active learning to engage faculty, provide opportunities for observation, and offer constructive and actionable feedback (Czajka & McConnell, 2016; Garet et al., 2001; Stes et al., 2010).

Teachers need sustained opportunities for authentic, hands-on experiences with integrating new tools, as well as opportunities to discuss these tools with colleagues (Cifuentes et al., 2011; Desimone et al., 2002; Garet et al., 2001; Gunter & Reeves, 2017; Liao et al., 2017). Many teachers may have technological knowledge that does not transfer into practice (Kim et al., 2013). Opportunities for collective participation are critical to pedagogical change. Effective professional development can lead to an increase in teachers’ technology self-efficacy and, therefore, an increase in integration of technology in the classroom (Gunter & Reeves, 2017; Hall et al., 2019).

Current barriers to technology integration include lack of time and sustained support (Alenezi, 2017; Cifuentes et al., 2011; Guenther, 2002; Voogt & McKenney, 2017). Additionally, due to the COVID-19 pandemic, in-person professional development opportunities were limited due to social distancing requirements (McBride, 2020). In response, K–12 districts nationwide have considered alternate forms of instructional technology professional development, such as online professional
development, to decrease those obstacles for teachers (Gunter & Reeves, 2017; Prestridge, 2017; Prestridge & Tondeur, 2015).

**Local Context**

South Carolina’s Educational Technology Plan recommends innovative and emerging instructional models to support student learning any time and any place (South Carolina Department of Education, 2020). In 2017, the State Department of Education released the *South Carolina Computer Science and Digital Literacy Standards* to promote “world-class knowledge, skills, and life and career characteristics identified in the Profile of the South Carolina Graduate” (South Carolina Department of Education, 2017, p. 5), which correlate to 21st-century skills.

School District One of Lakeview County (2019) supports the Educational Technology Plan and Computer Science and Digital Literacy Standards through the iFive Technology Initiative, which prioritizes preparing 21st-century students through innovative technologies that strengthen students’ work and citizenship competencies. The Digital Integration Specialist (DIS) position was created to support this district-wide vision. DISs are responsible for collaborating with teachers to integrate technology into the curriculum; assisting educators in creating lessons that utilize technology; and planning, developing, and facilitating professional development, training, and other technology sessions.

As a DIS at North Lake Intermediate School, I offered teachers the opportunity for instructional technology coaching, yet 100% either declined due to a lack of time or did not respond to my email. During the 2019–2020 school year, I offered less than 3 hours of instructional technology professional development. The administration at the
time did not provide protected time for instructional technology, and the 45-minute, one-shot workshops I was able to offer did not work well in promoting pedagogical change. Without sustainable, high-quality professional development, teachers cannot build the necessary technology self-efficacy to integrate innovative technologies in the classroom.

Statement of the Problem

Teachers at North Lake Intermediate School in South Carolina, do not utilize technology tools effectively or innovatively to support 21st-century students. Teachers without sufficient knowledge and skills about the integration of technology need to attend effective professional development to improve their technology self-efficacy and intention to integrate technology. Current professional development models do not lead to pedagogical change: opportunities are not sustained, inauthentic, and focus on tools rather than pedagogy. Instead, professional development designed following a TPACK framework can help teachers make connections among technology, content, and pedagogy.

Purpose Statement

The purpose of this study was to investigate how TPACK-focused online professional development influenced teachers’ development of technology self-efficacy and intention to integrate the tool, Pear Deck, and measure changes in their attitudes toward Pear Deck at North Lake Intermediate School in South Carolina.

Research Questions

1. How does a TPACK-focused online professional development experience influence intermediate school teachers’ development of technology self-efficacy?
2. How, if at all, do intermediate school teachers’ attitudes toward Pear Deck change following a TPACK-focused online professional development experience?

3. How does TPACK-focused online professional development influence intermediate school teachers’ intentions of continuing to use Pear Deck?

Statement of Research Subjectivities and Positionality

Having never planned to work in educational technology, I was lucky to fall into a career for which I have a great deal of passion. I became a teacher by chance, taking a long-term substitute position as a career changer after being encouraged by my parents, both of whom are educators. As my district moved to one-to-one iPads, I took on this challenge to try new things and found that being willing to make mistakes and try again allowed me to be innovative in my classroom. This willingness to try new pedagogical practices led to the opportunity to become an instructional technology coach.

I consider myself a lifelong learner and always want to be knowledgeable about my subject area. Having flunked out of college, I wanted to continue my education and prove to myself that I was still capable of achieving my dreams. After repeated failures of being accepted back into a bachelor’s program, I was finally accepted at University of South Carolina-Aiken and spent one year raising my GPA in order to transfer to University of South Carolina-Columbia. Once I became an instructional technology coach, I wanted to expand my expertise by earning a master’s degree in Digital Leading and Learning and subsequently applied to a doctoral program.

Having now spent more time as an instructional technology coach than as a classroom teacher, I am a bit biased about the importance of integrating technology in a meaningful way in the classroom. I believe all classes should utilize instructional
technology to personalize learning and incorporate 21st-century learning skills. I consider Kieschnick’s (2017) Bold School Framework imperative when incorporating any instructional technology in the classroom: teachers should “identify desired academic outcome(s), select a goal-aligned instructional strategy that works, choose [the] digital tool(s), plan instruction, self-assess [their] plans and progress with a framework” (p. 36). Placing the desired learning goals at the forefront can ensure instruction uses technology to enhance learning rather than simply for technology’s sake. The understanding of how pedagogy, content, and technology can work together to support the learning goals can foster engagement and student collaboration (Maor, 2013).

My research paradigm followed a pragmatic worldview. I was open to different avenues to conduct my study and followed the pragmatic ontological idea that individuals interpret reality in unique ways (Mertens, 2009). The understanding that individuals have their own perceptions of reality was an essential counterweight to my own biases.

Technically, I held an insider positionality, yet I believe I was often viewed as an outsider-within (Herr & Anderson, 2005). This view is, in part, due to the nature of the coaching role itself. Instructional technology coaches are not part of the administrative team but can be perceived as such. Herr and Anderson (2005) described this scenario well, stating: “We may occupy positions where we are included as insiders while simultaneously, in some dimensions, we identify as outsiders” (p. 44). I tried to minimize this perceived power differential by including the participants, inviting them to act as collaborators, and periodically seeking their feedback on what was working well during my action research study (Creswell & Creswell, 2018).
Definition of Terms

Adult Learning Theory: This study reflects the following principles of andragogy: (1) self-direction, (2) intrinsic motivation, (3) use of background knowledge to make connections to new learning, (4) readiness to learn and apply new knowledge, (5) need to know the why of the learning, and (6) ownership of the learning (Fornaciari & Lund Dean, 2014; Knowles, 1974, 1977, 1980, 1984).

Barriers: In this study, barriers include anything that prevents or inhibits implementation of educational technology.

Effective Professional Development: For the purpose of this study, effective professional development must focus on subject matter content; allow teachers to be active in their learning; be consistent and cohesive with school and state expectations and policies; encompass at least 20 hours of contact time; and include teachers from the same grade band and subject area to foster professional learning communities (Desimone, 2011; Lydon & King, 2009; Martin et al., 2015).

Enablers: For this study, enablers are factors positively influence teachers’ technology integration.

Online Professional Development: For this study, online professional development occurs asynchronously through technology tools.

Professional Development: My definition of professional development combines Garet et al.’s (2001) idea that it increases teachers’ knowledge and skills with Cochran-Smith and Lytle’s (1999) notion of knowledge in practice—that collaboration, reflection, and experience increase knowledge. In this study, professional development thus includes any
opportunity that increases teachers’ knowledge and skills through activities such as collaboration or reflection.

**Teacher Attitudes:** In this study, attitudes and beliefs are interchangeable terms, following the definition of an attitude as “a relatively enduring organization of beliefs around an object or situation predisposing one to respond in some preferential manner” (Rokeach, 1968, p. 112). Specifically, attitudes refer to teachers’ beliefs around technology that may affect classroom integration.

**Technology Integration:** Combining the Technology in Schools Taskforce (U.S. Department of Education, National Center for Education Statistics, 2002) and Albion et al.’s (2015) definitions, technology integration in this study refers to the incorporation of a variety of technology resources and technology-based practices into the daily classroom routine to engage students seamlessly and effectively in meaningful learning activities.

**Technology Professional Development:** In this study, technology professional development includes face-to-face, hybrid, or online learning experiences designed to increase teachers’ skills and knowledge around using technology for teaching.

**Technology Self-Efficacy:** I define technology self-efficacy as teachers’ belief in their ability to work with and use technology in their classrooms successfully.

**TPACK:** My use of this term reflects my understanding that knowing how content knowledge, technological knowledge, and pedagogical knowledge connect and interact enables teachers to combine these domains in deep and meaningful ways to improve student learning.
CHAPTER 2

LITERATURE REVIEW

The purpose of this mixed-methods action research study was to investigate how TPACK-focused online professional development influenced teachers’ technology self-efficacy and instructional planning at North Lake Intermediate School in South Carolina, to structure future professional development effectively. Reviewing current literature provided the necessary foundation to answer the following research questions:

1. How does a TPACK-focused online professional development experience influence intermediate school teachers’ development of technology self-efficacy?

2. How, if at all, do changes in intermediate school teachers’ attitudes toward Pear Deck change following a TPACK-focused online professional development experience?

3. How does TPACK-focused online professional development influence intermediate school teachers’ intentions of continuing to use Pear Deck?

Method

Based on my research questions, I used a variety of keywords to locate relevant literature, including teacher professional development or professional development, online professional development, barriers, information and communication (ICT) or technology integration, TPACK, self-efficacy, teacher attitudes, teacher beliefs, effective professional development, online learning, and action research. Combining keywords narrowed the results to more specific references, which I filtered to include only
resources from peer-reviewed journals, dissertations, or books published within the last 5 years. I gathered references for this review using databases through University of South Carolina Libraries, ERIC, EBSCO, Education Source, ScienceDirect, Taylor & Francis Group, Academic Search Complete, and ProQuest Dissertations & Theses Global. I also mined Google Scholar for references as needed and explored the reference sections of useful texts for additional sources. I applied Pyrczak and Tcherni-Buzzeo’s (2019) guidance to analyze each source’s relevance, bias, and validity.

This review of the current literature is organized into six major sections: (a) theoretical frameworks for professional development; (b) professional development, including online professional development; (c) technology integration; (d) teachers’ attitudes toward technology integration; and (e) teachers’ technology self-efficacy.

**Theoretical Frameworks for Professional Development**

Theoretical frameworks act as maps to guide researchers in organizing and supporting their data collection, analysis, and interpretation (Anfara & Mertz, 2014). This review of current literature begins with an examination of the four theoretical frameworks in this study. First, adult learning theory or *andrology* focuses on how adults learn. Second, self-efficacy is the belief in one’s own ability. Third, TPACK is the acronym for the combination and interaction of the three domains of technological knowledge, pedagogical knowledge, and content knowledge. Finally, the Technology Acceptance Model (TAM) is used to determine whether a technology will be accepted by a user based on perceived usefulness and perceived ease of use.
Knowles’s Andragogy or Adult Learning Theory

Adult learners warrant different approaches than younger students. The two aspects of adult learning theory most germane to my study are the definition of adult learning theory and a description of the characteristics of the adult learner.

**Definition of Adult Learning Theory**

Knowles (1980) defined adult learning theory, also known as andragogy, as the art and science of helping adults learn, in contrast with pedagogy, helping children learn. According to Knowles (1974), adult learners should: (a) be intrinsically motivated, (b) be self-directed, (c) use their experience as a reservoir for learning, (d) show a readiness to learn, (e) be problem-centered, and (f) be ready to apply new knowledge immediately. Knowles (1984) later added that adults need to know the why—or rationale—for learning. In line with Knowles’s description of self-directed learners, Fornaciari and Lund Dean (2014) highlighted how andragogical principles shift learning toward the adult learner and away from the teacher, supporting student ownership. Cox (2015) expounded on Knowles’s characteristics by correlating them with instructional coaching principles, suggesting teachers may need extrinsic motivation through coaching.

**Description of the Characteristics of the Adult Learner**

In this study, my definition of andragogy follows these prior understandings of key principles: (a) exhibiting self-direction, (b) possessing intrinsic motivation, (c) using background knowledge to make connections to new learning, (d) being ready to learn and apply new knowledge, (e) needing to know the why of the learning, and (f) taking ownership of one’s learning (Fornaciari & Lund Dean, 2014; Knowles, 1974, 1977, 1980, 1984). First, learners who are self-directed take responsibility and do not need others to
influence them to participate (Cox, 2015). Second, as learners mature into adults, extrinsic motivation becomes less necessary; their motivation becomes internal or intrinsic (Knowles, 1977). Another characteristic is that adults’ prior knowledge enables them to make connections to new learning. Further, adult learners learn when they are ready, especially when they are ready to apply new knowledge, so they tend to learn when something is new or changing (Cox, 2015). Knowles et al. (2011) added that knowing the why, or being life-centered (Cox, 2015), describes adults’ need to correlate learning to real-world problems. Lastly, adult learners take ownership of their learning through student-centered learning opportunities with a facilitator rather than an instructor (Fornaciari & Lund Dean, 2014).

**Bandura’s Theory of Self-Efficacy**

Bandura (1977) described perceived self-efficacy as individuals’ own judgment of their abilities to complete a particular action. Self-efficacy “is concerned not with the skills one has but with the judgments of what one can do with whatever skills one possesses” (Bandura, 1986, p. 391). With teachers, in particular, self-efficacy predicts their willingness to try innovations that may be perceived as difficult (Fogleman et al., 2011). Teachers’ self-efficacy beliefs are key contributors to “motivation and performance” (Hodges, 2008, p. 266) as well as the amount of effort, time, and resiliency put forth when trying something new (Pajares, 1996). The stronger the sense of self-efficacy, the greater the effort (Lee & Bobko, 1994; Pajares, 1996), whereas less self-efficacy can lead to avoidant behaviors (Kirsch, 1985).

Individuals’ feelings of inefficacy can alter performance (Pajares, 1996), inhibiting effort or causing avoidance (Bandura, 1997). In particular, teacher self-efficacy
can impact implementation of new practices (Keys & Bryan, 2000). Teachers with a strong sense of self-efficacy are more likely to persevere when faced with difficult situations (Lee & Bobko, 1994). For example, Inan and Lowther (2010) found that teachers’ technology self-efficacy can impact their technology integration.

According to Rosen and Weil (1995), teachers will not feel prepared to integrate technology until they feel “skilled and comfortable” (p. 25). As part of integrating technology, teachers need to develop “a nuanced understanding of the complex relationships between technology, content, and pedagogy” (Koehler & Mishra, 2006, p. 1029). In other words, understanding how to utilize technology properly could be considered a prerequisite for technology self-efficacy (Kwon et al., 2019).

**TPACK Framework**

In this section, I (a) define TPACK, (b) explain its influence on technology integration, and (c) explore TPACK-based professional development.

*Definition of TPACK*

The idea of technological knowledge emerged to account for the difference between technology introduction and technology integration in the classroom (Hickman, 1990). Koehler et al. (2002) suggested separate elements for teaching using technology—content, technology, representation, and pedagogy—must interact. The ensuing framework Koehler and Mishra (2005) developed became known as TPACK (see Figure 2.1). The TPACK framework is based on Shulman’s (1986) concept of pedagogical content knowledge: effective teaching requires combining the knowledge of teaching (i.e., pedagogy) with content knowledge.
TPACK comprises three main domains of teachers’ knowledge: technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK), as well as “interactions between and among these bodies of knowledge” (Koehler & Mishra, 2009, p. 62). Archambault and Barnett (2010) defined TPACK as understanding the connections and interactions between and among content knowledge (subject-matter that is to be taught), technological knowledge (computers, the Internet, digital video, etc.), and pedagogical knowledge (practices, processes, strategies, procedures, and methods of teaching and learning) to improve student learning. (p. 1656)

Similarly, I define TPACK as the understanding of how content knowledge, technological knowledge, and pedagogical knowledge connect and interact to effectively combine these domains in deep and meaningful ways to improve student learning (Koehler & Mishra, 2005).
Okojie et al. (2005) suggested that “technology used for teaching and learning should be considered an integral part of instruction and not as an object exclusive to itself” (p. 66). The TPACK framework brings together three necessary domains for successful classroom integration of technology. However, Bingimlas’s (2009) meta-analysis found that two of the most significant barriers to technology integration are a lack of confidence and competence. When teachers do not understand how technology can support pedagogy and content, their technology use will be surface-level (Bustamante, 2020; Koh et al., 2017). In contrast, effective technology integration meets the following criteria:
• technology integration is a unified part of the lesson;
• the purpose of the technology is clear and the teacher can explain its contribution;
• the focus is on learning and not technology;
• the teacher can explain how technology is supporting a student’s learning;
• the lesson objectives would be difficult to meet without technology; and
• all students are advancing and using the technology (Cifuentes et al., 2011).

Increasing teachers’ TPACK increases the likelihood of effective technology integration to support instruction (Bustamante, 2020; Dalal et al., 2017; Knapp, 2017).

Providing teachers with TPACK resources promotes necessary pedagogical change. Koh (2019) presented teachers with TPACK design scaffolds, including learning rubrics and TPACK activity types. Oda et al. (2020) used premade lessons to ease teachers into using new technology, and Koh et al. (2017) provided TPACK design rubrics for teachers to assess and redesign their lessons. Across these studies, technology integration increased when teachers used TPACK resources during professional development.

**TPACK-Focused Professional Development**

Increasing teachers’ TPACK requires effective professional development. Modeling, discussing, and reflecting on how technological knowledge, pedagogical knowledge, and content knowledge interact helps teachers gain a deeper understanding of TPACK. Professional development must explicitly teach the use of the technology and how it can intersect with pedagogy and content (Oda et al., 2020). Allowing reflection and discussions on how modeled lessons incorporate technology into the content helps teachers make connections between pedagogy and technology (Bustamante, 2020).
Modeling the use of technology in a content area as part of professional development especially improves teachers’ self-efficacy in the technology-related dimensions (TCK, TK, TPK, and TPACK) (Beriswill et al., 2016). To be effective, TPACK-based professional development should include these components. For this study, I will be using the TPACK framework to guide my research.

**Technology Acceptance Model**

The TAM is a “theoretical model that predicts how a user comes to accept and use a given information technology (Holden, 2011, p. 344). The TAM survey was first introduced by Davis in 1989 and focused on the Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) of a system. PU is defined as “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, 1989, p. 320), while PEOU refers to “the degree to which a person believes that using a particular system would be free of effort” (Davis, 1989, p. 320). The TAM (see Figure 2.2) makes an assertion that PU is influenced by PEOU which, in turn, impacts attitude (ATT), behavioral intention to use (BI), and actual use (Fathema et al., 2015). PU and ATT then have a direct influence on BI given that if a user finds a technology useful and has a positive attitude towards it, they “develop a positive intention of using it” (Fathema et al. 2015, p. 212). This model also was based off the theory of reasoned action (TRA) (Fishbein & Ajzen, 1975) which attempted to explain the relationship between a person’s attitude, intention to perform a behavior and performance of said behavior. Ajzen (1991) expanded on the TRA to include perceived behavioral control which was then developed into the theory of planned behavior. Lai (2013) defines
perceived behavioral control as “people’s perceptions of their ability and the availability of the support necessary to achieve an expected behavior” (p. 103).

Figure 2.2 Modified Technology Acceptance Model (TAM). Adapted from Davis, 1989

The TAM, extended TAM2 (Venkatesh & Davis, 2000), and Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003) illustrate how attitude contributes to behavioral intention of technology use.

**Professional Development**

This section of the literature review addresses five elements related to professional development. First, I define professional development. Then, I review the purpose of professional development in education. Next, I review features of effective professional development. The last two sections focus on technology professional development and online professional development.

**Definition of Professional Development**

Professional development once referred to meetings or training that focused on teachers’ feelings or commitment rather than the results of the training (Desimone, 2011). Garet et al. (2001) defined professional development as activities “that have significant, positive effects on teachers’ self-reported increases in knowledge and skills and changes
in classroom practice” (p. 916). Lydon and King (2009) described professional development as training that brings change to the classroom, while McChesney and Aldridge (2019) defined professional development as any “activit[y] or opportunit[y] for teachers’ professional learning, growth or development” (p. 1). Antoniou and Kyriakides (2013) approached professional development as activities that impact student achievement and teaching skills.

Cochran-Smith and Lytle (1999) presented three different definitions regarding teacher learning or professional development:

1. Knowledge for practice: knowing more leads to more effective practice.
2. Knowledge in practice: knowledge is acquired through experience and deliberate reflection; teachers can learn in collaboration.
3. Knowledge of practice: knowledge is generated through inquiry in the classroom, teachers’ connecting their work to more significant issues, and adopting a critical outlook on theories and research; in other words, practice within the classroom allows a teacher to gain knowledge.

Lastly, ESSA (2015) defined professional development as that which is “focused on improving teaching and student learning and achievement” (p. 127).

In this study, I combined Garet et al.’s (2001) idea that professional development increases teachers’ knowledge and skills with Cochran-Smith and Lytle’s (1999) notion of knowledge in practice, marked by collaboration, reflection, and experience. Professional development for my research refers to any opportunity that increases teachers’ knowledge and skills through activities such as collaboration or reflection.
Purpose of Professional Development

Professional development enables teachers to gain knowledge and skills to improve student achievement (Antoniou & Kyriakides, 2013; Garet et al., 2001). This section reviews the importance of professional development in education and how professional development has changed due to educational technologies.

Importance of Professional Development in Education

Professional development can increase teachers’ knowledge and skills, leading to improved student achievement (Antoniou & Kyriakides, 2013; Bayar, 2014; Doppelt et al., 2009; Kleickmann et al., 2016). Professional development focusing on instructional strategies has been shown to increase student achievement (Andersson & Palm, 2017; Valiandes & Neophytou, 2018). Yoon et al. (2007) found that sustained, content-specific professional development results in a moderate increase (i.e., up to 21 percentile points) in student achievement. Desimone et al. (2013), Lumpe et al. (2012), Antoniou and Kyriakides (2013), and Garet et al. (2001) all had similar results showing an increase in student achievement due to content-specific professional development. Given the correlation between professional development and student achievement, providing effective professional development opportunities for teachers is essential. As Guskey (1994) noted, “we cannot improve schools without improving the skills and abilities of the teachers within them” (p. 9).

Change in Professional Development due to Educational Technologies

In 1918, Bobbit wrote,

Education is now to develop a type of wisdom that can grow only out of participation in the living experiences of men, and never out of mere
memorization of verbal statements of facts. It must, therefore train thought and judgement in connection with actual life-situations, a task distinctly different from the cloistral activities of the past. (p. iv)

Some 100 years later, schools are still struggling with this change in pedagogical practices. Wang and Lu (2012) discussed how teaching is frequently perceived as simply disseminating information to students. However, because students can seek information through internet search engines, Selmer (2015) argued the role of schools is to be innovative and creative.

As society changes with advances in technology, the educational field must keep pace (Bobbit, 1918). The release of the *Profile of the South Carolina Graduate* tasked teachers with teaching new skills and knowledge (SC Education Oversight Committee, 2015). Teachers must have the proper training and opportunity to learn from one another to change pedagogical practice (Abadzi, 2016; Wang & Lu, 2012).

**Features of Effective Professional Development**

Multiple features are keystones in creating effective professional development for educators. These features include (a) a content-specific focus, (b) active learning and modeling, (c) consistent and sustained facilitation, (d) collaborative learning communities, and (e) needs-based design. This review includes scholarship that addresses these features.

**Content-specific**

Effective professional development provides material that is not generic but instead specific to the teacher’s content, (secondary) or grade level (primary) (Gulamhussein, 2013). Very few concepts apply across all disciplines and grade levels,
so content-specific professional development is key to creating pedagogical changes (Gulamhussein, 2013). Through subject-specific professional development, teachers learn how a pedagogical practice can apply to their content, which increases the likelihood of implementation (Desimone & Garet, 2015; Gunter & Reeves, 2017). Hughes (2005) noted, “the more content-specific the example, the more likely the teacher will see value and learn it” (p. 295).

**Active Learning and Modeling**

Active learning positions students as partners in the learning while the teacher acts as a guide or facilitator (Petress, 2008). Teachers can increase their self-efficacy when engaged in active and authentic learning experiences that model using a new practice (Darling-Hammond et al., 2017; Gulamhussein, 2013; Gunter & Reeves, 2017; Knapp, 2017). Hands-on participation builds teachers’ professional competency in incorporating the concept into their instruction (Haug & Mork, 2021; Knapp, 2017; Li et al., 2019; Liao et al., 2017). For example, Bustamante (2020) had participants collaboratively create a variety of technology-based products in the same way that students would be required and found an increase in integrating technology as teachers gained proficiency and understood the tools’ purposes. Not only can teachers gain a deeper understanding of how to combine new concepts in their instruction, but they can also gain confidence from having had the experience themselves (Gulamhussein, 2013; Gunter & Reeves, 2017; Knapp, 2017). In response to active learning strategies, such as open discussion, practice, observation, and feedback, teachers have shown improved knowledge and skills (Desimone, 2011; Desimone et al., 2002; Garet et al., 2001).
**Consistent and Sustained**

Research has repeatedly shown that the 1-day workshop model is ineffective in promoting teacher change (Darling-Hammond et al., 2017; Desimone, 2009; Desimone & Garet, 2015; Duran et al., 2012; Gulamhussein, 2013; Gunter & Reeves, 2017). Teachers need time to learn and master a new skill, which takes both consistency and duration (Darling-Hammond et al., 2017). According to Corcoran et al. (2003), teachers who receive more than 80 hours of professional development are significantly more likely to implement the new skill or practice than those who receive fewer hours. Rienties et al. (2013) recommended professional development spanning 8 to 12 weeks with a minimum of 20–25 hours; however, Desimone and Garet (2015) found that a minimum of 20 hours was sufficient to enact pedagogical change. Regardless of the duration, scholarship suggests effective professional development must occur over a sustained period.

**Collaborative**

Professional learning opportunities where teachers from similar grade levels, content areas, or schools collaborate can foster learning communities (Desimone & Garet, 2015; Haug & Mork, 2021). Such communities enable teachers to co-create educational materials (Admiraal et al., 2019). They also allow teachers to discuss how to facilitate change (Darling-Hammond et al., 2017; Garet et al., 2001) and motivate one another to positively impact the learning community culture (Darling-Hammond et al., 2017; Garet et al., 2001; Haug & Mork, 2021).

**Needs-based**
Just as teachers should formatively assess student learning and needs, professional development facilitators should use surveys or other instruments to determine and address teachers’ needs. Personalized learning opportunities motivate teachers to participate and find relevancy for their classrooms (Kopcha, 2012; Liao et al., 2017). Desimone and Garet (2015) found that teachers have varied responses to professional development due to the differences in content knowledge, experience, and classroom settings. Offering personalized professional development based on teachers’ needs helps teachers feel supported (Liao et al., 2017) and that the experience is relevant (Powell & Bodur, 2019).

**Technology Professional Development**

Technology professional development is integral in improving teachers’ self-efficacy regarding technology integration (Watson, 2006). This section defines technology professional development.

Technology professional development should not only focus on the tool in question but also “involve learning content in context and modeling pedagogically appropriate methods” (Gess-Newsome et al., 2003, p. 330). The goal of technology professional development is for teachers to “provide better instruction for the 21st-century learner and increase student achievement through technology-enhanced learning opportunities” (Lawless & Pellegrino, 2007, pp. 597–598). These principles align with Guskey’s (2000) guidance for professional development in general—that it be “(a) intentional, (b) ongoing, and (c) systemic” (p. 16). Likewise, Holland (2001) argued all professional development should “help and support [teachers] in integrating new knowledge and skills into their classroom teaching” (p. 245).
These definitions are useful but fail to address all necessary features. In my study, technology professional development refers to face-to-face, hybrid, or online learning experiences designed to increase teachers’ skills and knowledge around using technology for teaching.

**Online Professional Development**

Online professional development has become more prevalent, particularly due to COVID-19 (Hartshorne et al., 2020). In this review, I (a) define online professional development, (b) discuss online professional development and technology integration, (c) discuss the benefits of online professional development, and (d) explore online professional development design considerations.

**Definition of Online Professional Development**

Prestridge and Tondeur (2015) described online professional learning as “any-time, self-generating, and on-demand” (p. 200). Similarly, Vrasidas and Zembylas (2004) defined online professional development as “anytime, anywhere” (p. 326). Bates et al. (2016) went further to distinguish between *synchronous* learning that occurs in real-time (e.g., a webinar, live virtual training) and *asynchronous* learning that occurs at different times for different people (e.g., self-paced courses or training). According to Powell and Bodur (2019), online professional development is flexible, cost-effective, and not subject to geographical restrictions.

For this study, online professional development refers to professional development that occurs asynchronously through technology tools.

**Online Teacher Professional Development and Technology Integration**
Online teacher professional development (OTPD), as an alternative to the traditional face-to-face professional development model, can increase teachers’ knowledge and skills around technology integration. Seferoglu and Celen (2020) used online professional development that offered examples of new technologies, collaboration, modeling, and personalization based on participant needs. The experience increased teachers’ skills and knowledge around technology integration, contributing to increased technology integration in the classroom. Sullivan et al. (2018) also used an online model for introducing new tools through hands-on activities. The professional development modules, which described how to use the technologies in various instructional settings, led to an increase in technology integration. Gunter and Reeves (2017) provided teachers with an online professional development model incorporating hands-on activities, scaffolding, and subject-specific content related to new instructional strategies and saw an increase in participants’ technology self-efficacy for classroom integration.

**Benefits of Online Teacher Professional Development**

Online professional development has many benefits due to the nature of being online and potentially asynchronous. Dede et al. (2009) and Stanford-Bowers (2008) cited the popularity of online professional development due to the anytime, anywhere flexibility that fits into teachers’ busy schedules. Asynchronicity allows teachers to work through resources at their own pace when they have time (Russell et al., 2009). Online professional development also provides opportunities that may not be available locally (Dede et al., 2009; Stanford-Bowers, 2008).

**Online Teacher Professional Development Design Considerations**
OTPD should adhere to the same features that make face-to-face professional development effective; however, other features also warrant consideration (Collins & Liang, 2015). These features include reflection, discussion forums, collaboration, feedback, and personalization.

One critical OTPD design consideration is incorporating reflection. Self-reflection helps teachers process their learning and think about how to incorporate it into their practice (Beriswill et al., 2016; Powell & Bodur, 2019; Vrasidas & Zembylas, 2004). Reflective components of professional development give teachers necessary time to think about their learning and how to apply it, increasing the likelihood of instructional change.

Another feature of high-quality OTPD is using discussion forums to build community and informally assess learning. Asynchronous discussions allow participants to learn from others’ experiences (Rienties et al., 2013), while synchronous discussions create engagement through communities of practice (Powell & Bodur, 2019; Vrasidas & Zembylas, 2004). For example, Rienties et al. (2013) invited participants to converse asynchronously about their assignments, experiences, and challenges via discussion forums. Powell and Bodur (2019) found that synchronous discussions addressed participants’ need for social interaction which, in turn, promoted engagement and learning. Communities of practice also arise through collaboration, which addresses the social aspects of learning. Providing opportunities in OTPD for teachers to interact with one another promotes engagement and learning (Powell & Bodur, 2019; Teräväinen & Kartoglu, 2017), as does allowing participants to discuss challenges that emerge during the OTPD (Rienties et al., 2013).
Opportunities for participants to receive feedback are another design consideration in OTPD. Whether automated, from a peer, or from a mentor or facilitator, feedback stimulates reflection, which is necessary for pedagogical change (Philipsen et al., 2019). Woodward and Hutchison (2018) found that lack of feedback acted as a barrier to implementing a technology integration plan in the classroom, while Teräis and Kartoglu (2017) found that both peer and mentor feedback promote learning.

A final OTPD design consideration is personalization, which enhances relevance. Lack of personalization can frustrate teachers, as Powell and Bodur (2019) noted, yet an OTPD experience can address personalization in several ways. Woodward and Hutchison (2018) used weekly emails to offer personalized support based on participants’ goals. OTPD can be personalized through content or delivery method (e.g., videos, discussions, modeling), based on a preliminary needs assessment (Liao et al., 2017; Seferoglu & Celen, 2020). A third way to personalize OTPD is providing a variety of course or session options (Hall & Trespalacios, 2019). School District One of Lakeview County uses the latter method: for district-wide technology professional development, teachers choose to learn about a variety of tools or instructional strategies.

**Technology Integration**

A central theme related to this study is technology integration. The information in this section is organized into the following topics: (a) defining technology integration, (b) reviewing the history and importance of technology integration in education, (c) identifying factors affecting technology integration, (d) and discussing instruments to measure teachers’ technology integration, along with previous research methodologies.

**Definition of Technology Integration**
Technology integration has varied definitions in research, particularly as one-to-one initiatives have become more prevalent. For example, the 2003–2009 Educational Technology Plan for Virginia described technology integration as enhancing instruction through technology (Virginia Department of Education, 2003); however, this vague definition lacks clarity and guidance. In the 2010–2015 plan, the Department of Education updated their definition by adopting the *School Technology and Readiness Report*, which stated that “effective technology integration ‘transforms the learning environment so that it is student-centered, problem and project-centered, collaborative, communicative, customized and productive’” (The CEO Forum on Education and Technology, 2001, p. 5).

According to the National Educational Technology Standards for Students, effective technology integration occurs when students can select the appropriate technology tool to reach their learning goal (International Society for Technology in Education, 2016). Others, such as Albion et al. (2015), argued instead for technology-enabled learning, which “engag[es] [students] in meaningful learning activities rather than ICT integration being adopted as an isolated goal” (p. 657). Beetham and Sharpe (2013) also used this term to describe situations when technology enables students “to interact with each other and with the representations of the subject matter [in ways] that could simply not be achieved for those learners without it” (p. 67). These definitions have suitable components but fail to encompass a full definition—from the technology used to the act of integration. The Technology in Schools Taskforce provided a clearer definition:

Technology integration is the incorporation of technology resources and technology-based practices into the daily routines, work, and management
of schools. Technology resources are computers and specialized software, network-based communication systems, and other equipment and infrastructure. Practices include collaborative work and communication, Internet-based research, remote access to instrumentation, network-based transmission and retrieval of data, and other methods. This definition is not in itself sufficient to describe successful integration: it is important that integration be routine, seamless, and both efficient and effective in supporting school goals and purposes. (U.S. Department of Education National Center for Education Statistics, 2002, p. 75)

Combining this definition with that from Albion et al. (2015), my study treats technology integration as the incorporation of a variety of technology resources and technology-based practices into the daily classroom routine to seamlessly and effectively engage students in meaningful learning activities.

**Value of Technology Integration in Education**

The creation of the Internet and personal computers greatly impacted how individuals choose to access information, learn, and socialize (Chung, 2007; Hartman et al., 2019). Cloete (2017) went so far as to argue that technology is a “medium that shapes culture” rather than simply a tool (p. 1). With information available at one’s fingertips, the traditional educational setting no longer addresses students’ current needs (Office of Educational Technology, U.S. Department of Education, 2017).

Technology integration in education facilitates change in learning culture from traditional, teacher-centered instruction to student-centered instruction (Hartman et al., 2019; Moeller & Reitzes, 2011). Hsu (2016) found that teachers with constructivist, or
student-centered, pedagogical beliefs tended to have high technology self-efficacy, found value in technology use, and integrated technology accordingly. Technology has also “increase[d] access to education and improve[d] its relevance and quality” (Raja & Nagasubramani, 2018, p. 34). Additionally, new technologies have increased student performance, learner efficiency, engagement, and student attitudes toward learning (British Educational Communications and Technology Agency [BECTA], 2009), as well as provided enhanced learning opportunities that previously would have been unavailable (Raja & Nagasubramani, 2018). To produce those qualities and skills described in the Framework for 21st Century Learning (Partnership for 21st Century Learning, 2019) and the Profile of the South Carolina Graduate (SC Education Oversight Committee, 2015), schools must enable students to use technology regularly in preparation for success in today’s world and workplace.

**Factors Affecting Technology Integration**

Two main factors affect technology integration: barriers, such as lack of confidence, lack of time, and lack of leadership; and enablers, such as integration into the curriculum, leadership support, and teacher attitudes and beliefs. In this section, I define barriers and enablers before elaborating on the following factors: (a) time, (b) leadership support, (c) professional development, (d) teacher attitude, and (e) self-efficacy.

Barriers include anything that may prevent a teacher from integrating technology in their classroom. Ertmer (1999) defined barriers to include both first-order and second-order barriers. First-order barriers are extrinsic factors such as lack of resources and technical support. Second-order barriers are intrinsic and include lack of confidence, lack of time, lack of resources, attitudes, and beliefs. BECTA (2004, as cited by Bingimlas,
defined barriers based on whether they were caused by the individual (i.e., time, confidence, attitudes) or institution (i.e., lack of training or resources). Another definition of barriers, from Pelgrum (2001), deals with whether the barrier is material (e.g., lack of computers) or nonmaterial (e.g., lack of knowledge or time). For this study, I defined barriers as anything that prevents or inhibits technology integration into education.

Opposite of barriers are enablers or those factors that act as positive influences on teachers’ technology integration (Cifuentes et al., 2011; Ertmer & Ottenbreit-Leftwich, 2010; Goktas et al., 2009). These forces support and promote technology integration within a building. According to Goktas et al. (2009), enablers, like barriers, may be extrinsic (e.g., funds for technology in the building, leadership support) or intrinsic (e.g., teachers’ attitudes and self-efficacy). However, for this study, I treat enablers as anything that supports or enables technology implementation in the classroom.

Time

One of the most significant factors affecting teachers’ technology integration is time. Teachers need the opportunity to play with new technology before attempting to implement it in the classroom (Cifuentes et al., 2011; Ertmer & Ottenbreit-Leftwich, 2010; Kopcha, 2012; Lawrence & Tar, 2018), as well as time to plan technology-enhanced lessons (Francom, 2020; Kopcha, 2012). Otherwise, they may get caught in a loop, thinking, “I don’t know how to do it and I don’t have the time to learn, and if I learn, I don’t have time to do it” (Ertmer et al., 2012, p. 429). Providing time for teachers to learn and plan to use new technologies acts as a positive factor for technology integration, whereas a lack of time acts as a barrier (Lawrence & Tar, 2018).

Leadership Support
School leaders and administrators contribute to school culture. In fact, Gibson (2001) suggested teacher preparation is not the biggest issue with technology integration; rather, effective leadership has the most significant effect. Leaders must provide broad support for technology (Cifuentes et al., 2011; Thannimalai & Raman, 2018), yet I am referring specifically to the need to support and encourage teachers’ technology integration in the classroom. Leaders must encourage and model appropriate technology integration (Francom, 2020; Mouza, 2002). Teachers and administrators must have a shared vision of technology integration for it to occur (Kopcha, 2012; Lawrence & Tar, 2018; Thannimalai & Raman, 2018). Additionally, teachers must feel supported to try new technologies in their classrooms (Ertmer & Ottenbreit-Leftwich, 2010; Lawrence & Tar, 2018). When building leaders support technology integration, teachers are more likely to use technology in the classroom. For example, Grant et al. (2015) found that administrators who championed the use of technology were an important support for teachers when integrating technology. Without support, fewer teachers will be willing to integrate (Ertmer et al., 2012).

Professional Development

Professional development for technology integration must focus on the intersection of technology and pedagogy to effectively impact change. Technology should support instruction and content rather than serve as a standalone tool (Kieschnick, 2017; Okojie et al., 2005). Therefore, professional development must train teachers on the how of a tool and how the tool can support instruction (Ertmer & Ottenbreit-Leftwich, 2010, 2013). Wetzel et al. (2001) found that providing opportunities for teachers to learn about a technology and design technology-enhanced lessons led to an
increase in technology integration. Liao et al.’s (2017) surveys also showed that content-specific professional development for technology is more effective.

**Teacher Attitude**

Teachers’ attitudes toward technology, technology integration, and the value of technology play a role in classroom integration (Bingimlas, 2009; Ertmer & Ottenbreit-Leftwich, 2010; Ertmer et al., 2012; Francom, 2020; Kao et al., 2020; Lawrence & Tar, 2018). Ertmer et al. (2012) found that internal barriers such as self-efficacy and attitudes notwithstanding, the most significant factor in teachers’ technology integration was other teachers’ beliefs and attitudes—a topic I address later in this literature review.

**Self-Efficacy**

Teacher self-efficacy with technology use is another factor that greatly influences whether a teacher is ready and willing to integrate technology in the classroom (Bingimlas, 2009; Ertmer & Ottenbreit-Leftwich, 2010; Holden & Rada, 2011; Lawrence & Tar, 2018). Teachers’ beliefs in their abilities to successfully use technology can act as a deterrent if their self-efficacy is low (Holden & Rada, 2011). I discuss this topic in greater detail in a later section.

**Professional Development for Technology Integration Research Methods**

This section examines methodologies in previous studies of how professional development impacts technology integration. I address quantitative, qualitative, and mixed-methods approaches.

**Quantitative Studies**
Quantitative studies gather data that can be compared numerically. For example, survey research can measure attitudes and characteristics to take a snapshot of a population (Mertler, 2020). In previous studies regarding professional development and technology integration, surveys served as pre and post assessments of change over time. For example, Li (2019) used longitudinal surveys to study the impact of professional development for 4 years, whereas Beriswill et al. (2016) used survey data to research change for 4 weeks. Rientes et al. (2013) also used pre and post survey data to measure how teachers’ beliefs and intentions toward using technology changed over the 8–12 week online professional development model.

**Qualitative Studies**

Historically, professional development has proven ineffective (Birman et al., 2000; Darling-Hammond et al., 2017). Therefore, qualitative data can provide more insight into the how and why of professional development’s impact (Yin, 2014). Conducive to a deeper understanding of how professional development affects technology integration, gathering qualitative data enables researchers to “richly describ[e] a scene” (Tracy, 2020, p. 5). For example, Bustamante’s (2020) case study of Spanish teachers’ professional development on technology included interviews, observations, and documents to explore how participants’ experiences in the professional development affected their technology integration in the classroom. Liu et al. (2015) utilized observations, instructional plans (i.e., lesson plans), and focus-group interviews to gain a deeper understanding of the benefits of collaboration between preservice and mentor teachers in developing their technology integration. Sullivan et al. (2018) employed summary reflective posts and comments on a professional development blog to analyze
participants’ experiences and learning and gain insight for developing future opportunities. Prestridge (2014) also analyzed reflective blogs to understand how professional development activities impacted participants’ pedagogical practices when using technology; however, only one of 16 teachers maintained a reflective blog for the entire year.

Open-ended survey questions are often part of mixed-methods studies that combine the analytical aspect of a survey with descriptions at the end of the survey to understand how interventions impact the outcome; however, Oda et al. (2020) used a pre and post survey and discussions to qualitatively examine how a TPACK-based professional development experience influenced technology integration for geography teachers. All of these qualitative studies allowed the researchers to gain a deeper understanding of the specificities of why or how professional development enacted change if any.

**Mixed-Methods Studies**

Mixed-methods studies combine quantitative numerical data with descriptive qualitative data, yielding “a stronger understanding of the problem or question than either by itself” (Creswell & Creswell, 2018, p. 213). For example, Hutchison and Woodward (2018) combined quantitative pre and post surveys on self-efficacy with journals, observations, interviews, and fieldnotes to understand the effect of professional development on planning technology-rich lessons and self-efficacy changes. Barton and Dexter (2020) used a similar method, collecting monthly quantitative survey data examining informal and formal professional learning opportunities with teacher interviews regarding technology integration and teachers’ confidence using technologies.
Kim et al. (2013) used quantitative survey data to measure teachers’ beliefs and interviews and observations to examine teachers’ technology use. After a 4-year professional development program, the researchers collected these data to explore why integration levels among teachers vary to help improve professional development in technology integration.

Loftus (2020) used a triangulated, or concurrent, mixed-methods research design in which participants completed quantitative pre and post surveys on their beliefs about technology integration and posted on discussion boards. Additionally, Loftus interviewed selected participants. The survey allowed for comparison of participants’ beliefs before and after professional development, while the discussion posts and interviews let the researcher explore how the experience influenced teacher readiness for technology integration. Dalal et al. (2017) also used concurrent mixed methods to explore the complexities of how professional development impacts technology integration, particularly when using the TPACK framework. This particular mixed-methods design enables researchers to “directly compare and contrast quantitative statistical results with qualitative findings or to validate or expand quantitative results with qualitative data” (Creswell & Clark, 2007, p. 62). This process synthesizes exploration of quantitative data (e.g., surveys) and qualitative data (e.g., interviews, observations) for a more complete understanding of how professional development impacts technology integration.

**Teachers’ Attitudes Toward Technology Integration**

An important factor influencing technology integration is teachers’ attitudes and beliefs toward technology integration. This section defines teachers’ attitudes and discusses how teachers’ attitudes impact technology integration.
Defining Teachers’ Attitudes

Attitudes determine how people view situations and their corresponding behavior (Pickens, 2005). Teachers’ attitudes toward technology can serve as a barrier to integrating technology (Ertmer et al., 2012); however, positive attitudes toward technology can positively correlate to technology integration (Akbaba, 2013).

According to Cherry (2019), attitudes have three components:

- the cognitive component, meaning thoughts or beliefs regarding a subject;
- the affective component, meaning feelings about the subject; and
- the behavioral component, meaning how attitude influences behavior.

However, Fishbein (1967) noted empirical research treats the three components separately, causing confusion around the term attitude.

For this study, I use attitudes and beliefs as interchangeable terms and define attitude as “a relatively enduring organization of beliefs around an object or situation predisposing one to respond in some preferential manner” (Rokeach, 1968, p. 112). Specifically, attitudes and beliefs interchangeably refer to teachers’ beliefs around technology and corresponding effects on their integration of technology in the classroom.

Teacher Attitudes and Their Impact on Technology Integration

Teachers’ attitudes have been shown to serve as a significant barrier or enabler to technology integration (Bingimlas, 2009; Khlaif, 2018). Positive teacher attitudes toward technology increase the likelihood of their using technology in the classroom (Khlaif, 2018), and negative attitudes decrease integration (Bingimlas, 2009; Khlaif, 2018). Vannatta and Fordham (2004) found that a teacher who is open to change and willing to
spend time outside of formal training opportunities is more likely to integrate technology than those who are ambivalent.

Kao et al. (2020) found that when teachers had more confidence with a given technology, they had more positive attitudes toward the technology, and therefore, a higher likelihood of integrating the technology in the classroom. Teachers’ experiences with technology can affect their confidence and, therefore, their attitude. Those with more experience with technology are more likely to have positive attitudes (Buabeng-Andoh, 2012). Lawrence and Tar (2018) suggested that when teachers do not receive enough training on a new tool, they resist change, which acts as a barrier to technology integration.

Teachers’ attitudes toward the value of technology can impact technology integration as well. When teachers understand how technologies can benefit learning in the classroom, the attitude or resistance toward integration can shift (Bingimlas, 2009). For example, Demirci’s (2009) study on the integration of geographic information systems (GIS) found that regardless of external barriers, such as lack of hardware or software, the teachers’ attitudes toward GIS were a determining factor for GIS integration in the classroom. If a teacher does not find value in the technology and how it can support good pedagogy, they are not likely to utilize the technology (Inan & Lowther, 2010; Tondeur et al., 2017).

Teachers must also feel confident in their use of technology to ensure effective integration. Ertmer et al. (2012) found that teachers’ attitudes and beliefs around the usage of technology correlated to practice. That is, if technology is useful for collaboration, teachers are more likely to use it for a collaborative activity. Yet Kim et al.
(2013), Liu (2011), and Tondeur et al. (2017) found that although teachers’ attitudes and technology integration are closely related, attitude does not necessarily correlate to practice. Therefore, professional development must not only address teacher attitudes but also focus on a change in practice.

**Teachers’ Technology Self-Efficacy**

Teachers’ technology self-efficacy is an important factor for technology integration. This section defines technology self-efficacy, describes how authentic learning experiences positively impact teachers’ technology self-efficacy, and explains how those with higher technology self-efficacy are more likely to integrate technology.

**Defining Technology Self-Efficacy**

Self-efficacy is one’s belief that one can complete a task (Bandura, 1977) in a domain-specific area (Bandura et al., 1996), such as technology. Technology self-efficacy, often referred to as teacher readiness, defines “teachers’ feeling and perception of their capabilities and skills required for technology integration” (Inan & Lowther, 2010, p. 142). In other words, technology self-efficacy is “teachers’ beliefs in their capacity to work effectively with technology” (Wang & Lu, 2012, p. 231). Barton and Dexter (2020) proposed a slightly differing definition, adding to teachers’ belief regarding the value of technology by describing technology self-efficacy as the “beliefs in both the value of and one’s capacity for effectively using technology in the classroom” (p. 90). Klassen and Chiu (2010) and Pendergast et al. (2011) described self-efficacy as a mix of four factors: (a) teachers’ own experiences with success, (b) others’ experiences with success, (c) confidence toward the task, and (d) persuasion or encouragement from others. Hsu (2016) distinguished between capability and knowledge, stating teachers’
self-efficacy as “their beliefs about what they are capable of doing with technology in the classroom as opposed to the knowledge they possess” (p. 31).

Based on these descriptions, my definition for technology self-efficacy is teachers’ belief in their ability to work with and use technology in their classroom successfully.

**Authentic Learning Experiences**

Authentic learning experiences allow teachers to experience using technology much like a student would. When teachers understand how to appropriately integrate technology with content and pedagogy, their overall understanding and confidence increase (Gunter & Reeves, 2017). Hall and Trespalacios (2019), utilizing guided practice sessions and authentic assessment design, showed an increase in teachers’ technology self-efficacy by increasing coherence between professional development and the classroom. Teräs and Kartoglu (2017) had similar findings showing that authentic tasks in professional development impacted professional practice through increased self-efficacy and confidence in one’s abilities.

**Self-Efficacy and Technology Integration**

Lack of confidence (Bingimlas, 2009; Buabeng-Andoh, 2012; Ertmer, 2005) and lack of technological knowledge (Lawless & Pellegrino, 2007; Lee & Tsai, 2010; Voogt & McKenney, 2017) have been cited as barriers to technology integration. BECTA (2004), in its review of literature on technology integration barriers, stated, “Many teachers who do not consider themselves to be well skilled in using ICT [technologies] feel anxious about using it in front of a class of children who perhaps know more than they do” (p. 7). Gunter and Reeves (2017) found that teachers felt empowered to integrate
technology in their classrooms by developing or increasing self-efficacy. Barton and Dexter (2020) and Ertmer (2005) found that vicarious experiences (i.e., observing other teachers doing the same activity using technology) can increase teachers’ technology self-efficacy, which can lead to more positive attitude toward technology (Kao et al., 2020). In turn, positive teacher attitudes increase the likelihood of technology integration (Khlaif, 2018). Indeed, Tweed (2013) showed a correlation between teachers with higher technology self-efficacy and the likelihood of integrating technology.

**Chapter Summary**

While one-to-one technology initiatives have been prevalent, there is still a lack of effective technology integration (Bingimlas, 2009; Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010; Okojie et al., 2005). Teachers often lack the necessary knowledge to use technology as instructional support rather than a tool for instruction, as described by Okojie et al. (2005). Teachers need purposefully structured professional development opportunities to learn how technological knowledge, pedagogical knowledge, and content knowledge interrelate to create more dynamic learning experiences for students. Because teachers are adults, these professional development experiences must be carefully designed to meet learners’ needs (Knowles, 1974) and create changes in teacher practices and beliefs (Guskey, 1986).

Professional development endows teachers with knowledge and skills to increase student achievement; however, for professional development to be effective, it must be personalized for teachers based on their content and needs (Desimone, 2011; Martin et al., 2015). To improve technology integration skills and knowledge, technology professional development must intentionally combine technology (TK), content (CK),
and pedagogical knowledge (PK) to build the skills necessary to integrate technology as part of the instruction and not a standalone tool.

As presented in the review of the related literature, there are barriers and enablers that support or detract from teachers’ technology integration. Two of the biggest influences on a teachers’ integration of technology are their attitude (Buabeng-Andoh, 2012; Ertmer et al., 2012; Moeller & Reitzes, 2011; Vannatta & Fordham, 2004) and self-efficacy (Ertmer & Ottenbreit-Leftwich, 2010; Hsu, 2016; Inan & Lowther, 2010). Positive attitudes and high self-efficacy tend to correlate to higher technology integration, while negative attitudes or low self-efficacy decrease technology integration. Therefore, professional development must focus on those features that increase self-efficacy and positive attitudes toward technology integration.
CHAPTER 3

METHOD

The purpose of this mixed-methods action research study was to investigate how TPACK-focused online professional development influenced teachers’ development of technology self-efficacy and intention to integrate the tool, Pear Deck, and measure changes in their attitudes toward Pear Deck at North Lake Intermediate School in South Carolina. The following research questions guided this study:

1. How does a TPACK-focused online professional development experience influence intermediate school teachers’ development of technology self-efficacy?
2. How, if at all, do intermediate school teachers’ attitudes toward Pear Deck change following a TPACK-focused online professional development experience?
3. How does TPACK-focused online professional development influence intermediate school teachers’ intentions of continuing to use Pear Deck?

Research Design

Action research is a systematic approach that connects research and practice, empowering practitioners to make decisions regarding their practice and productive changes in their working environments (Duesbery & Twyman, 2020). This research method differs from others in that the researcher is also a participant seeking solutions to a local problem rather than generalized findings (Herr & Anderson, 2005; Mertler, 2020). Conducting action research enabled me to gather information systematically and collaboratively about a problem occurring in my school (Mertler, 2020; Mills, 2011).
Action research was suitable for this study because as an instructional coach, I was studying how the professional development I provided affected teachers’ technology self-efficacy and intentions to continue to integrate Pear Deck. I could apply the findings toward enhancing the effectiveness of my future practice (Mertler, 2020). Following the four stages as proposed by Mertler and Charles (2011), I cyclically planned, acted, developed, and reflected with my colleagues. Following the action research cycle allowed me, as the participant-researcher, to use an iterative design to investigate how TPACK-focused online professional development impacts teachers’ technology self-efficacy and intent to use technology (Herr & Anderson, 2005; Mertler, 2020).

This action research study utilized a convergent mixed-methods design, blending the strengths of both quantitative and qualitative designs and merging the data to provide a more holistic and in-depth understanding of the problem (Creswell & Creswell, 2018). Qualitative data sources such as interviews and reflections allowed me to speak with the participants and have a better understanding of their thoughts so I could record any pertinent information or opinions (Creswell & Creswell, 2018). Survey data offered a quantifiable view of teachers’ self-efficacy with, intentions of using, and attitudes toward technology. By combining both qualitative and quantitative research methods, I gained a clearer understanding of how I can use professional development to impact teachers’ technology self-efficacy and intention to integrate technology (Creswell, 2014).

I used a convergent-parallel mixed-methods design to improve the validity of my findings while also trying to limit any inherent bias (Mertler, 2020). In other words, I collected quantitative and qualitative data separately but concurrently during the same period, triangulating the data. This convergence helped me understand the relationship
between sustained TPACK-focused online professional development, any change in teachers’ technology self-efficacy, and any change in teachers’ intentions to integrate technology (see Figure 3.1).

Figure 3.1 Convergent Mixed-Methods Design

**Setting**

This action research study took place at North Lake Intermediate School in South Carolina. North Lake is an all sixth-grade school with 32 core content teachers, 11 related arts teachers, five special education teachers, and two support teachers. For this study, core content classes were defined as science, social studies, English Language Arts (ELA), and mathematics. The class sizes ranged from 18–25 students of various ethnicities, and classes met Monday through Friday for 55 minutes each day. Each classroom contained a teacher laptop, a teacher Chromebook, a projector, and a SMART board, and all students had a district-issued Chromebook for home and school use. Prior to the school’s temporary shift to a virtual model due to COVID-19, the district provided teachers with the Google Apps for Education Suite and BrainPOP (K–8). Due to the shift in teaching modalities, the district made the following tools available for all secondary
schools: Google Apps for Education, BrainPOP (K–8), Pear Deck, Screencastify, EdPuzzle, Apex Learning, Progress Learning, and Kami.

The student population was comprised of approximately 700 students from across School District One of Lakeview County. During the 2021–2022 school year, the population was 55.86% male and 44.14% female with 36.1% White, 45.0% African American, 6.4% Hispanic, 8.0% two or more races, 3.4% Asian, 0.6% Pacific Islander, and 0.4% American Indian. Approximately half of the students, 53%, qualified for free or reduced-price lunch. North Lake is unique in that most students in our district attend this school before splitting off into one of three middle schools.

Each intermediate, middle, and high school in the district has an onsite DIS responsible for collaborating with teachers to integrate technology into the curriculum and create technology-rich lessons, as well as developing and facilitating professional development and training to build teachers’ capacity with digital pedagogies (School District One of Lakeview County, 2019). My role in this action research study was to serve not only as the researcher, but also as the DIS at North Lake—the creator and facilitator of the school-based instructional technology professional development and trainings.

During the 2018–2019 school year at North Lake Intermediate School, teachers received less than 8 hours of instructional technology professional development. Furthermore, the majority of teachers that year ranked themselves as emergent on using key 21st-century skills (i.e., communication, collaboration, creativity, and critical thinking) in their classrooms (Clarity 3.0, 2019). Amid the shift to virtual instruction during COVID-19, the school placed a much larger emphasis on instructional technology
professional development. Over half of teachers at North Lake received more than 20 hours of instructional technology professional development during the 2020–2021 school year, with the majority of teachers ranking themselves as proficient on using key 21st-century skills (Clarity 3.0, 2021). Due to this shift, the school district decided to include instructional technology professional development as part of the professional development rotation. Teachers now participate in two district-based instructional technology professional development experiences and three school-based instructional technology professional development experiences as of the 2021–2022 school year.

The instructional technology professional development provided for teachers has primarily focused on introducing new tools without addressing the pedagogy behind the tools or offering opportunities to discuss relevant uses. The DIS team has been studying and incorporating Kieschnick’s (2017) practice of “identify[ing] desired academic outcome(s), select[ing] a goal-aligned instructional strategy that works, choos[ing] digital tool(s), plan[ning] instruction, [and] self-assess[ing one’s] plans” (p. 36) in our work with teachers. This idea aligns with the TPACK framework; thus, I chose a TPACK-focused online professional development approach to help teachers use the technology tool, Pear Deck, efficiently to enhance learning rather than for technology’s sake (Dalal et al., 2017).

Participants

I used a typical case purposive sampling method to determine how my professional development affects teachers’ technology self-efficacy and intentions to continue to integrate Pear Deck (see Appendix A for school approval). This sampling method uses expert knowledge of the population to subjectively identify a sample that
represents the typical population (Battaglia, 2011). All 47 teachers at North Lake Intermediate were required to participate in after-school professional development; however, I recruited 16 to complete the presurvey and 14 of these completed the postsurvey. Out of the 14, I chose 9 participants for the written artifacts and interviews. I chose based on years of experience, perceived technology self-efficacy, attitude toward technology, and content area. All participants received a letter (see Appendix B) prior to participating to ensure their informed consent.

The teacher population at North Lake Intermediate School is not very diverse. Out of the 14 participants, only 7% identified as male. The average length of their teaching experience was 17.7 years, and 7 of the teachers were new to our school. Out of the 14 teachers, 79% were White, 14% were African American, and 7% Latinx.

**Innovation**

The innovation for this study was a TPACK-focused, online, asynchronous professional development opportunity for teachers at North Lake. Studies have shown that lack of self-efficacy and competence are two of the biggest hindrances to technology integration (Bingimlas, 2009). Lack of self-efficacy keeps technology integration at the surface level, which does not enhance student learning (Bustamante, 2020; Koh et al., 2017). Professional development within a TPACK framework helps teachers connect pedagogy, content, and technology to integrate technology more effectively and improve student learning (Archambault & Barnett, 2010; Oda et al., 2020). I also included elements such as reflection and discussion (Bustamante, 2020), as well as modeling (Beriswill et al., 2016) to help participants think about how to use Pear Deck in their classrooms. With the addition of other barriers to technology integration like the lack of
time and the lack of sustained support (Alenezi, 2017; Cifuentes et al., 2011; Guenther, 2002; Voogt & McKenney, 2017), the format of this asynchronous online teacher professional development could help the teachers overcome those obstacles (Gunter & Reeves, 2017; Prestridge, 2017; Prestridge & Tondeur, 2015).

Innovation and Theoretical Frameworks

This study focused on understanding how TPACK-focused online professional development affects teachers’ technology self-efficacy and intention to continue to integrate Pear Deck. My innovation incorporated Knowles’s (1974) adult learning theory and Koehler and Mishra’s (2009) TPACK framework.

Knowles (1980) defined adult learning theory, or andragogy, as the art and science of helping adults learn. For this study, I applied principles from Knowles, as well as Fornaciari and Lund Dean (2014), to view adult learners as: (a) self-directed, (b) intrinsically motivated, (c) able to use background knowledge to make connections to new learning, (d) ready to learn and apply new knowledge, (e) needing to know the why of the learning, and (f) taking ownership of their learning. I purposely structured the innovation to support these characteristics (see Table 3.1). Through reading articles that explained TPACK prior to the professional development experience, participants had an opportunity to understand the why behind the TPACK focus. An asynchronous structure allowed participants to be self-directed and take ownership of their learning to complete the professional development when convenient within the allotted time frame. Participants could use prior learning experiences to discuss concerns or offer support to others using the discussion boards in the pre-learning or professional development phases. After the completion of the professional development session, participants could
immediately incorporate questioning and feedback strategies via Pear Deck. By using background knowledge about previous technology tools and usage of Pear Deck combined with learning how to incorporate the new instructional strategies in more intentional ways, this innovation could support application of new learning. These instructional strategies are also two of the three instructional foci for North Lake Intermediate, which could support teacher observations and student outcomes.

Table 3.1 Innovation Design and Adult Learning Theory

<table>
<thead>
<tr>
<th>Design component</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-learning articles</td>
<td>To convey the why of using TPACK as a focus for professional development</td>
</tr>
<tr>
<td>Discussion boards</td>
<td>To enable participants to use prior knowledge to discuss concerns and suggestions on how to implement Pear Deck, facilitating new connections</td>
</tr>
<tr>
<td>Online, asynchronous format</td>
<td>To ensure convenience and allow participants a choice (i.e., self-direction)</td>
</tr>
<tr>
<td>Instructional strategies (Questioning and Feedback)</td>
<td>To align with strategies administrators hope to see during teacher observations, thereby appealing to participants’ intrinsic motivation</td>
</tr>
<tr>
<td>Pear Deck</td>
<td>To enable immediate application of new learning with a tool already purchased by the district</td>
</tr>
</tbody>
</table>

This innovation had a TPACK focus, prioritizing “connection and interactions between and among content knowledge (subject-matter that is to be taught), technological knowledge (computers, the Internet, digital video, etc.), and pedagogical knowledge (practices, processes, strategies, procedures, and methods of teaching and learning) to improve student learning” (Archambault & Barnett, 2010, p. 1656). Thus, teachers had the opportunity to gain technological knowledge through the use of Pear Deck,
pedagogical knowledge of the instructional strategies questioning and feedback, and connections to their content knowledge to improve student learning. This innovation also invited teachers to reflect on their professional development and how technology can support and connect to content and pedagogical practice (Bustamante, 2020).

**Innovation Design, Effective Professional Development, and Self-Efficacy**

This innovation also reflected effective professional development design principles (see Table 3.2), implemented to increase teachers’ knowledge, skills, and self-efficacy (Gunter & Reeves, 2017), which can lead to increased student achievement (Desimone et al., 2013; Garet et al., 2001; Yoon et al., 2007). Self-efficacy is a vital contributor to the amount of time, effort, and resiliency a teacher is willing to put forth when trying something new (Pajares, 1996). Throughout the innovation, I modeled the instructional strategies I incorporated into the Pear Deck presentation. Studies have shown that authentic learning opportunities with modeling increase teacher self-efficacy (Darling-Hammond et al., 2017; Gulamhussein, 2013; Gunter & Reeves, 2017; Knapp, 2017). By participating in an activity much like a student would, teachers can gain a deeper understanding of how the practice can benefit students (Bustamante, 2020) and become more confident (Gulamhussein, 2013; Gunter & Reeves, 2017; Knapp, 2017).

**Table 3.2 Innovation Design, Effective Professional Development, and Self-Efficacy**

<table>
<thead>
<tr>
<th>Design component</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modeling</td>
<td>To position participants as students, facilitating a deeper understanding of the benefits through an authentic learning experience that could increase their self-efficacy</td>
</tr>
<tr>
<td>Sustained time period</td>
<td>To provide time for participants to process and productively struggle with the new tool</td>
</tr>
<tr>
<td>Subject-specific content</td>
<td>To make the experience relevant, which helps teachers feel supported in using new strategies, thereby increasing self-efficacy</td>
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<tr>
<td>--------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Reflection prompts</td>
<td>To enable participants to process their learning and think about how they could incorporate the new learning into their practice</td>
</tr>
<tr>
<td>Discussion forums</td>
<td>To create community and engagement, as well as providing space to discuss implementation challenges, concerns, and successes</td>
</tr>
<tr>
<td>Personalized feedback reports</td>
<td>To offer personalized feedback that can promote learning, stimulate reflection, and enhance relevance</td>
</tr>
</tbody>
</table>

Multiple studies have found that one-shot professional development is ineffective (Darling-Hammond et al., 2017; Desimone, 2009; Desimone & Garet, 2015; Duran et al., 2012; Gulamhussein, 2013; Gunter & Reeves, 2017) and that teachers need time to work with a new practice (Darling-Hammond et al., 2017). Due to COVID-19 and teachers feeling overwhelmed, the original plan of having a semester long professional development was changed to only having the opportunity for one 1-hour long session. To combat this one-shot professional development, pre-learning and post-learning opportunities were included to extend the learning time. By focusing on one technology tool within the TPACK framework over an extended period of time (Gulamhussein, 2013), I reasoned teachers would be more likely to enact pedagogical change.

Given the online format of the professional development, online professional design considerations also shaped my innovation. Opportunities for reflection are critical to help teachers process their learning and potential applications in their classroom (Beriswill et al., 2016; Powell & Bodur, 2019; Vrasidas & Zembylas, 2004). I included
discussion forums to build community and engagement (Teräs & Kartoglu, 2017), as well as to allow participants a space to discuss challenges (Rientes et al., 2013).

Professional development must be content-specific to create pedagogical changes (Gulamhussein, 2013). I provided subject-specific examples in the presentation so teachers could see how Pear Deck can apply to their specific content, increasing the likelihood of implementation (Desimone & Garet, 2015) and enhancing their technology self-efficacy (Gunter & Reeves, 2017).

Finally, I also provided personalization and feedback. Feedback stimulates reflection (Philipsen et al., 2019), whereas lack of feedback can impede technology integration (Woodward & Hutchison, 2018). Teräs and Kartoglu (2017) showed that feedback helps promote learning. Therefore, I followed up with participants through observation with a personalized feedback report, similar to the emails Woodward and Hutchison (2018) used. Lack of personalization creates frustration for teachers (Powell & Bodur, 2019), so I intended these reports to make the experience more relevant.

**Innovation Design**

The innovation’s longitudinal, TPACK-focused, online, asynchronous structure gave teachers the opportunity to increase their technology self-efficacy and effective technology integration. By design, the professional development was sustained, authentic, and focused on the interrelation among content, pedagogy, and technology rather than centered on the tool. Online professional development allows teachers to learn “anytime, anywhere” (Vrasidas & Zembylas, 2004, p. 326), when convenient (Dede et al., 2009; Stanford-Bowers, 2008). Specifically, the innovation comprised three parts: (a)
a pre-learning phase, (b) the professional development presentation, and (c) a follow-up phase that included personalized feedback reports.

**Pre-learning**

The pre-learning phase lasted a total of 3 weeks and included two different parts: (a) educational articles for participants to read and (b) a discussion board. I gave participants access to a series of educational articles explaining TPACK 2 weeks prior to the asynchronous online professional development. The articles addressed the different knowledge domains of TPACK and included examples of how TPACK can enhance technology integration in the classroom. I chose the articles so the teachers would understand why focusing on how content and pedagogy interact with technology is important, consistent with principles of adult learning theory (Knowles, 1984). I posted the articles in North Lake Intermediate School’s Professional Development Google Classroom and encouraged—but did not require based on administration’s guidance—the teachers to read them in the weeks prior to participating in the asynchronous online professional development experience. Each article was posted in a Google Form and questions regarding the pre-learning articles were added at the end so I, as the researcher, knew who chose to participate.

During the pre-learning phase, a discussion board located in the North Lake Intermediate School’s Professional Development Google Classroom was also available for teachers to post their thoughts, concerns, or ideas about the articles (see Figure 3.2). Like the articles, this feature was not required but available to foster an online community. There were three discussion questions posed at the beginning of the pre-learning phase and participants were given the entirety of the pre-learning phase to
answer and respond. Given these discussions were not required, there was no response nor length requirement.

**Discussion Questions:**
1. After reading the pre-learning articles and example TPACK, what are your thoughts on using the TPACK framework to integrate technology in your classroom?
2. Do you have any concerns about using the TPACK framework? If so, what are they?
3. Do you have any thoughts on how you can implement the TPACK framework using PearDeck in your classroom?

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**February 7**

- I think using TPACK framework to enhance technology within the classroom would enhance lessons and create a more engaging lesson for students. By using TPACK, teachers could be more intentional about how they are teaching content - focus on the standard and then let the rest follow with integrating the technology.
- No - I like how it is something that it can give you the opportunity to help differentiate and alter your curriculum to meet all the needs of students.
- I loved the example given on the Writer's Workshop. Students have a hard time understanding that reading and writing is recursive - it is a never ending cycle. By included technology to this concept I believe students could understand this better - and see it in real time happening through the technology used. I would like to explore how to incorporate this with PearDeck - I know there is a way, just not sure that way yet.

---

**Figure 3.2 Pre-Learning Discussion**

**Professional Development**

This phase of my innovation lasted a total of 2 weeks and included two parts: (a) the asynchronous Pear Deck presentation and (b) the discussion board with reflection questions. The 2-week time frame enabled participants to complete the asynchronous online professional development when convenient. The discussion board was available for participants to discuss any concerns or thoughts, as well as answer the reflection
questions about the professional development while engaging in an online community. Forum activities were not a compulsory component.

**Pear Deck**

The TPACK-focused asynchronous online professional development focused on a specific technology tool, Pear Deck, which is a Google Slides add-on that allows teachers to create interactive presentations that can include formative assessments, questions, audio, video, and teacher feedback. Based on a meta-analysis of almost 1200 empirical articles, Hattie (1992) identified an effect size of 0.40 as the point where an innovation or instructional strategy has an average effect on achievement. The two instructional strategies I highlighted were how Pear Deck facilitates questioning, which has an effect size of 0.48, and providing feedback, which has an effect size of 0.75 (Hattie, 2012). Teachers participated in an asynchronous Pear Deck that introduced them to effective applications of questioning and providing feedback, including how to use Pear Deck to facilitate these strategies. The Pear Deck also modeled these strategies by including questions and facilitator feedback to help each individual grow.

Teachers learned how the pedagogical practices of questioning and feedback can enhance student understanding of content (see Figure 3.3). The professional development also modeled and taught how Pear Deck enables effective integration of these strategies in the classroom (see Appendix C), demonstrating how the pedagogical practice, content knowledge, and technology tool interrelate. The end of the Pear Deck presentation contained a link to the postsurvey questions.
Discussion Board Posts and Responses

During the pre-learning and presentation phases of the professional development, I posted discussion questions so participants could engage their colleagues in a dialogue around their plans to integrate Pear Deck, concerns with integration, suggestions for using Pear Deck in relation to the strategies of questioning and providing feedback, and overall reflection on the integration of this innovative technology so others may learn from their successes or challenges (Beriswill et al., 2016; Powell & Bodur, 2019; Vrasidas & Zembylas, 2004). For example (see Figure 3.4):

- After learning about Pear Deck and how it could be used in the classroom for questioning, how are you feeling about implementing this tool?
- If you have tried implementing Pear Deck, what were some challenges you experienced? What were some successes you experienced?
- What will you modify before using this tool again?
The discussion boards were located in the North Lake Intermediate School’s Professional Development Google Classroom. As the facilitator, I also participated to help teachers think through any potential issues or ways to improve the integration. The discussion board, therefore, created community by promoting engagement and learning through collaboration (Powell & Bodur, 2019; Teräs & Kartoglu, 2017) and discussion of challenges and successes (Rienties et al., 2013).

Figure 3.4 Teacher Discussions
To foster trust and open dialogue, these discussion boards were only visible to me and the participants. Posts served as an informational tool for me to see how the teachers were feeling throughout the process, providing insight into their attitude and confidence toward the use of technology tools and integration thereof, which helped me, as the researcher, craft personalized feedback reports and additional interview questions. For the participants, the discussion boards served as a safe place for thoughtful dialogue and collaboration.

**Follow-up**

The post-learning phase lasted 3 weeks and comprised two parts: (a) personalized feedback reports and (b) a collection of lesson plans. I sent the reports via email after viewing teachers’ lesson plans and reflections on the professional development.

**Personalized Feedback Reports**

Based on the completed Pear Deck responses and discussion posts, I sent personalized reports to each participant, clarifying any misconceptions, providing more in-depth feedback based on their responses, and encouraging them to move forward with Pear Deck in ways that engage students in questioning strategies and provide feedback. While I did not use a set template, the emails included information tailored to their responses on Pear Deck including at minimum of one pedagogical suggestion for their content area and a pre-made template to help support their use of Pear Deck. For many participants, there was also an instructional resource (article or YouTube video) included.

As the DIS, I want to build teacher capacity and self-efficacy in using new technologies, so the emails were geared to support the teachers through the planning process and
implementation to build self-efficacy, with the end goal being that the teachers could use the strategy appropriately without support.

**Data Collection and Sources**

Several sources yielded data that informed the results of this study, including (a) survey instruments, (b) participant interviews, and (c) written artifacts. This section describes each data collection method as aligned to the research questions. Table 3.3 contains a brief overview of the sources and their alignment.

Table 3.3 Research Question and Data Sources Alignment

<table>
<thead>
<tr>
<th>Question</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How does a TPACK-focused online professional development experience influence intermediate school teachers’ development of technology self-efficacy?</td>
<td>• teacher technology survey</td>
</tr>
<tr>
<td></td>
<td>• semi-structured interviews</td>
</tr>
<tr>
<td></td>
<td>• teacher reflections</td>
</tr>
<tr>
<td>2. How, if at all, do intermediate school teachers’ attitudes toward Pear Deck change following a TPACK-focused online professional development experience?</td>
<td>• teacher technology survey</td>
</tr>
<tr>
<td></td>
<td>• semi-structured interviews</td>
</tr>
<tr>
<td></td>
<td>• teacher reflections</td>
</tr>
<tr>
<td>3. How does TPACK-focused online professional development influence intermediate school teachers’ intentions of continuing to use Pear Deck?</td>
<td>• teacher technology survey</td>
</tr>
<tr>
<td></td>
<td>• semi-structured interviews</td>
</tr>
<tr>
<td></td>
<td>• teacher reflections</td>
</tr>
<tr>
<td></td>
<td>• lesson plans</td>
</tr>
</tbody>
</table>

**Teacher Technology Survey**

This study used a modified Technology Acceptance Model (TAM) for the Teacher Technology Survey (TTS) pre and postsurvey.

All constructs in the TAM satisfied the criteria of reliability and convergent and discriminant validity. Internal consistency reliabilities were found to be greater than 0.70 for all constructs while the item loadings were found to be greater than or equal to 0.70 for all constructs. The validity and reliability have been tested and found to be acceptable in other studies (Ho et al., 2020; Setiyani et al., 2021).
The modified TAM consisted of 19 items on a seven-point Likert scale that ranged from 1 (Strongly Disagree), 2 (Disagree), 3 (Somewhat Disagree), 4 (Neutral), 5 (Somewhat Agree), 6 (Agree), to 7 (Strongly Agree). The five constructs that made up this survey were: perceived usefulness, perceived ease of use, perceived self-efficacy, attitude toward using, and continuance intention to use. The items have been adapted to address the appropriate technology tool (see Appendix D).

Perceived Usefulness (PU). Perceived usefulness is the degree to which an individual believes that using the technology tool would be beneficial to their job (Davis, 1989; Davis et al., 1989). Perceived usefulness helps determine an individual’s intention to use a technology tool (Venkatesh, 2000). Three items (Wu & Chen, 2017; Wu & Zhang, 2014; Kim et al. 2010) on the survey measured this construct, as seen in Appendix D. A sample item for this construct was: Using Pear Deck in my classroom enhances my effectiveness in my job.

Perceived Ease of Use (PEOU). The survey also measured the degree to which an individual believes that using the technology tool would be easy or free from difficulty (Davis, 1989). Those who perceive a tool to be easy to use are more likely to accept it (Davis, 1989) and find it useful (Venkatesh, 2000). Three items (Wu & Chen, 2017; Wu & Zhang, 2014) on the survey measured this construct, as seen in Appendix D. A sample item for this construct was: Learning to use Pear Deck is easy.

Perceived Self-Efficacy (PSE). Perceived self-efficacy is the degree to which an individual judges their abilities to complete a particular task (Bandura, 1977). Self-efficacy acts as a predictor of teachers’ willingness to try new things that may be perceived as difficult (Fogleman et al., 2011). Three items (Park, 2009) on the survey
measured this construct, as seen in Appendix D. A sample item for this construct was: I feel confident using Pear Deck features.

**Attitude Towards Pear Deck (ATT).** The survey also measured the degree to which a teacher believes Pear Deck will be helpful in the classroom. Teo (2010, 2012) and Jan and Conteras (2011) found that perceived usefulness and perceived ease of use greatly predicted an individual’s attitude towards using the technology. Three items (Wu & Chen, 2017; Kim et al. 2010) on the survey measured this construct, as seen in Appendix D. A sample item for this construct was: I believe that using Pear Deck is a good idea.

**Continuance Intentions to Use (CITU).** Continuance intentions to use Pear Deck is the degree to which teachers intend to continue to use Pear Deck in the classroom following the Professional Development. Previous studies have found that perceived usefulness and attitude have a positive impact on continuance intentions (Arteaga & Duarte, 2010; Wu & Chen, 2017). Three items (Wu & Chen, 2017; Wu & Zhang, 2014) on the survey measured this construct, as seen in Appendix D. A sample item for this construct was: I intend to continue to use Pear Deck in the future.

**Semi-Structured Interviews**

Semi-structured interviews following a protocol (see Appendix E) provided an in-depth look into how asynchronous TPACK-focused professional development impacts teachers’ technology self-efficacy, intentions of continuing to use Pear Deck, and attitudes toward Pear Deck. Allowing participants to answer some base questions with appropriate follow-up questions yielded “truly qualitative data” (Mertler, 2020, p. 134).
Using a semi-structured protocol facilitated variation in my approach to gain a better understanding of participants’ answers (Creswell, 2003).

I purposively selected nine participants for individual interviews lasting approximately 45 minutes after the asynchronous professional development experience. I recorded and transcribed each interview, sharing transcripts with the participants. The interview questions aligned with my research questions to help me determine the impact of online teacher professional development on teachers’ intention to integrate technology (see Table 3.4).

Table 3.4 Semi-Structured Interview Questions Alignment

<table>
<thead>
<tr>
<th>Research question</th>
<th>Interview questions</th>
</tr>
</thead>
</table>
| 1. How does a TPACK-focused online professional development experience influence intermediate school teachers’ development of technology self-efficacy? | • How confident would you consider yourself in using Pear Deck in the classroom? What factors do you attribute to your self-confidence?  
• Can you describe a professional development or professional learning that has had a positive or negative affect on your self-confidence in using Pear Deck for your classroom instruction? |
| 2. How, if at all, do intermediate school teachers’ attitudes toward Pear Deck change following a TPACK-focused online professional development experience? | • How would you describe your attitude towards using Pear Deck?  
• What do you believe would help make you more comfortable in using Pear Deck in your classroom instruction? Why?  
• Do you feel that using Pear Deck would help you accomplish your instructional goals quicker or easier? In either case, why? |
| 3. How does TPACK-focused online professional development influence intermediate school teachers’ intentions of continuing to use Pear Deck? | • Now that you have completed this professional development, do you plan on continuing to use Pear Deck? Has anything changed in terms of how you will use Pear Deck?  
• Did receiving personalized feedback affect your intention to use Pear Deck? If so, how?  
• What, if any, are some of the challenges in using Pear Deck? Do these affect your intention to use Pear Deck? |
Teacher Reflections

I asked all participants to reflect on their learning at the end of the professional learning module. Reflection prompts encouraged them to consider how to integrate the new pedagogical practice and technology in their classrooms sought to assess their comfort level with the tool (see Figure 3.5): Sample prompts are described below:

- After learning about Pear Deck, how might you use this tool to help impact student learning?
- Think about your lessons coming up, what may be a good topic to try incorporating feedback and questioning via Pear Deck?
- Reflect on how you may be able to use questioning or feedback to help move student learning forward. What concerns you? What excites you?

Reflections were confidential, allowing participants to share any concerns or questions they may not have felt comfortable posting in the group discussion forum.

Figure 3.5 Teacher Reflections
Lesson Plans

Teacher lesson plans were gathered for the one- to two-week period following the professional development. By collecting lesson plans, I was able to determine whether teachers intended to use Pear Deck in their classrooms after the professional development. If a teacher included Pear Deck in the lesson plan, this indicated their intention to continue use of this tool.

Data Analysis

I analyzed quantitative data from surveys with descriptive statistics and paired sample t-tests. Using descriptive statistics allowed me to describe the central tendency (Fisher & Marshall, 2006) and dispersion of the quantitative data, while the paired sample t-tests facilitated inferences based on the data—specifically to measure if the difference in the data collected over the semester was due to chance or the innovation (Marshall & Jonker, 2011). I analyzed qualitative data using inductive thematic analysis (see Table 3.5).

Table 3.5 Research Questions, Data Sources, and Data Analysis Alignment

<table>
<thead>
<tr>
<th>Question</th>
<th>Sources</th>
<th>Analysis</th>
</tr>
</thead>
</table>
| 1. How does a TPACK-focused online professional development experience influence intermediate school teachers’ development of technology self-efficacy? | • teacher technology survey  
• semi-structured interviews  
• teacher reflections | • descriptive statistics  
• paired sample t-test  
• inductive/thematic analysis |

| 2. How, if at all, do intermediate school teachers’ attitudes toward Pear Deck change following a TPACK-focused online | • teacher technology survey  
• semi-structured interviews  
• teacher reflections | • descriptive statistics  
• paired sample t-test  
• inductive/thematic analysis |
3. How does TPACK-focused online professional development influence intermediate school teachers’ intentions of continuing to use Pear Deck?

- teacher technology survey
- semi-structured interviews
- teacher reflections
- lesson plans
- descriptive statistics
- paired sample t-test
- inductive/thematic analysis

Quantitative Data Analysis

I analyzed pre and post survey data from the modified TAM using descriptive statistics. I sought a “quantitative description of trends” (Mertler, 2020, p. 147) about the teachers’ technology self-efficacy, attitudes, and intentions of continuing to use Pear Deck. A paired sample t-test enabled me to examine any statistically significant differences in teachers’ self-efficacy, attitudes toward Pear Deck, and intentions of continuing to use Pear Deck before and after the intervention. I calculated statistical significance with a significance level of $\alpha = 0.05$.

Qualitative Data Analysis

Qualitative data can supplement interpretation of quantitative data (Tracy, 2020). I analyzed all qualitative protocols (i.e., semi-structured interviews, teacher reflections) using inductive analysis (Creswell, 2002) to develop categories and themes that allowed for the grouping of objects, events, or other elements with similar characteristics (Rosch, 1978). Coding occurred in two cycles to surface codes, categories, and themes. The first cycle consisted of developing codes by reading the qualitative data and identifying the important or frequent concepts (Saldaña, 2009; Tracy, 2020), using the CAQDAS tool, Delve, to label these words or phrases. After pulling those marked phrases into a separate Google Sheet, the second cycle of coding helped me synthesize the primary codes into
themes, revealing patterns and interpretations (Tracy, 2020). I triangulated findings from this analysis “by examining evidence from the sources and using it to build a coherent justification” (Creswell & Creswell, 2018, p. 200) before producing the narrative in Chapter 4. I included thick, rich description (Tracy, 2020) by using examples from interviews to support the themes.

**Procedures and Timeline**

This innovation spanned four phases. This section describes each phase as presented in Table 3.6.

**Table 3.6 Timeline of Consent, Innovation, and Data Collection and Analysis**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Participant’s role</th>
<th>Researcher’s role</th>
<th>Duration</th>
</tr>
</thead>
</table>
| Pre-learning |  ￭ Complete consent forms  
 ￭ Complete modified TAM presurvey  
 ￭ Read pre-learning material and participate in discussion board |  ￭ Email consent forms  
 ￭ Email modified TAM presurvey  
 ￭ Release pre-learning material | 3 weeks |
| Presentaion |  ￭ Participate in online, asynchronous TPACK-focused professional development  
 ￭ Complete discussion board posts  
 ￭ Complete teacher reflections  
 ￭ Complete modified TAM postsurvey |  ￭ Participate in discussion board as needed | 2 weeks |
| Follow-up |  ￭ Integrate Pear Deck in instruction  
 ￭ Complete modified TAM postsurvey  
 ￭ Participate in semi-structured interviews and member checking as needed  
 ￭ Submit lesson plans |  ￭ Send personalized feedback reports  
 ￭ Conduct interviews  
 ￭ Review teacher lesson plans for intention to use | 3 weeks |
During Phase 1, I distributed a consent form and survey to all teachers who participate in after-school professional development at North Lake Intermediate School. I released reading materials on TPACK for the teachers to read prior to the professional development as well as a discussion board to discuss concerns or prior use of Pear Deck. While I strongly encouraged the reading of these materials, they were not required.

In Phase 2, participants engaged in online, asynchronous school-based professional development. I created the module with a TPACK focus on a specific technology tool—Pear Deck—they could use to enhance instruction. Participants used a discussion board to converse about challenges and successes with Pear Deck as well as complete a reflection. I participated in the discussions as needed. Participants also completed the modified TAM survey at the end of the Pear Deck presentation.

Phase 3 consisted of follow-up from the professional development. Based on the pre and post survey, discussion posts, and teachers’ reflections, I purposively selected nine participants to complete the follow-up and sent personalized feedback reports to help them continue to grow capacity. This smaller group participated in semi-structured interviews.

Lastly, during Phase 4, I transcribed the interviews and written artifacts from the professional development and used inductive analysis to determine codes. I asked participants to member-check the transcribed data to ensure validity. I also analyzed
quantitative survey data using descriptive statistics and a paired sample $t$-test. These analyses were then converged, compared, and interpreted to determine the findings.

**Rigor and Trustworthiness**

I used several methods to ensure rigor and trustworthiness in this mixed-methods study: a variety of data sources, thick description, and both member checking and peer debriefing (Mertler, 2020). The following sections describe my approach to: (a) triangulation, (b) member checking, (c) peer review, (d) keeping an audit trail, and (e) producing thick, rich descriptions.

**Triangulation**

Triangulation is the use of multiple data sources and methods to mitigate bias and increase validity (Jonsen & Jehn, 2009). I triangulated data by comparing my quantitative survey data to the information gathered from interviews, observations, reflections, and discussions. This process ensured variance in the data was due to the traits rather than the research method (Jick, 1979). Triangulation also illuminated why the participants answered the survey questions as they did, adding another layer of clarification to ensure accuracy and credibility (Mertler, 2020).

**Member Checking**

Member checking also increases rigor and trustworthiness (Creswell, 2014; Creswell & Creswell, 2018; Tracy, 2020). I invited participants to review a brief summary of the findings from interviews and observations. This approach helped me verify that my interpretations of the data accurately represent participants’ thoughts and beliefs (Glesne, 2006).
Peer Review

Peer debriefing is another means of enhancing validity (Creswell & Creswell, 2018). Having a colleague who is also a fellow student review and ask questions helped me consider other perspectives (Bloomberg & Volpe, 2012; Creswell & Creswell, 2018; Tracy, 2020), which led to amendments that would not have been possible without peer feedback (Shenton, 2004). One example was discussing using a category of student apathy based on previous research. After discussing and reflecting, this was not included in my study. I met with my major professor and co-advisor almost weekly during the semester prior to my defense. During these meetings, we would review my most recent writings and discuss. From these conversations, several changes were made: (1) using the tabletop method to spatially visualize my codes, (2) reframing pattern codes and categories to better align with the TAM, and (3) rewriting some categories to be less specific and more generalized. Moreover, my dissertation chair and committee members critiqued my findings to further solidify my research.

Audit Trail

Maintaining an audit trail lends trustworthiness to the qualitative part of my study by providing readers with evidence of decisions I made throughout my research. An audit trail allows other researchers to follow the path of my decisions and justifications (Johnson & Waterfield, 2004). I used my notes from my researcher’s journal to document the how and why of my decisions, thus ensuring rigor in the description of my research.

Rich, Thick Description

Achieving rigor also required me, as the researcher, to maintain fidelity to the topic. For example, “understanding the community members’ slang and inside jokes”
(Tracy, 2020, p. 271), or being conversant in the vernacular enables rich, thick description of qualitative data. I endeavored to create a picture for the reader of the setting and participants, adding credibility to the themes I developed (Creswell & Creswell, 2018). In Chapter 4, I used quotes from interviews to support the findings (Merriam & Tisdell, 2015).

**Plan for Sharing and Communicating Findings**

I shared my findings with participants, administrators, and the district coordinators for professional learning and instructional technology. I shared the findings with participants online through email. I asked them to reflect via a Google Forms survey on their participation and offer any feedback that could help improve the professional development moving forward. For administrators and district personnel, I shared the findings presentation-style during our summer district iFive meeting. This meeting offered opportunities for these stakeholders to ask questions and provide any feedback. I also shared these findings with the DIS team to better support professional learning opportunities. Throughout the reporting of this study, I protected participants’ identities with pseudonyms.
CHAPTER 4

ANALYSIS AND FINDINGS

The purpose of this mixed-methods action research study was to investigate how TPACK-based online professional development influenced teachers’ technology self-efficacy and instructional planning at North Lake Intermediate School in South Carolina. The findings can enhance the effectiveness of future professional development for teachers in local school districts or similar settings. Quantitative and qualitative data collection and analysis aligned with the following three research questions:

1. How does a TPACK-focused online professional development experience influence intermediate school teachers’ development of technology self-efficacy?
2. How, if at all, do intermediate school teachers’ attitudes toward Pear Deck change following a TPACK-focused online professional development experience?
3. How does TPACK-focused online professional development influence intermediate school teachers’ intentions of continuing to use Pear Deck?

This chapter describes the analyses and findings from data collected via a teacher technology survey, lesson plans, and semi-structured interviews. The chapter is divided into three sections: discussion of quantitative data followed by qualitative data, concluding with a combination of the findings, consistent with a mixed methods design.
Quantitative Analysis and Findings

This section presents the quantitative results from the teacher technology pre and post survey and analysis of lesson plans.

Teacher Technology Survey

I administered the TTS to 14 participants prior to and after completion of the asynchronous online professional development on Pear Deck. The survey consisted of 19 questions: four demographic questions and 15 seven-point Likert-type scale questions. The demographic questions asked for information such as gender, age range, years of experience, and current content area. The Likert-type questions assessed five subscales from the TAM model, including Perceived Usefulness, Perceived Ease of Use, Perceived Self-Efficacy, Attitude Toward Using, and Continuance Intention to Use. The Likert-type questions were grouped into sections representing each of the five subscales. Each question asked teachers to rank their level of agreement from 1 (Strongly Disagree) to 7 (Strongly Agree). I tested the pre and post TTS for internal consistency to determine if the scale is reliable ($N = 14$). A Cronbach’s alpha below .60 is considered unacceptable, between .60 and .65 undesirable, between .65 and .70 minimally acceptable, between .70 and .80 respectable, and anything above .80 is considered very good (Kumar et al., 2021). The Cronbach’s alpha for the pre ($\alpha = .93$) and post TTS ($\alpha = .95$) indicate very good reliability. Table 4.1 shows the reliability for each of the subscales. All values for Cronbach’s alpha are very good except for the post TTS Self-Efficacy subscale, which was undesirable ($\alpha = .64$). A low Cronbach’s alpha could be attributed to a low number of questions (Tavakol & Dennick, 2011).
Table 4.1 Internal Consistency for Each Subscale

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Cronbach’s α</th>
<th>Pre-Survey a</th>
<th>Post-Survey b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Usefulness</td>
<td>.96</td>
<td>.97</td>
<td></td>
</tr>
<tr>
<td>Perceived Ease of Use</td>
<td>.86</td>
<td>.91</td>
<td></td>
</tr>
<tr>
<td>Perceived Self-Efficacy</td>
<td>.82</td>
<td>.64</td>
<td></td>
</tr>
<tr>
<td>Attitude Toward Using</td>
<td>.87</td>
<td>.94</td>
<td></td>
</tr>
<tr>
<td>Continuance Intention to Use</td>
<td>.97</td>
<td>.87</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>.90</td>
<td>.87</td>
<td></td>
</tr>
</tbody>
</table>

Note. N = 14.

**Descriptive Statistics**

The descriptive statistics for each subscale are shown in Table 4.2. The pre TTS ($M = 4.81, SD = 1.19$) and the post TTS ($M = 5.51, SD = 1.10$) results show an overall increase in participants’ mean perception of usefulness, ease of use, self-efficacy, attitude, and continuance intention. The largest increase within the subscales was Perceived Self-Efficacy.

Table 4.2 Descriptive Statistics for Each Subscale

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Pre-Survey a</th>
<th>Post-Survey b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Perceived Usefulness</td>
<td>4.38</td>
<td>1.70</td>
</tr>
<tr>
<td>Perceived Ease of Use</td>
<td>5.00</td>
<td>1.23</td>
</tr>
<tr>
<td>Perceived Self-Efficacy</td>
<td>4.40</td>
<td>1.58</td>
</tr>
<tr>
<td>Attitude Toward Using</td>
<td>5.17</td>
<td>1.36</td>
</tr>
</tbody>
</table>
Shapiro-Wilk Normality Tests

I conducted a Shapiro-Wilk test of normality (see Table 4.3) on the difference between pre and post results for each of the five subscales to determine if the assumption of normal distribution was met. The resulting $p$-value $> .05$ for all the subscales indicated a normal distribution; therefore, a paired sample $t$-test was appropriate.

Table 4.3 Shapiro-Wilk Normality Tests

<table>
<thead>
<tr>
<th>Subscale</th>
<th>$W$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Usefulness</td>
<td>.91</td>
<td>.13</td>
</tr>
<tr>
<td>Perceived Ease of Use</td>
<td>.96</td>
<td>.65</td>
</tr>
<tr>
<td>Perceived Self-Efficacy</td>
<td>.92</td>
<td>.20</td>
</tr>
<tr>
<td>Attitude Toward Using</td>
<td>.92</td>
<td>.18</td>
</tr>
<tr>
<td>Continuance Intention to Use</td>
<td>.91</td>
<td>.18</td>
</tr>
</tbody>
</table>

Paired Sample $t$-Tests

Paired sample $t$-tests were used to determine if the difference between the pre and post tests were statistically significant based on an alpha of less than 0.05. PU, PSE, ATT, and CITU all showed a statistically significant increase while PEOU did not. This could be due to teachers having some familiarity with the tool before the innovation occurred. All effect sizes were in the medium range. The results appear in Table 4.4.
Table 4.4 Paired Sample $t$-Tests – TTS Surveys

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Pre-Survey&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Post-Survey&lt;sup&gt;b&lt;/sup&gt;</th>
<th>$M$</th>
<th>$SD$</th>
<th>$M$</th>
<th>$SD$</th>
<th>$t$</th>
<th>$df$</th>
<th>$p$</th>
<th>$d$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Usefulness</td>
<td></td>
<td></td>
<td>4.38</td>
<td>1.70</td>
<td>5.26</td>
<td>1.62</td>
<td>2.63</td>
<td>13</td>
<td>.02</td>
<td>0.70</td>
</tr>
<tr>
<td>Perceived Ease of Use</td>
<td></td>
<td></td>
<td>5.00</td>
<td>1.23</td>
<td>5.47</td>
<td>1.10</td>
<td>1.40</td>
<td>13</td>
<td>.19</td>
<td>0.37</td>
</tr>
<tr>
<td>Perceived Self-Efficacy</td>
<td></td>
<td></td>
<td>4.40</td>
<td>1.58</td>
<td>5.50</td>
<td>0.97</td>
<td>2.63</td>
<td>13</td>
<td>.02</td>
<td>0.70</td>
</tr>
<tr>
<td>Attitude Towards Using</td>
<td></td>
<td></td>
<td>5.17</td>
<td>1.36</td>
<td>5.64</td>
<td>1.39</td>
<td>2.46</td>
<td>13</td>
<td>.03</td>
<td>0.66</td>
</tr>
<tr>
<td>Continuance Intention to Use</td>
<td></td>
<td></td>
<td>5.10</td>
<td>1.86</td>
<td>5.67</td>
<td>1.39</td>
<td>2.16</td>
<td>13</td>
<td>.05</td>
<td>0.58</td>
</tr>
</tbody>
</table>

**Lesson Plans**

This data source enabled me to evaluate whether teachers mentioned or included their intention to use Pear Deck in their lesson plans. I analyzed plans for the presence or absence of the intention to use Pear Deck and quantified this data (1 = present, 0 = absent). Presence was indicated by the mentioning of Pear Deck within the lesson plan. Eight out of nine interview participants submitted a lesson plan. Out of those eight lesson plans, seven (87.5%) showed the intention to continue to use Pear Deck in their classroom. Intention to continue to use was determined by reviewing the upcoming week to two weeks of teachers’ lesson plans and identifying whether teachers had included one or more Pear Deck lessons in their lesson plan (see Figures 4.1 and 4.2). If at least one Pear Deck was included, the teacher was identified as intending to continue to use Pear
Deck. For the teacher who did not include a Pear Deck lesson in her lesson plan, she was identified as not intending to continue to use Pear Deck.

**Text Structures**

**Standards**
- RL.K.6.12 Analyze and critique how the author uses structures in print and multimedia texts to shape meaning and impact the reader. See...
- RL.K.6.12 Compare and contrast how different text structures contribute to meaning and impact the reader. South Carolina Grade 6 English...
- RL.K.6.11.2 Students are expected to build upon and continue applying previous learning. South Carolina Grade 6 English Language Arts (2015)

**I Can**
I can determine the text structure of a text

**Strategies**
Blended learning, teachers conferencing, guided practice, gradual release

**Agenda**
- Smash, Boom, Best: “Pizza vs. Tacos” Debate (organizer) Claim, Argument, counterargument
- Finish Cornell Notes (Text Structure)
- Text Structure Pear Deck (Practice)
- Text Structure Google Form

**Assessment**
Quiz scores; Pear Deck Results

Figure 4.1 Lesson Plan One
<table>
<thead>
<tr>
<th>Monday</th>
<th>Teacher/Topic</th>
<th>Fact vs. Fiction</th>
<th>Fact vs. Fiction</th>
<th>3rd</th>
<th>4th</th>
<th>Lunch/Planning</th>
<th>Fact vs Fiction</th>
</tr>
</thead>
</table>
| **Agenda** | - Independent Reading  
  - Review Play  
  - Identify Fact vs. Fiction (analyze and underline in the play)  
  - Introduce PearDeck  
  - Discussion Questions for what students will work on together tomorrow | - Independent Reading  
  - Review Play  
  - Identify Fact vs. Fiction (analyze and underline in the play)  
  - Introduce PearDeck  
  - Discussion Questions for what students will work on together tomorrow |  |  |  |  |  |

<table>
<thead>
<tr>
<th>Tuesday</th>
<th>Teacher/Topic</th>
<th>Fact vs. Fiction</th>
<th>Fact vs. Fiction</th>
<th>3rd</th>
<th>4th</th>
<th>Lunch/Planning</th>
<th>Fact vs Fiction</th>
</tr>
</thead>
</table>
| **Agenda** | - Independent Reading  
  - Students will complete PearDeck Discussion questions in partners or individually  
  - Teacher will walk around and pull small groups to assess understanding of Fact vs. Fiction & add feedback to PearDeck | - Independent Reading  
  - Students will complete PearDeck Discussion questions in partners or individually  
  - Teacher will walk around and pull small groups to assess understanding of Fact vs. Fiction & add feedback to PearDeck |  |  |  |  |  |

---

**Figure 4.2 Lesson Plan Two**
Qualitative Analysis and Findings

This section addresses the results of the qualitative portion of this mixed-methods study, using data from semi-structured interviews and teacher reflections. First, I describe the two sources in more detail. Second, I articulate my process for analyzing the qualitative data through coding. Finally, I present findings and describe how themes developed from the codes.

Description of Qualitative Data

This study included qualitative data from nine semi-structured interviews and 10 teacher reflections. I collected both types of data to gain understanding regarding teachers’ perceptions of using Pear Deck, the structure of the professional development, and enablers and barriers that influence teachers’ intentions to continue using Pear Deck. Table 4.5 presents the number of codes applied to each qualitative data source.

Table 4.5 Summary of Qualitative Data Sources

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>semi-structured interviews</td>
<td>9</td>
<td>522</td>
</tr>
<tr>
<td>teacher reflections</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>547</td>
</tr>
</tbody>
</table>

I chose a purposive sample of nine survey participants to participate in a semi-structured interview (see Table 4.6). These nine individuals also completed the teacher reflection portion, along with one other survey participant who was not interested in participating as an interviewee as this was her last year before retiring. Out of the nine teachers who participated in the interview, three were ELA teachers, with one being a relatively new teacher; two were experienced science teachers; one was an experienced
elementary school teacher who recently shifted to sixth-grade social studies; two were related arts teachers, with one being new to our district; and one was an intervention teacher (designated as a related arts class) and was also new to teaching sixth grade.

Table 4.6 Interview Participants

<table>
<thead>
<tr>
<th>Participant Pseudonym</th>
<th>Age Range</th>
<th>Gender</th>
<th>Years of Experience</th>
<th>Content Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grace</td>
<td>21-25</td>
<td>Female</td>
<td>2</td>
<td>ELA</td>
</tr>
<tr>
<td>Bobbie</td>
<td>31-35</td>
<td>Female</td>
<td>10</td>
<td>Related Arts</td>
</tr>
<tr>
<td>Katie</td>
<td>46-50</td>
<td>Female</td>
<td>21</td>
<td>Social Studies</td>
</tr>
<tr>
<td>Jonathan</td>
<td>51-55</td>
<td>Male</td>
<td>25</td>
<td>Science</td>
</tr>
<tr>
<td>Amy</td>
<td>26-30</td>
<td>Female</td>
<td>4</td>
<td>Related Arts</td>
</tr>
<tr>
<td>Theresa</td>
<td>36-40</td>
<td>Female</td>
<td>10</td>
<td>Related Arts</td>
</tr>
<tr>
<td>Janet</td>
<td>51-55</td>
<td>Female</td>
<td>29</td>
<td>ELA</td>
</tr>
<tr>
<td>Monica</td>
<td>31-35</td>
<td>Female</td>
<td>13</td>
<td>Science</td>
</tr>
<tr>
<td>Lisa</td>
<td>46-50</td>
<td>Female</td>
<td>23</td>
<td>ELA</td>
</tr>
</tbody>
</table>

The semi-structured interviews were recorded using Google Meet and exported as .mp4 files, which I uploaded to the website Happy Scribe to generate transcripts. I reviewed and compared each transcript to the corresponding audio file to fix any incorrect wording. I uploaded the transcripts to Delve, software for organizing and analyzing qualitative data. I then used inductive analysis (Creswell, 2002) to begin grouping similar elements together (Rosch, 1978) to develop categories and themes.

After reviewing the transcripts, I emailed each participant their individual document for them to review and ensure that the transcript was an accurate account of our conversation. No participant emailed any corrections to their transcripts. Once I had
generated categories and themes, I emailed participants again to ensure my findings accurately reflected participants’ thoughts and beliefs. I did not receive any corrections from the participants. Member checking increased reliability by validating my findings (Saldaña, 2016).

The 10 survey participants who provided reflections did so by responding to questions posted in the post-learning portion of the North Lake Intermediate Professional Development Google Classroom. Completion of the prompts was requested but not mandatory. I copied the responses from Google Classroom and pasted them into Delve as one combined file that underwent analysis.

**Description of Qualitative Data Analysis**

I utilized inductive analysis as I, the researcher, “gathere[ed] detailed information from participants and then form[ed] this information into categories or themes” (Creswell & Creswell, 2018, p. 63). I coded qualitative data by assigning summative attributions to words or phrases (Saldaña, 2016). According to Charmaz (2001), coding allows researchers to create a link between data and meaning. My codes led to patterns, categories, and themes later in the analysis process (Vogt et al., 2014).

Qualitative analysis of the data occurred in two cycles. The first cycle consisted of two rounds in which I looked for the important pieces of data. The two rounds I used in this process were in-vivo coding and values coding. The purpose of the first round was to begin to establish a general understanding of the data and generate initial codes. I used these initial codes in the second round of coding with the goal of developing a “categorical, thematic, conceptual, and/or theoretical organization from [my] array of
first cycle codes” (Saldaña, 2016, p. 234). After transitioning to the second coding cycle, I used pattern coding to group codes into categories.

This section describes the processes and thoughts behind my analysis of the qualitative data. It includes three subsections: (a) first cycle of coding, (b) transition to the second cycle of coding, and (c) second cycle of coding.

**First-Cycle Methods**

**In-Vivo Coding.** For the first round of the first cycle of coding, I employed in-vivo coding, which refers to word(s) or phrases from an interview using “the terms used by [participants] themselves” (Strauss, 1987, p. 33). Saldaña (2016) noted that in-vivo coding, while appropriate for most qualitative studies, is particularly appropriate for researchers first learning to code data. This type of coding is beneficial for checking to see if the researcher has truly grasped what the participant found to be significant (Charmaz, 2014).

For my first round, I uploaded each participant’s transcript as an individual file in Delve. I also added the teacher reflections as a single file. I went in alphabetical order, starting at the beginning of the files. In other words, I coded seven interviews, the teacher reflection file, then the final two interviews. This approach gave me an easy structure to follow, as I did not always have extended time to sit and code. By going alphabetically, I could easily see how much I had accomplished and how much I had to complete, which kept me motivated.

Figure 4.3 illustrates how, as I read through each transcript, I coded and highlighted meaningful units of words to capture important ideas, thoughts, or phrases teachers said (Saldaña, 2016). These units were often entire sentences, which facilitated a
proper understanding of the meaning of the quote. If a quote warranted clarity, I used parentheses to provide the necessary information.

![Image](image_url)

**Figure 4.3 In Vivo Coding in Delve**

After completing the first round of coding, I reflected on the chosen codes and added or removed codes as necessary. For example, when looking over my in-vivo codes, I noticed some participants whose transcripts I coded later in the process mentioning students’ being willing to help if a teacher is not familiar with technology. This data piece was not something I had deemed a code for in earlier transcripts; therefore, I went back and added some additional codes for the beginning transcripts. This first round generated 428 codes.

**Values Coding.** During the second round of the first cycle, I used values coding. Given my pragmatic research paradigm and the idea that each person interprets reality in their own way (Mertens, 2009), values coding enabled me to understand each participant’s perspective (Saldaña, 2016). Ho (2021) described this approach as pertaining to what a participant (a) judges as important, (b) feels or thinks about something, and (c) accepts as true based off their attitudes and beliefs. When coding, I assigned a V (values code) for something a teacher felt was important (e.g., feeling technology is beneficial for students), an A (attitude code) to identify the way a teacher thinks or feels about something (e.g., thinking Pear Deck is easy or helpful), and a B (beliefs code) for items that include attitude, values, and personal options (e.g., students
need to be off of technology). For example, I assigned the code “A: helpful to view from student perspective” to statements that reflected teachers’ feelings and thoughts regarding the professional development format. Another example of a values code was “V: kids are off task,” applied to statements about behavior—an issue teachers find important and one that can impact their choice to use technology (see Figure 4.4).

Similar to my process after the first round of coding, upon completing the second round, I reviewed my codes and reworded, added, and removed codes as necessary. I sought to ensure I used the same codes to represent similar values. For example, I had several similar codes dealing with teachers’ needing time, including “playtime is helpful,” “being able to play,” “dabble time,” “dabble with it,” and “not enough time.” I consolidated these items into two codes: “need more time” and “playtime is necessary.”

Figure 4.4 Values Coding

_**Transition to the Second Cycle of Coding**_

After completing the two rounds of the first cycle, I transitioned to the second cycle of coding. To begin this process, I first downloaded both rounds of codes, including the interview snippets from Delve, as Microsoft Excel files that I uploaded as two separate tabs on a Google Sheet labeled as “Round 1 Cycle 1 Snippets” and “Round 2, Cycle 1 Snippets” (See Figure 4.5). I read through all codes and reevaluated whether or not they were relevant to the overall story of my research. A few codes I deemed...
irrelevant and removed. For example, two codes, “feedback is beneficial” and “questioning is beneficial,” did not relate back to my research.

Figure 4.5 Google Sheet Organization

**Second-Cycle Methods**

In my second cycle of coding, I used pattern coding to begin grouping my first-cycle codes into smaller clusters to create “more meaningful units” (Saldaña, 2016, p. 236). After downloading my first two rounds from Delve to Google Sheets, I printed each tab in the spreadsheet as a separate document, used a binder clip to keep them together, and used colored pens to begin marking similarities and patterns that I noticed (see Figure 4.6). To remain focused, I looked for thoughts or comments that showed similar characteristics and went page-by-page through each spreadsheet, making marks when coming across a code I thought fit this pattern. This approach allowed me to begin thinking about commonalities and patterns within my code while not yet assigning pattern codes or specific groupings to my data.
Next, I copied and pasted each snippet and code marked with the same color into a new tab for each color (see Figure 4.7). I placed any item I had not colored under a tab called neutral. Many codes underneath the neutral tab I later deemed irrelevant or an exception. For example, the code *Difference between teacher-paced and student-paced*
did not relate to teacher perception regarding the use or attitude toward technology; it was
simply an observation. One teacher’s comment out of all nine interviews led to the code
*Pear Deck is not useful to me*; however, she did not utilize any technology in her
classroom so this code was an outlier.

Figure 4.7 Color Coding for Organization

Once I labeled these tabs, I copied and pasted the information into a single tab
labeled CYCLE 1. Each snippet and code were labeled with its assigned color chosen
from a dropdown box (see Figure 4.8). I then organized the sheet alphabetically by color
so I could see similar groupings and began looking for patterns within the codes.

Figure 4.8 Alphabetized Colors

Within each colored tab, I began looking for, and labeling, pattern codes based on
commonalities from the first-cycle codes. One of my pattern codes, *Pre-made Resources*,
derived from a group of codes: *Use premade Pear Decks*, “I have never created my own
*{Pear Decks} but I have used ones my department have created,” and *question
stems/sentence starters would be helpful for questioning* (see Figure 4.9). As I created
pattern codes, I created a separate tab for these as well that identified the original color so
I could review the codes and snippets if I needed to clarify any contextual meaning (see Figure 4.10).

<table>
<thead>
<tr>
<th>Snippet</th>
<th>First Cycle Code</th>
<th>Pattern Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>I love that you gave, like, sentence starters.</td>
<td>question stems/sentence starters would be helpful for questioning</td>
<td>Premade resources encourage use</td>
</tr>
<tr>
<td>I have never created my own but I have used ones my department have created.</td>
<td>use premade peardecks</td>
<td>Premade resources encourage use</td>
</tr>
<tr>
<td>like to have question stems ready for myself to use that could be applied to any type of lesson. When I am teaching a lesson, sometimes I get so involved with the lesson itself and the students that I forget the resources that I have at my disposal.</td>
<td>question stems/sentence starters would be helpful for questioning</td>
<td>Premade resources encourage use</td>
</tr>
<tr>
<td>My confidence when other like in my department, people have used them, our department had made some peardecks and shared them with the department, which meant that I was just able to make my own copy and kind of play, so I didn't feel as frustrated or confused when I was making my own. So the thing that made me feel better about it was just practicing and already having them made so I could get used to it and then jumping off into making my own.</td>
<td>use premade peardecks</td>
<td>Premade resources encourage use</td>
</tr>
<tr>
<td>I think a general one at first and then maybe break out sessions by content would be helpful since each content you use them.</td>
<td>Content specific examples are helpful</td>
<td>Content specific examples are helpful</td>
</tr>
<tr>
<td>More modeling, I guess.</td>
<td>&quot;more modeling (in pd)&quot;</td>
<td>Content specific examples are helpful</td>
</tr>
</tbody>
</table>

Figure 4.9 Beginning of Pattern Coding
Once I placed all pattern codes I developed into this tab, I attempted to synthesize pattern codes into categories. To distinguish between codes and categories, Charmaz (2014) turned to metaphors, suggesting, “coding ‘generates the bones of your analysis . . . [I]ntegration will assemble those bones into a working skeleton’” (as cited in Saldaña, 2016, p. 113). I read and reread my pattern codes and recoded them as needed; however, I struggled to place pattern codes into categories. Based on a conversation with my co-advisor, I decided to use the tabletop method to spatially arrange my codes (Saldaña, 2016). I printed the codes and cut them into strips to have a tangible way to create
groups. Being able to physically manipulate the codes allowed me to rearrange them multiple times until I had organized the pattern codes into groups that made sense to me as a holistic category. Reviewing the groups, as an idea came, I created a temporary category name labeled with a small sticky note (see Figure 4.11). I put these category ideas in a new tab on my spreadsheet with the category name as well as the pattern codes nested underneath (see Figure 4.12).

<table>
<thead>
<tr>
<th>Categories</th>
<th>Pattern Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-technology/outside barriers</td>
<td>change in standards/curriculum discouragement</td>
</tr>
<tr>
<td></td>
<td>Other teachers' ineffective usage of PearDeck influences use</td>
</tr>
<tr>
<td>PearDeck specific barriers</td>
<td>Confusion over what students see</td>
</tr>
<tr>
<td></td>
<td>Confusion over how to use</td>
</tr>
<tr>
<td></td>
<td>Students are tired of Pear Deck</td>
</tr>
<tr>
<td></td>
<td>PearDeck is not useful to me</td>
</tr>
</tbody>
</table>

Figure 4.11 Tabletop Method

Figure 4.12 Beginning Category Names
When I met with my co-advisors to discuss these preliminary categories, my major professor suggested that I reframe my pattern codes and categories based on the TAM, which aligned with my survey. Therefore, I inserted a column between my original categories and pattern codes and worked on reframing my pattern codes to align more with the TAM. For example, I reframed the original pattern code change in standards/curriculum discourages creation as external variables affecting perceived usefulness/intention to use. Once I reframed all pattern codes, I duplicated the tab and deleted the old categories from the new tab, resulting in a clear workspace for grouping the new pattern codes into new categories as needed. At this stage, I met with the co-advisor, who suggested the categories were too specific and recommended I make them a bit more general. I made these adjustments on my spreadsheet. One example of a tweaked category developed from two pattern codes, Pre-learning activities and Pre-made Resources. I simplified the original category, “Extras” that can encourage Pear Deck use, to Teacher Preparation, which I used to describe pieces of the professional development that influenced teachers’ intentions to use Pear Deck in their classrooms.

With simplified categories, I inserted a two-column table in a blank document and began chunking similar categories in Column 1 that developed from the new pattern codes. I then used these categories to jot ideas for themes in Column 2 (see Figure 4.13). I shared this table with my co-advisors and received digital feedback prior to a virtual meeting with my major professor in which we further discussed my ideas and he guided me with questions that led to a combination of two proposed theme ideas.
Finally, I created a document to input my tentative themes, categories, and pattern codes. I shared this item with both professors prior to meeting with them. I received some feedback and suggestions as to tweaks and clarifications for my themes table but left this meeting with a solid idea of my themes.

Throughout the coding process, my co-advisors and I discussed the codes, categories, or themes I developed. They engaged me by questioning different codes or categories, their meaning, and why I had assigned the code or category to that particular statement. A fellow student in the same cohort served to peer review and discuss my categories and talk through some thought processes. In particular, as we discussed student apathy, my peer raised the idea of relationships as another program graduate had found a connection between culturally responsive teaching’s focus on relationships and student engagement. After reviewing my data, however, I did not feel like my research was diving into relationships or a lack thereof with students.
Presentation of Findings

The purpose of this mixed-methods action research study was to investigate how TPACK-focused online professional development influenced teachers’ development of technology self-efficacy and intention to integrate the tool, Pear Deck, and measure changes in their attitudes toward Pear Deck at North Lake Intermediate School in South Carolina. Ultimately, I hoped to enhance the effectiveness of future professional development for teachers in local school districts or other similar settings. Synthesis of my qualitative data produced four themes: (a) teachers perceived the design elements of the professional development as beneficial (b) TPACK-focused professional development influences the antecedent of teachers’ intentions of using Pear Deck, (c) teacher expectations about students’ reception of technology affects PU, and (d) professional development cannot address external barriers. Table 4.7 displays each theme along with the corresponding categories, pattern codes, and exemplar first-cycle codes. For example, first-cycle coding produced the codes *Kids are off task, Not participating appropriately,* and “they’re (students) not doing what they’re supposed to be doing.” Combining these codes yielded the pattern code *Off Task Behavior,* which describes any sort of undesired student behavior that does not directly relate to the task students are being asked to complete. I combined this pattern code with another pattern code, “Classroom management impacts Pear Deck use,” to form the category, Classroom Management. This category describes a teacher’s ability and skill to keep students focused, on task, and learning effectively. Combining this category with other categories led to the theme “Professional development cannot address external barriers.”
<table>
<thead>
<tr>
<th>Theme</th>
<th>Categories</th>
<th>Pattern Codes</th>
<th>First Cycle Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers perceived the design elements of the professional development as beneficial</td>
<td>Asynchronous Training</td>
<td>• Asynchronous-complete when time is available</td>
<td>• “Work at my own pace” (Katie)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Asynchronous-deep dive into interests</td>
<td>• V: Asynchronous format allows choice</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• differentiate the material” (Amy)</td>
</tr>
<tr>
<td>Teacher Preparedness</td>
<td></td>
<td>• Pre-learning activities</td>
<td>• A: Articles helped with new ideas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Pre-made resources</td>
<td>• A: Better understand TPACK</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• A: Question stems/sentence starters are helpful</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• B: Pre-made resources encourage use</td>
</tr>
<tr>
<td>Integrating Student Perspective</td>
<td></td>
<td>• Helpful to view from student perspective</td>
<td>• “Like having the student view” (Theresa)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Modeling</td>
<td>• V: Understand what students see</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• A: Feel more comfortable</td>
</tr>
<tr>
<td>Personalized Feedback Report</td>
<td></td>
<td>• Personalized report provided tips for next steps</td>
<td>• “personalized feedback was really powerful” (Katie)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Personalized report affected intentions to use</td>
<td>• V: Email provided ideas</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• “email…had great resources” (Monica)</td>
</tr>
<tr>
<td>Theme</td>
<td>Categories</td>
<td>Pattern Codes</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>TPACK-focused professional development influences the antecedent of</td>
<td>Technological Knowledge</td>
<td>• Easy to Use</td>
<td></td>
</tr>
<tr>
<td>teachers’ intentions of using Pear Deck</td>
<td></td>
<td>• Using the platform in PD built confidence</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technological-Pedagogical Knowledge</td>
<td>• Beneficial for instruction</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Engaging and interactive for students</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• PD focusing on pedagogical practices increased PU and CITU</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technological-Content Knowledge</td>
<td>• Content specific examples</td>
<td></td>
</tr>
<tr>
<td>Teacher expectation about students’ reception of technology affects</td>
<td>Increased PU with Honors</td>
<td>• Pear Deck is more successful in an honors class</td>
<td></td>
</tr>
<tr>
<td>PU</td>
<td></td>
<td>• Works well with Honors</td>
<td></td>
</tr>
</tbody>
</table>

First Cycle Codes
- “I will...use that information” (Bobbie)
- “[PD] was helpful” (Lisa)
- “boosted my self-confidence” (Jonathan)
- “Students were more engaged” (Janet)
- “students were interacting, they were learning more” (Amy)
- A: Pear Deck is engaging
- V: Allows for feedback
- B: Beneficial for instruction
- B: Using pre-made Pear Decks
- V: Specific examples are helpful
- “Seeing how it works for somebody else” (Bobbie)
- “I can see it [Pear Deck] working well in an Honors” (Theresa)
- “my Honors class, they usually do a great job of interacting” (Lisa)
<table>
<thead>
<tr>
<th>Theme</th>
<th>Categories</th>
<th>Pattern Codes</th>
<th>First Cycle Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers more willing to use Pear Deck with classes they deemed more supportive</td>
<td>• Students can be supportive when the teacher is trying a new technology</td>
<td>• “I do have one class I could do that [use as a test subject]” (Katie)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• B: More successful with certain groups of students (guinea pigs)</td>
<td></td>
</tr>
<tr>
<td>Perceived student apathy</td>
<td>• Teacher thinks kids won’t complete assignment</td>
<td>• “kids won’t complete it” (Theresa)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• “They won’t do it on their own” (Monica)</td>
<td></td>
</tr>
<tr>
<td>Perceived Student Behavior</td>
<td>• Students are more likely to comply using paper and pencil</td>
<td>• “If you give them paper and pencil, they’re working” (Grace)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Students are not prepared for class (do not bring Chromebooks)</td>
<td>• V: Paper/pencil gets more compliance</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• “kids who aren't going to be able to participate.” (Lisa)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• “It's almost like you're dead in water if you don't have a class that's prepared with a device” (Katie)</td>
<td></td>
</tr>
<tr>
<td>Professional development cannot address external barriers</td>
<td>Classroom Management</td>
<td>• Classroom management impacts Pear Deck use</td>
<td>• “I don't want to deal with that piece of classroom management” (Janet)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Off-task behavior</td>
<td>• V: Kids are off task</td>
</tr>
<tr>
<td>Theme</td>
<td>Categories</td>
<td>Pattern Codes</td>
<td>First Cycle Codes</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Teachers are burnt out</td>
<td>• Teachers want a break from technology</td>
<td>• A: Not participating appropriately</td>
<td></td>
</tr>
<tr>
<td>on technology</td>
<td>• Important to get them (students) off the computer.</td>
<td>• “They’re not doing what they’re supposed to be doing” (Theresa)</td>
<td></td>
</tr>
<tr>
<td>Students are burnt out</td>
<td>• Kids are tired of Pear Deck</td>
<td>• B: Not using technology as much this year</td>
<td></td>
</tr>
<tr>
<td>on technology</td>
<td>• Kids want a break from technology</td>
<td>• “go more to the hands on” (Jonathan)</td>
<td></td>
</tr>
<tr>
<td>Other teachers’ use of</td>
<td>• Teachers base use of Pear Deck on other teachers.</td>
<td>• “Sometimes they (students) want a break from technology” (Katie)</td>
<td></td>
</tr>
<tr>
<td>Pear Deck</td>
<td>• Changing standards discourages creation</td>
<td>• A: They’re just done with Pear Deck” (Bobbie)</td>
<td></td>
</tr>
<tr>
<td>Changing</td>
<td>• Time for play</td>
<td>• “not every teacher uses it as effectively” (Bobbie)</td>
<td></td>
</tr>
<tr>
<td>standards/curriculum</td>
<td>• Time for creation</td>
<td>• “I don’t want to devote too much time to it” (Monica)</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td></td>
<td>• V: Standards change in 2022</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• “I think playing and just experimenting with it makes me more confident.” (Lisa)</td>
<td></td>
</tr>
<tr>
<td>Theme</td>
<td>Categories</td>
<td>Pattern Codes</td>
<td>First Cycle Codes</td>
</tr>
<tr>
<td>-------</td>
<td>------------</td>
<td>---------------</td>
<td>-------------------</td>
</tr>
</tbody>
</table>
|       |            | • “having the time to prepare different pieces of curriculum” (Monica) | • V: Playtime is necessary  
• B: Need more time |
|       |            |               |                   |
Theme 1: Teachers Perceived the Design Elements of the Professional Development As Beneficial

The participants spoke to the particular aspects of the innovation that mitigated barriers and influenced their intention to use Pear Deck, consistent with literature regarding best practices for professional development. Modeling (Darling-Hammond et al., 2017; Gulamhussein, 2013; Gunter & Reeves, 2017; Knapp, 2007), providing pre-learning articles to begin thinking about how to use tools appropriately (Voogt & McKenney, 2017), allowing teachers to complete the professional development as it fit in their schedule (Russell et al., 2009), and providing personalized feedback reports through email (Woodward & Hutchinson, 2018) are all items supported by research for best practice for professional development. This theme consists of four categories participants mentioned that had some effect on their intentions to use Pear Deck again: (a) asynchronous training, (b) teacher preparedness, (c) integrating student perspective, and (d) personalized feedback reports.

Asynchronous training. I defined this category as teachers’ having the opportunity to complete professional development as it suited their schedule within a specific time frame. Offering professional development when convenient provides teachers autonomy and choice, which has an impact on their attitude toward professional development. When teachers are forced to complete professional development at a set time and with a set sequence, teachers seem to be less engaged. Lisa appreciated being able to complete the training when she was ready to focus. She said,

I feel like it’s valuable time that can be spent really focus[ed] on something instead of . . . I tend to be like my students, and if I’m in the cafeteria doing that
[whole-group professional development], I would have been like, looking around.

But with this, I was able to focus and do it on my own time. Another participant, Katie, spoke positively regarding the asynchronous format of professional development by stating,

I do like being able to do things on my own time when I want to do them. That’s just how I like to learn, as opposed to having to sit and be in a certain place at a certain time and have somebody telling you, okay, now we’re going to do this. Now we’re going to do that. So I just like the idea of it’s 6:00 and somebody’s at riding lessons, and I can just sit and just, oh, I’m going to go ahead and pop this open. Go ahead and work on this right now. So to me, that was important because I got to do it on my terms.

Asynchronous training gives teachers a choice to work when it suits them best. Another participant (Amy) discussed how the asynchronous format allowed them to dive deeper into the content, saying, “I was able to go at my own pace and explore each added information that was included on the slide instead of clicking the link and taking the time instead of rushing through it.” In a traditional sit and get professional development, teachers do not have this opportunity to dive deeper.

Giving teachers autonomy to complete the professional development when they were ready allowed them to be more open to Pear Deck as exemplified by the following response from Theresa:

Well, because of our PD, now, I’m more inclined to use it versus if I didn’t have that [asynchronous] PD with you. Had we done it like normal, I would have been
like, it’s okay, and kind of just look[ed] quickly over it and just been scared to use it.

Similarly, another participant (Jonathan) shared, “I realized that this [Pear Deck] is a great way to help supplement some of the things that we’re doing [in science class].” By providing teachers choice, it meets the self-direction aspect of Knowles’ (1980) andragogy.

Two participants discussed how the format of the professional development allowed for differentiation, which is a topic we often promote for our students. Amy shared, “I enjoyed doing it on my own instead of a whole-group-type session, and it allowed me to kind of differentiate the material for myself so I knew what I could do instead of just like generalities.” One experienced teacher (Lisa), yet a non-digital native, enjoyed the asynchronous format because “just like my students, we [teachers] all work at different paces,” and this structure allowed her to work through the program without feeling rushed or overwhelmed.

All nine interviewees mentioned the asynchronous format as neutral or positive due to the autonomy it provided.

**Teacher Preparedness.** I defined this category as any resource that set teachers up for success prior to using Pear Deck. It derived from two pattern codes: *pre-learning resources and pre-made resources*. The pre-learning articles helped teachers to understand the importance of using technology tools to support best practices within their content area versus simply choosing a tool because it is cool (Okojie et al., 2005). Encouraging teachers to learn more about TPACK domains prepared them to select appropriate technologies that complement their content and “use the tools in
pedagogically appropriate and effective ways” (Voogt & McKenney, 2017, p. 72). Katie spoke to her perspective after completing the pre-learning articles,

I think using the TPACK framework to enhance technology within the classroom would enhance lessons and create a more engaging lesson for students. By using TPACK teachers could be more intentional about how they are teaching content -- focus on the standard and then let the rest follow with integrating the technology.

This introduction of the TPACK domains ahead of the professional development allowed for teachers to have a deeper understanding of the interrelatedness of technology, content, and pedagogy prior to participating in the professional development.

The other aspect of teacher preparation was pre-made resources such as templates from Pear Deck, sentence starters, question stems, or Pear Decks other teachers have made and shared. One participant had used Pear Decks developed by colleagues to minimize the confusion of using an unfamiliar tool. Lisa explained,

My confidence, when others, like in my department, . . . [have] made some Pear Decks and shared them with the department, meant that I was just able to make my own copy and kind of play. So I didn’t feel as frustrated or confused when I was making my own. So the thing that made me feel better about it was just practicing and already having them made so I could get used to it and then jumping off into making my own.

While using department resources is beneficial for those that teach the same subject, it can also help those in other subject areas. Another participant (Amy) said, “I need to see it being done effectively so that I can think of my own time, how do I apply it in my classroom and how can I tweak it so that it’s effective in [my] setting?” Providing
teachers with resources throughout the professional development can remove or lessen barriers such as time and low self-efficacy.

**Integrating Student Perspective.** The category of integrating student perspective describes teachers’ experiencing the professional development through the student side of Pear Deck. Previous studies have shown active and authentic learning experiences that model the practice being taught can lead to an increase in teacher self-efficacy (Darling-Hammond et al, 2017; Gulamhussein, 2013; Gunter & Reeves, 2017; Knapp, 2017). Experiencing the student perspective allows teachers to see how students would interact and engage with the technology and builds confidence (Gulamhussein, 2013; Gunter & Reeves, 2017; Knapp, 2017). This integration of the student perspective helped create understanding of and confidence in using Pear Deck for participants.

Katie: So by us being a student, we kind of see it from the other side and it’s like, oh, I like that, or oh, I didn’t like that. So we can take that and then kind of bring it in when we’re doing it with our kids.

Janet: Because if you’re comfortable using it from the other end, you kind of see it through a different lens. So if I can see it as a student, I’m like, hey, this kept me engaged. And I didn’t think this was going to be interesting, but it really was because I got to give my feedback and my thoughts, and I wasn’t just sitting there listening to someone talk at me. I was actually part of the lesson.

Theresa: That [participating as a student] was so much better because I got to see what it was that I [would be] displaying and I got to see what they were going to see and how they were going to perceive it. So it’s very important. I feel like I needed to see that.
Through the student experience, teachers had the opportunity to see how Pear Deck kept them engaged and able to respond throughout the lesson, which facilitated connections to how it could be useful in their own classroom to support good pedagogy and engagement.

**Personalized Feedback Reports** This category pertains to the personalized feedback report each participant received from me via email based on their Pear Deck and discussion responses. Each report was tailored to a participant’s comments, provided answers to their questions, and suggested resources based on their responses (see Figures 4.14 and 4.15). One participant (Amy) said, “the email that you sent was so informative and it was definitely specialized just for what I had done. I really appreciated it. I thought it had great resources and cool ideas.” These resources could help teachers with moving forward in their use of Pear Deck.
Research: Follow Up
1 message

Based on your Pear Deck and discussion responses, I have a few "food for thoughts" to take or leave.

I know one concern you mentioned was CP classes on the lower end of the DOK spectrum. I wonder if posting a paragraph of information (or two), having them annotate, and then answer a question may help scaffold this. Just a thought. While this YouTube is ELA-based, it may show you what I mean.

Another thought is to maybe try to use Pear Deck to incorporate 2 or 3 scripted, open-ended questions to address while going through the information. You could then pull up the answers anonymously to provide some whole-group feedback and/or discussion based on your questions to address, kind of help showcase/model the necessary thinking for higher DOK.

Lastly, in your discussion, you mentioned using Pear Deck for plants—you may want to take a look through the Science Templates, Animatis Templates, or Earth Day Templates Pear Deck has created. It may give a good starting point (remember, these are all editable!). You could also add in a diagram for them to label or even draw the flow of water or nutrients (using certain colors).

If you do decide to try something from above, I always recommend starting small—maybe just one class, one lesson, etc.

Thank you for participating!

Kat Dogar, M.Ed
The personalized feedback reports also provided teachers with new ideas on how to utilize Pear Deck, which can make teachers less hesitant to implement Pear Deck in their classrooms. A science teacher (Jonathan) said, “you gave me other avenues that I haven’t considered before with the science templates and stuff like that.” Another
participant, Lisa, recognized the suggestions in the report as new information she could use in the classroom:

> It opened my eyes to some of the things I didn’t know yet. I didn’t know what I didn’t know. So now that I know those things, I will definitely take that into consideration and more than likely use that information.

This personalized support makes the professional development more relevant for teachers (Woodward & Hutchison, 2018).

Lastly, these personalized reports helped some teachers identify their next steps in using Pear Deck, with Monica stating, “It gives me action steps on what to do next.” The information teachers received in their personalized report provided each participant with answers, resources, and suggestions as to how they could use this tool in their classroom. Seven out of nine teachers felt these personalized feedback reports helped move them forward with their usage of Pear Deck.

**Summary.** The first theme is reflective of specific formatting aspects of a professional development experience that influenced teachers’ intention to use the technology tool, Pear Deck. Teachers recognized particular aspects of the innovation that they deemed beneficial or helpful and that influenced their intentions to use Pear Deck. Being able to complete the professional development when it suited their individual schedule (i.e., asynchronous training), being provided with pre-learning activities and pre-made resources, having Pear Deck modeled from the student perspective, and receiving a personalized feedback report all influenced teachers’ intention to use Pear Deck.
Theme 2: TPACK-focused Professional Development Influences the Antecedent of Teachers’ Intentions of Using Pear Deck

This theme emphasizes the innovation’s influence on teachers’ perceptions about using Pear Deck for teaching. It describes how the professional development focus on TPACK domains influenced teachers’ perceptions regarding ease of use (PEOU), usefulness (PU), self-efficacy (PSE), attitude toward using Pear Deck (ATT), and intention to continue using Pear Deck (CITU) (Powell & Bodur, 2019). The categories are as follow: (a) increasing technological knowledge, (b) increasing technological pedagogical knowledge, and (c) increasing technological content knowledge.

**Technological Knowledge.** This category describes the focus to increase teachers’ knowledge of how to use Pear Deck. This increased understanding influences teachers’ perceived ease of use of the tool, as exemplified by one participant (Theresa) who said, “I’m more inclined to use it versus if I didn’t have that PD with you, I would have been like, it’s okay, and kind of just look quickly over it and just been scared to use it.” Teachers’ understanding of how to use the tool can increase confidence and self-efficacy. One other participant (Bobbie) said very simply that after the professional development and understanding more about Pear Deck she is, “inclined to use it more.” A third participant (Janet) summed up this idea quite well by stating, “I feel like if you have the how, then it would determine the frequency [of use].” When teachers understand how to use a tool better, they have more confidence. This increase in confidence leads to more positive attitudes and a higher likelihood of integrating the technology (Kao et al., 2020)
Another teacher found that increasing her knowledge of how to use Pear Deck impacted her perception of her self-efficacy when using Pear Deck. Lisa stated, “So that [professional development] was helpful. I went, oh, I can do that.” One other teacher (Monica) mentioned that in contrast to prior professional development opportunities on how to use Pear Deck, this one encouraged taking the next step by “show[ing] us how to take it deeper. That helped build my confidence, just having that opportunity where I was not forced, but forced to do it [use Pear Deck].” By increasing technological knowledge of a tool, teacher confidence increased.

**Technological Pedagogical Knowledge.** This category addresses teachers’ understanding of how certain uses of Pear Deck can impact teaching and learning. This category also takes into account the teachers’ understanding of the constraints and affordances of Pear Deck in the classroom. One participant (Theresa) spoke about the benefit of using Pear Deck for academic vocabulary in the classroom, suggesting when students “are interacting with the vocabulary on their Chromebook [on Pear Deck], I feel that it’s just not me saying, ‘Here’s your vocabulary.’ It’s on Google Classroom.” This focus on the pedagogy of engagement, defined as “an act or state of involvement in an activity (mental or physical)” (Davies, 2021), combined with Pear Deck improved teachers’ perception of the usefulness of Pear Deck and their intention to continue to use Pear Deck in the classroom.

One teacher switched from using Google Slides to Pear Deck as she saw students were more engaged. Monica explained, “I like Pear Deck because it’s engaging, and it takes Google Slides to another level because they can do more than just one type of answer.” This allows teachers to have more options when formatively assessing their
students. Another teacher (Katie) concurred, “Students were more engaged [on Pear Deck] than with a Google Slides presentation.” Students have the opportunity to engage with the Pear Deck lesson rather than sitting and watching a teacher go through a Google Slide. Lisa noted,

I like Pear Deck because of the engagement that it gets. And at first, the kids like to fiddle and play with the drawing and with the drawing and the moving the mouse, then the drop and drags and all that. But ultimately, it’s just to keep them engaged and hopefully learning in a different way, especially for the ones who need that kind of engagement.

Although there are other ways to engage students in the classroom, Pear Deck provides some benefits that may be more difficult to attain without the use of technology. Grace found the ability for all students to answer the question and see all student responses helped maximize student participation. She stated,

I like the piece [teacher dashboard] that you can pull up all of their responses and you can go through them together or you can just have them later on your own. I do find that helpful because oftentimes if you do just a class discussion and you ask a question, you’re going to get a response from maybe one kid or maybe just five kids.

Another teacher, Katie, agreed with this idea, stating, “It gives students a chance to be a part of the conversation instead of the teacher doing all of the talking. It makes students make connections and use different skills to come up with their answer.” In addition to allowing teachers to hear from every student, Pear Deck facilitates student collaboration. Amy said, “I thought it increased engagement and also allowed the students to work
individually and collaboratively. So I have that option of working, grouping them in the ways that they want it.”

Categorically, the increase in technological pedagogical knowledge I detected pertained not only to understanding how Pear Deck can enhance pedagogical practices such as engagement and collaboration but also to understanding the constraints of the tool. As Janet said, “I think you got to make sure you have the right activity to make it work.” One teacher struggled with figuring out the right question type to use in order to gather the desired formative data. Amy stated,

I did a Pear Deck a couple of weeks ago, and I had them do drag the dots for multiple choice. And then, as I [was] looking at the teacher view, it was just all the dots [were] being dropped, and I wasn’t able to see immediately which student was choosing. It was just a group of dots. So I knew I should have just done the multiple choice.

This understanding of both allowances and constraints of Pear Deck allows teachers to better support pedagogical practices through the use of technology.

Increasing teachers’ technological pedagogical knowledge can also influence teachers’ attitude toward using Pear Deck. One teacher, Bobbie, described the benefit of understanding how Pear Deck could support her students:

I could make sure I was reaching every kid and they could go back [to look at their work]. That was the other thing, is that kids, if they were absent, they didn’t miss a lesson because they had the lesson[on Pear Deck].

She had a more positive attitude toward the tool, explaining, “I’m going to try this new thing [Pear Deck] because I find value in it.”
With TPK, teachers have a better understanding of how a technology tool, such as Pear Deck, can support best practices in the classroom.

**Technological Content Knowledge.** This category describes how understanding TCK leads to an increase in teachers’ perception of Pear Deck’s usefulness. Mishra and Koehler (2009) defined TCK as the “need to understand which specific technologies are best suited for addressing subject-matter learning in their domains and how the content dictates or perhaps even changes the technology” (p. 65).

Using content-specific examples in the innovation showed teachers how they could use Pear Deck in their classroom. One teacher (Janet) cited a “helpful” example: “when you were doing the individual responses because it’s more specific to what my subject area warranted and needed.” This connection to what is needed in the classroom can help make the tool more relevant for teachers. A non-core content teacher (Amy) also appreciated the examples, explaining, “I think any of the core contents . . . I mean, when you’re presenting content, it might be skilled or content-based, but you’re still having to apply it in the classroom,” so showing “effective lessons that have worked and then I could maybe alter it to what curriculum I have” was helpful.

**Summary.** The second theme focuses on how teachers’ knowledge of TPACK domains influence teachers’ perceptions regarding the (a) usefulness, (b) self-efficacy, and (c) ease of use; (d) attitude toward Pear Deck; and (e) intentions to continue using Pear Deck for teaching. With increased technological knowledge, teachers’ perception of Pear Deck’s ease of use and self-efficacy also changed. Understanding how technology and pedagogy can work together to support best practice influenced teachers’ perceptions of Pear Deck’s usefulness in the classroom, their attitude toward Pear Deck, and their
intentions to continue using Pear Deck. Lastly, understanding how technology can support content through content-specific examples impacted teachers’ perception of the usefulness of Pear Deck. This TPACK focus influenced a greater range of teacher perceptions versus the traditional “how-to” professional development, which only addresses teachers’ technological knowledge.

**Theme 3: Teacher Expectations About Students’ Reception of Technology Affects PU**

The third theme states that teacher expectations about students’ reception of technology affects perceived usefulness. When teachers had positive expectations about students’ reception of technology, they felt Pear Deck would be useful; however, when teachers expected students to be apathetic or misbehaving, teacher responses indicated Pear Deck would not be as useful for them. The following categories led to the development of this theme: (a) increased perceived usefulness with honors classes, (b) teachers’ willingness to use Pear Deck with classes they deem supportive, (c) perceived student apathy, and (d) perceived student behavior.

**Increased Perceived Usefulness With Honors Classes.** This category describes teacher discussion on how an Honors class would do better when using Pear Deck than a College Prep (CP) class. One teacher (Janet) stated, “I can see [Pear Deck] working well in an honors [class] perhaps but that’s really it.” This teacher’s perception of its usefulness greatly impacted her choice to use Pear Deck. Another teacher (Monica) mentioned the feedback feature would not be as useful in a CP class as in an Honors class because “The CP, most of them would not [go back and look at feedback] as much as Honors would.” Participants also voiced concerns regarding perceived student behavior, as I discuss later; however, one participant (Lisa) noted, “[In] CP classes, there’s a lot
more of the playing,” which minimized the teacher’s perception regarding the usefulness of Pear Deck. The three teachers who mentioned Honors being more receptive were all core content teachers who had both Honors and CP level classes.

**Teachers’ Willingness to use Pear Deck With Classes They Deem Supportive.**

This category emerged from teacher discussions about their willingness to try Pear Deck if they felt students would be supportive and the teacher learning the platform would not derail the class. Katie mentioned having a group willing to be test subjects, saying:

being able to use it on our kids as like test subjects and say, ‘Hey, I want to try something with you guys and let’s see how it works.’ And I do have one class I could do that with and they wouldn’t tear [into] me, [if] it was a hot mess. It would be like, ‘Oh, she tried it. It didn’t work.’

In addition, Katie also mentioned that the honesty with students that a teacher is trying out something new can lead to a more positive response.

I tell my kids when I’m doing something, if it’s not something I’m really comfortable with, I’m like, ‘OK, we’re going to do this and just be patient with me.’ And if you kind of put that up front, they tend to be less critical of it. (Katie)

Another teacher (Lisa) pointed out that using Pear Deck can work with some classes yet not with others: “Knowing my kids, sometimes you can do something with one class and it goes great, and other classes you’re like, maybe I just don’t need to do that with them today.” This support from students helps to mitigate the anxiety of using technology in front of students who may know more than they do (BECTA, 2004).

**Perceived Student Apathy.** This category describes teachers’ perceptions regarding student indifference toward preparing for or participating in class. All nine
interviewees mentioned either students’ not bringing their Chromebooks to class at all or not charging them, rendering them unusable during class. As one participant (Katie) summarized, “having the device and having the charged device is definitely a challenge anytime you want to use technology in the classroom.” The lack of devices or not having devices charged can lead to the choice to use the textbook instead, as Monica explained, My only other issue is kids’ not having Chromebooks this year, really especially [in] CP, it’s not charged, and I have my last two classes [that] are CP [and] by the time they get to me, it’s already dead or they didn’t even bring it, so we’re resorting to the textbook.

Because of students’ history of being unprepared, teachers expected students would not engage with any technology.

Beyond the issue of students’ devices, participants indicated their expectation of a lack of student engagement. This perceived lack of interest in participating is a challenge for teachers. One participant (Janet) said, “It’s more so with the students sometimes—getting them to buy into it [the assignment], getting them to want to participate, getting them to realize, ‘Hey, I can answer this question,’” while Amy suggested, “completing [a Pear Deck assignment], I guess, too, is a hurdle sometimes. If I’m not up in the front leading them through something, they won’t necessarily do it on their own.” Because of this perceived student apathy, some teachers will choose not to use Pear Deck. One teacher (Grace) said her kids just want to finish tasks as soon as possible, explaining their thinking as “I’m just clicking through it. I’m just answering the question. I’m just going to get done.” While some kids rush through, there is also the issue of not participating at all as explained by Katie, “Some kids, it doesn’t matter what you do, they don’t want to
engage.” One teacher (Bobbie) chalked student apathy up to COVID-19, saying, “It’s that kids are just different. COVID has really changed it.” Yet, because teachers expect students will not participate and engage in Pear Deck, they do not provide them with this proven engagement tool (Pear Deck, 2023).

**Perceived Student Behavior.** This category describes teachers’ expectations and perceptions of student behavior. If teachers expect students will be nonresponsive or unengaged with Pear Deck, they may choose not to use it in class. For example, one teacher (Bobbie) said, “sometimes I'll choose not to use it just because I know the kids won’t complete it.” Another teacher (Janet) believes students will be more receptive to paper and pencil than technology in terms of complying with completing their work, stating, “Give them paper–pencil, and then they’ll work.” This preconceived notion that students will or won’t engage with Pear Deck affects the teachers’ perception of the usefulness of Pear Deck.

**Summary.** The third theme addresses how teachers’ expectations of students and their reception, whether positive or negative, of technology impact teacher perception of the usefulness of Pear Deck. Teachers who taught both Honors and CP classes appeared to expect a better reception of technology with Honors classes and therefore perceived Pear Deck as more useful with these students. There was also an expectation that certain groups of kids would be more receptive, and therefore, teachers were more willing to try the technology with these students. Conversely, when teachers expected students would be apathetic or noncompliant, many teachers simply chose not to use Pear Deck, deeming it not useful.
**Theme 4: Professional Development Cannot Address External Barriers**

The fourth and last theme states professional development cannot address external barriers. Professional development can influence teachers’ attitudes and perceptions regarding the use of a tool such as Pear Deck but cannot address those barriers deemed outside their sphere of influence. Therefore, while professional development can influence many aspects as to why a teacher may want to use Pear Deck, it cannot address all barriers that impact teachers’ intentions to continue using Pear Deck. This final theme is comprised of six categories: (a) classroom management, (b) teachers are burnt out on technology, (c) students are burnt out on technology, (d) other teachers’ use of Pear Deck, (e) changing standards and curriculum, and (f) time.

**Classroom Management.** This category describes the challenge of classroom management and how it impacts the decision to use Pear Deck. Classroom management is defined as

the methods and strategies an educator uses to maintain a classroom environment that is conducive to student success and learning. Including the management of the student Content (space, materials, equipment, movement, and lessons), Conduct (discipline problems), and Covenant (social dynamics and interpersonal relationships). (Froyen & Iverson, 1999, p. 128)

However, as class size increases, teachers spend more time on behavioral management and less time on instruction. According to the National Council of Teachers of English (2014), “Students display less disruptive behavior in small classes, and teachers spend less time on discipline, leaving more time for instruction” (p. 3). South Carolina has limits on the number of students teachers should have in the classroom but has not
enforced these caps since 2010 (Bowers, 2019). Therefore, teachers often take the path of least resistance. Janet shared, “I don’t want to deal with that piece of classroom management [being off-task on Chromebook] because there are so many other pieces of classroom management in two of my classes.” As I noted earlier, many teachers felt students were more likely to comply using pencil and paper.

How students behave on their Chromebooks impacts teachers’ use of Pear Deck. Multiple participants highlighted why they may choose not to use Pear Deck based on such behavior. For example, one participant (Janet) explained, “When I use it as a whole class, not everyone participates appropriately, and sometimes it’s hard to monitor that or they’re not on the site.” This lack of on-task behavior on the Chromebooks is noted elsewhere with another teacher (Grace) justifying their intentions by sharing, “I guess just because I feel like I’m trying to put out fires, like checking to see what they’re actually on.” A third participant (Katie) described extreme instances of classroom management: “I have my students, when they start going totally off the rails, then sometimes there have been occasions where I’ve had to just shut it down because they were just being too off topic and just going way out there.” This issue of off-task and non-compliant behavior has an impact on a teacher’s decision to use Pear Deck.

**Teachers Are Burnt Out on Technology.** This category describes how teachers may choose not to use Pear Deck simply because they are tired of being on technology or do not want to use it for their students. Given the limited instructional strategies they could use during COVID-19, one teacher, Grace, suggested pandemic burnout “plays a big part in it because you can ask me, like, I don’t like to use Chromebooks.” Others want students to be more hands-on. For example, Jonathan stated, “I wanted to get away from
the computer and go more to the hands on.” Some teachers are also tired of their students’ being on technology. One teacher (Lisa) prefers more traditional paper-and-pencil methods, reasoning, “[It] is really important for me, getting them off the computer, because I noticed a lot of them are so focused in on the computer already.” The feeling of overuse of technology during the pandemic has led to a regression of technology use in the classroom.

**Students Are Burnt Out on Technology.** Similar to the prior category, this category illustrates how many students are tired of being on technology; therefore, teachers may choose to give students a break from technology. One teacher tries to use a mix of technology and paper to give students a break. Katie stated,

So this week coming up, we’re taking a step away from the technology and going more to paper and pencil. They’re going to have to use their Chromebooks to help them, but we’re going to be doing more paper and pencil this week to kind of give them that break. And that was coming from them—how they were tired of always being on their Chromebooks. So I flip-flop it, kind of give them a break for a while and then we’ll go back to it, just kind of mix it up a little bit.

Another teacher’s students voiced their need for a technology break. Janet shared, “My students have said to me that they’re on their Chromebooks all day long and sometimes they want a break,” which influenced her plans to use Pear Deck. A second teacher (Bobbie) expressed a similar sentiment: “By the time they get to my class, they’re like, ‘Oh, well, I’ve already done, like, three Pear Decks today, and it’s a lot of reading.’”

**Other Teachers’ Use of Pear Deck.** This category emerged from Bobbie’s interview. It describes why other teachers’ use of Pear Deck sometimes influences her
decision not to use Pear Deck. She addressed student technology burnout as mentioned in the prior section; however, she extended the discussion by suggesting many teachers are “asking the kid to read, but you’re not asking them to engage with the reading.” When she invites students to complete a Pear Deck where they have to read, she finds they are not engaging and “finishing [Pear Decks] a lot faster than they used to.” For this reason, she added, “sometimes I choose not to use a Pear Deck because so many teachers are using Pear Deck, but not every teacher uses it as effectively or correctly.”

**Changing Standards and Curriculum.** This category addresses how changing standards and curriculum deter teachers from creating Pear Deck resources. This category is influenced by the next category, time. One teacher (Monica) pointed out, “We’re not getting our new standards until . . . well, we’re getting them next year, but we can’t fully teach them because they have to be tested and everything. So, we have to be tested on 2014 standards.” She continued, “with us getting new standards in 2 years, I don’t want to devote too much time to it making these really cool Pear Decks and then getting the [new] standards.” The shift in standards and textbooks every few years is a reality for most core content teachers and acts as a barrier to the creation of Pear Deck resources.

**Time.** The last category that informed Theme four is time. This category was evident across all nine interviews and describes the challenge of not having enough time to (a) play with Pear Deck to increase teachers’ comfort levels or (b) make Pear Deck resources. Teachers want play time to become more comfortable with new technology tools. One participant (Katie) described a need for “just having the time to play with.” Grace said, “I think the playing and just experimenting with [Pear Deck] makes more
confidence.” This request for play time is not limited to Pear Deck but any technology tool introduced during a professional development. Lisa shared,

I definitely would like to see, especially with Pear Deck or any technology that’s introduced us, a lot of times it’s introduced and then other things go on and you don’t get play time and I need play time to figure out what I’m doing.

The second barrier related to time is simply having the time to make the lessons.

This topic resounded in the interviews:

Monica: My only reason for not using it as often, it’s just making the lessons in time.

Janet: Time. Time to prepare different pieces of curriculum.

Jonathan: Just having time to sit there and develop.

Katie: Just having the time to go in and decide what do I want them to do on this slide or what I want them to do on that slide. So just basically having the time to go in and be able to do it.

Lisa: It’s just hard when you get a new technology tool to find time to integrate it.

Having time to play with Pear Deck is an obvious necessity, yet teachers clearly need unencumbered time to build Pear Deck lessons.

**Summary.** The final theme emphasizes the external barriers that professional development cannot address. While professional development can influence teachers’ attitudes and perceptions toward a technology tool like Pear Deck, it cannot impact those items such as classroom management, technology burnout, other teachers’ use of Pear Deck, changing curriculum, nor time.

**Chapter Summary**
This mixed-methods study employed quantitative and qualitative data to address how teachers’ technology self-efficacy and intentions to continue using Pear Deck were influenced by TPACK-focused online professional development. Quantitative data from a survey showcased teachers’ perceptions of (a) ease of use, (b) usefulness, (c) self-efficacy, (d) attitude toward using Pear Deck, and (e) continuance intentions to use Pear Deck. Additionally, quantitative data collected via teacher lesson plans provided evidence of teachers’ intentions to continue using Pear Deck in their classrooms. Qualitative data were collected through semi-structured interviews and teacher reflections. The analysis of both quantitative and qualitative data led to the development of four themes: (a) Teachers perceived the design elements of the professional development as beneficial; (b) TPACK-focused professional development influences the antecedent of teachers’ intentions of using Pear Deck; (c) teacher expectations about students’ reception of technology affect perceived usefulness; and (d) professional development cannot address external barriers. Combining both quantitative and qualitative data allowed a more holistic understanding of how TPACK-focused online professional development can influence teachers’ technology self-efficacy, intentions of continuing to use Pear Deck, and attitude toward Pear Deck. Chapter 5 discusses these findings as well as the implications.
CHAPTER 5

DISCUSSION, IMPLICATIONS AND LIMITATIONS

The purpose of this mixed-methods action research study was to investigate how TPACK-focused online professional development influenced teachers’ development of technology self-efficacy and intention to integrate the tool, Pear Deck, and measure changes in their attitudes toward Pear Deck in order make recommendations for the design of more effective technology professional development. Four themes were generated from the data analysis of both quantitative (i.e., teacher technology survey and lesson plans) and qualitative data (i.e., semi-structured interviews, and teacher reflections) sources. The purpose of this chapter is to triangulate the findings of this study with the support of previous literature to situate my findings. The (a) discussion, (b) implications, and (c) limitations of this study are discussed below.

Discussion

To answer the research questions that guided this study, it is necessary to situate the findings of this research within the larger context of research on professional development. Both quantitative and qualitative data were converged to create a more holistic understanding of the outcomes. The discussion of findings is arranged by the three research questions that guided this study.

Research Question 1: How does a TPACK-focused online professional development experience influence intermediate school teachers’ development of technology self-efficacy?
In this study, teachers’ development of technology self-efficacy is defined as teachers’ belief in their ability to work with and use technology in their classroom successfully. Previous research suggests that a lack of technology self-efficacy is one of the two biggest hindrances when it comes to technology integration (Bingimlas, 2009). Along these same lines, other studies support an increase in self-efficacy led to teachers feeling more empowered to integrate technology (Gunter & Reeves, 2017). Herman (2002) found that two of the most significant influences on technology use in the classroom were attitude and self-efficacy. The findings of this research question will be discussed below.

The quantitative data supported a TPACK-focused online professional development experience influencing intermediate school teachers’ development of technology self-efficacy. The mean for the TTS Perceived Self-Efficacy significantly increased from the pretest ($M = 4.40$, $SD = 1.58$) to the posttest ($M = 5.50$, $SD = 0.97$). Venkatesh and Davis (1996) suggest a close link between self-efficacy and perceived ease of use given that PEOU is defined as “the degree to which a person believes that using a particular system would be free of effort” (Davis, 1989, p. 320) and technology self-efficacy is one’s belief in the ability to work with and use technology in the classroom successfully. The Perceived Ease of Use before the innovation ($M = 5.0$, $SD = 1.23$) showed an increase in the mean score after participants completed the professional development ($M = 5.47$, $SD = 1.1$) but the change was not statistically significant. This could be in part to having previously used Pear Deck or attending district professional development on Pear Deck.
The qualitative data supports the increase of teachers’ self-efficacy through the use of authentic learning opportunities (Darling-Hammond et al., 2017; Gulamhussein, 2013; Gunter & Reeves, 2017; Knapp, 2017) such as modeling for teachers and content-specific examples were built in to the innovation. Modeling the new practice while engaging teachers in authentic learning experiences can lead to an increase in self-efficacy (Darling-Hammond et al., 2017; Gulamhussein, 2013; Gunter & Reeves, 2017; Knapp, 2017). Participation in the professional development as a student allowed teachers to see a different perspective and gain more understanding of how using Pear Deck could be beneficial for students and build teacher confidence (Gulamhussein, 2013; Gunter & Reeves, 2017; Knapp, 2017; Bustamante, 2020). This was also supported by interview data. Research by Gulamhussein (2013) suggests that one of the features of effective professional development is providing content-specific examples rather than generic ones. These content-specific examples help teachers apply their new knowledge to their content which leads to a higher chance of implementation (Desimone & Garet, 2015) and an increase in technology self-efficacy (Gunter & Reeves, 2017).

Vicarious experiences, where a teacher observes another teacher completing the activity, can also lead to an increase in teachers’ technology self-efficacy (Barton & Dexter, 2020; Ertmer, 2005); however, with the current teacher shortage it can often be difficult to observe another teacher during his or her practice. Using Pear Decks that other teachers have created helped bridge the gap between a lack of self-efficacy and having an opportunity to vicariously observe another teacher.

Overall, the quantitative and qualitative data provide evidence that TPACK-focused online professional development can influence teachers’ technology self-efficacy
when learning how to use Pear Deck. While the professional development may have led to an increase in Perceived Ease of Use of Pear Deck, this cannot be solely due to the innovation. One factor to consider is that teachers have had previous professional developments on how to use Pear Deck and it is a tool many teachers used to support virtual learning during COVID-19.

**Research Question 2: How, if at all, do intermediate school teachers’ attitudes towards Pear Deck change following a TPACK-focused online professional development experience?**

In this study, attitude describes a teacher’s belief around technology and how that may affect the integration of technology, specifically Pear Deck, in the classroom. A positive attitude has been found to correlate to increased technology integration (Akbaba, 2013) while a negative attitude may serve as a barrier (Bingimlas, 2009; Ertmer et al. 2012). According to Holden (2011), attitude towards a technology is influenced by both perceived usefulness and perceived ease of use while Kao et al. (2020) found an increase in technology self-efficacy leads to a better attitude towards a technology. Additionally, a teacher must find value in the pedagogical benefit of the technology tool (Inan & Lowther, 2010; Tondeur et al. 2017). The findings of research question two will be discussed below.

The quantitative data showed that teachers’ attitudes towards using Pear Deck showed an increase from pre innovation ($M = 5.17, SD = 1.36$) to post innovation ($M = 5.64, SD = 1.39$). This was shown to be a statistically significant increase due to the professional development rather than other factors. The participants showed a statistically significant increase in PU after the professional development ($M = 5.26, SD = 1.62$) in
comparison to prior to the professional development ($M = 4.38$, $SD = 1.70$). Research shows that when teachers find value in the usage of technology tool and its support of pedagogical practice, they are more likely to have a positive attitude (Bingimlas, 2009; Demirci, 2009). Participants also showed an increase in the overall mean scores of the PEOU; however, this data was not shown to be statistically significant. This could potentially be contributed to outside factors such as having been familiar with how to use Pear Deck prior to the professional development. The data shows an increase in both PU and PEOU from pre and post innovation which supports the idea that these cognitive responses influence teacher attitude towards technology; however, attitude does not always translate into practice (Kim et al., 2013; Liu, 2011; Tonduer et al., 2017).

The teacher-participants in this study used statements to indicate a positive attitude towards Pear Deck post innovation. Participants made positive comments regarding the engagement, collaboration, ability to accomplish instructional goals, and ease of gathering formative data. However, there were some voiced frustrations around external factors that impacted attitude towards the implementation of Pear Deck yet not the tool itself. This corroborates the findings of the study by Gunter and Reeves (2017) that found online professional development could lead to a significant change in teachers’ attitudes towards using technology but goes against what Guskey (2002) and Huag and Mork (2021) found in their research. Their studies showed that teachers only experience significant changes in their attitude after seeing a positive impact on student engagement and achievement. This dispute could partly be since teachers were already familiar with Pear Deck and how it can engage students, they already had the opportunity to see the impact on student achievement.
The quantitative and qualitative data suggest that TPACK-focused online professional development can change teachers’ attitudes towards Pear Deck; however, the qualitative data also provided evidence that external factors can have a negative impact on teachers’ attitudes towards the use of Pear Deck in the classroom. While teachers showed an overall increase in attitude towards Pear Deck, this does not necessarily equate to deciding to use Pear Deck in the classroom.

**Research Question 3: How does TPACK-focused online professional development influence intermediate school teachers’ intentions of continuing to use Pear Deck?**

In this study, teachers’ intentions of continuing to use Pear Deck describes the decision made by a teacher to continue to use Pear Deck in the classroom following the TPACK-focused online professional development. Previous research suggests that PU and ATT have a positive impact on the intentions to continue to use technology (Arteaga & Duarte, 2010; Wu & Chen, 2017).

Quantitatively, Continuance Intentions to Use (CITU) postsurvey scores \((M = 5.67, SD = 1.39)\) were significantly higher than presurvey scores \((M = 5.10, SD = 1.86)\). These data were statistically significant and likely due to the innovation rather than chance. According to Wu and Zhang (2013), perceived usefulness and attitude are critical to teachers’ continuance intentions while Tweed (2013) correlates an increase in self-efficacy to an increase in integration of technology. As noted above, there was a statistically significant increase in both the mean scores of PU, PSE, and ATT towards using Pear Deck in the post survey data which supports the increase in continuance intentions.
The quantitative data suggests that teachers are likely to continue using Pear Deck in their classrooms. While this is true in many cases, qualitative data suggests some external factors may impact a teacher’s choice to use Pear Deck in the classroom. Khlaif (2018) suggests that positive teacher attitudes towards a technology increase the likelihood of integration; however, external factors do play a part in teachers continuing to use Pear Deck in their classroom. Several teachers disclosed that student behavior bore a large influence on whether a teacher uses Pear Deck, regardless of their attitude towards the technology. The constant need for redirection or ensuring students are on-task on their devices can cause teachers to choose to not use Pear Deck.

One behavioral factor affecting intentions to continue to use was students forgetting to bring their devices to school or forgetting to bring them charged. Due to COVID-19, loaner Chromebooks were no longer available for students. Five out of nine teachers interviewed discussed how a lack of preparation on the student’s end, whether the device was not present or not charged, influenced their intentions to use Pear Deck.

Another external factor that, regardless of attitude, influenced teachers’ intentions to use Pear Deck was time. Every teacher mentioned the need for more time to play with the technology as well as time to create their lessons. This supports other studies that denote time as a critical barrier (Becta, 2004; Binglimas, 2009; Francom, 2020) to technology use regardless of attitude or technology self-efficacy.

The findings of this research question support other previous research by Kim et al. (2013), Liu (2011), and Tondeur et al. (2017) that state while teachers’ attitudes and the integration of technology are closely related, these do not necessarily correlate to practice in the classroom. This is in opposition to what Ertmer et al. (2012) found in their
study that supported the idea that attitudes and technology integration do correlate to practice in the classroom.

One external factor that impacted teachers’ continuance intentions to use Pear Deck but was not supported by previous research was the technology burn out of both teachers and students. During the peak of COVID-19, teachers and students attended school virtually before shifting to a hybrid model. As social distancing and sanitizing protocols limited group work and sharing materials, many, if not most, lessons were completed on the Chromebook. This led to a technology burn out with multiple teachers noting they may choose not to use Pear Deck because (a) they are tired of being on technology or (b) students need a break from technology.

In general, the quantitative data and qualitative data are a bit at odds. The quantitative data supports that teachers’ continuance intentions to use Pear Deck are influenced by a TPACK-focused professional development; however, the qualitative data shows that external factors such as student behavior, technology burn out, and student preparedness can negatively affect teachers’ intentions to use Pear Deck.

**Implications**

The findings of this research have implications for me, professional development facilitators, as well as other leaders in the district. The goal of action research is to address a problem of practice within the working environment and make productive changes (Duesbery & Twyman, 2020). The discussion of implications will be divided into three sections: (a) personal implications, (b) implications for practice at North Lake Intermediate, and (c) future action research.
Personal Implications

Throughout this process, there have been several personal implications that have resulted from this study. Below I will discuss the implications related to action research, mixed-methods study, qualitative data analysis, and TPACK professional development.

Action Research

Learning about action research has allowed me to investigate my own practice as a professional development designer and facilitator to discover what worked for the teachers in my building (Mertler, 2020). While no longer in my role as a Digital Integration Specialist, I continue to use action research to look internally at how I can continue to improve and address problems of practice within the professional development realm.

Mixed Methods Study

Utilizing mixed-methods as my research design has allowed me to gain a deeper understanding of both quantitative and qualitative data and how they intersect. In education, whether as a technology coach or as a trainer, there is a need for innovation and flexibility based on unique situations within each school setting. A mixed-methods approach will allow me the ability to gather quantitative data to address more technical items while also collecting qualitative data to better understand other issues that may impact teachers’ ability or desire to use technology tools in the classroom (Creswell & Creswell, 2018). This deeper understanding of how I can use both quantitative and qualitative data will help me address a variety of stakeholders with both numerical and anecdotal data.
**Qualitative Data Analysis**

Learning how to gather and analyze qualitative data, particularly through interviews has helped me think about the purpose of the conversations I have with teachers and how it can help me understand how individuals interpret their experiences and the meaning behind those experiences (Merriam & Tisdell, 2016). Analyzing interview transcripts and reflection answers gave me a better understanding of why a teacher may or may not choose to use Pear Deck in the classroom. Sometimes this conflicted with the quantitative data so the qualitative data allowed me to find the why behind teachers’ choices. This knowledge of how to analyze qualitative data will serve me well as I continue to improve my professional development skills. Being able to take teacher comments and begin to look for values or patterns will allow me to take a more in-depth look at the real meaning behind a teacher’s decision to use or not use a particular technology tool.

**TPACK Professional Development**

Resulting from this action research study, I have learned ways to continue to improve my practice as a designer, developer, and facilitator of professional development as well as share this knowledge with others. I have greatly increased my knowledge and understanding of the TAM and TPACK frameworks and how teachers’ perceptions of a technology tool, combined with the understanding of how this tool can support technology, pedagogy, and content will support me in my career path as a Professional Development Specialist. This understanding allows me to tailor my Lumio trainings better to both grade-level and content-specific groups and makes me a more successful trainer. Having engaged in a mixed-methods action research study, I better understand
how the format and structure of professional development is integral to teachers gaining a deeper understanding of how a technology tool can be used to support pedagogical practice and content. I now know how to utilize, analyze, and converge quantitative and qualitative data to better support my work through action research. Knowing how professional development’s structure and format can impact teachers’ technology self-efficacy and intention to use a technology in the classroom will guide my work with school districts as I work with their stakeholders on a professional development plan. With a high teacher turnover, many districts are asking me to help create Lumio onboarding professional developments. Given my schedule and lack of availability for all of these sessions, asynchronous professional development has been part of the conversation during the planning sessions.

**Implications for Professional Development for Lakeview County**

Based on personal experiences and conversations with colleagues, the issue of time has always been a prevalent barrier when it comes to developing and implementing professional developments that truly begin to move the needle on technology integration. Given this barrier and Lakeview’s focus on standard, strategy, and then tool, an action research study developed around this topic seemed like a prevalent problem within my building. It is my hope that teachers benefited from the asynchronous format and began looking at technology tools as holistic supports of both content and pedagogical best practices.

I hope that the sharing of my findings can be brought into the design and development of further technology professional developments at School District One of Lakeview County. By providing evidence of teachers’ preferences for asynchronous
training and the impact that a TPACK-focused professional development can have on teachers’ attitudes and self-efficacy, I hope to start a conversation with previous colleagues and stakeholders who develop the professional development about some potential shifts in the professional development structure for instructional technology professional developments. Based on the findings from this study, I would suggest that District Five provides more asynchronous professional development at the school level. Additionally, professional development should have a clear focus on how the technology tool can support pedagogical practices within each content area with examples or pre-made resources provided. When available, the professional development should be created using the tool that teachers will be learning about to allow teachers to experience the student perspective.

**Implications for Future Action Research**

This study has implications for instructional technology coaches and leadership at both the school- and district- level. Coaches are often in charge of designing, developing, and facilitating technology professional development for teachers and may be interested in future research as it relates to TPACK-focused online professional development. Given this research was done with a smaller sample of the teacher population, replicating this study on a larger-scale within a school may give researchers the opportunity to understand how a TPACK-focused online professional development can influence both technology self-efficacy and continuance intentions for a technology tool. Additionally, the professional development could be structured in a way which requires the discussion posts or offers alternative response methods (i.e., Flip) to help facilitate the building of an online community.
The purpose of this research was to gain a deeper understanding of how TPACK-focused online professional development influenced teachers’ development of technology self-efficacy and intention to integrate the tool, Pear Deck, and measure changes in their attitudes toward Pear Deck to make recommendations for further professional development planning. Further research should be done with other technology tools and more sustained online, asynchronous professional development.

Limitations

This mixed-methods study was subject to limitations. The goal of action research is to identify a problem occurring in my work environment and gather information to try and find a solution to this local problem rather than generalized findings (Herr & Anderson, 2005; Mertler, 2020). Therefore, the findings from this study should not be generalized outside of this context. Findings from this research support previous research on effective professional development and online professional development, but the results should be taken into consideration based on these limitations.

One limitation of this research relates to the survey and is due to the Cronbach’s alpha for the TTS Post-Survey Perceived Self-Efficacy subscale being undesirable (α = 0.64). This could be attributed to a low number of questions (Tavakol & Dennick, 2011). Increasing the number of questions in this subscale could increase alpha (Gliem & Gliem, 2003; Tavakol & Dennick, 2011). Another limitation could be due to the small number of survey questions. Also, this study conducted several paired sample \( t \)-tests but did not use Bonferroni correction given the tests were performed separately to different subscales of the survey.
Other limitations are related to the participants and setting. The population of the school contains a large majority of females, resulting in all but one participant being female. Additionally, no math teachers choose to participate. Two of the original survey respondents did not complete the professional development which lowered the survey population size. Additionally, even though I used both peer debriefing and member checking to help increase trustworthiness and validity, there is chance of subjective bias within my qualitative data. Additionally, given that I asked teachers to provide lesson plans may have inadvertently encouraged them to include Pear Deck.

Another limitation was time for professional development. Although I did not facilitate 20 hours of professional development as recommended, the pre- and post-learning opportunities within the professional development created as much sustainability as possible within the time constraints. Lastly, not having requirements around the discussion posts limited the written information I received from teachers.


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APPENDIX A

SCHOOL APPROVAL LETTER

Lais

Mon, Oct 18, 3:45 PM

Dear Ms. Deger,

Thank you for considering our district for your research study. You do not need our permission to survey our staff. Please be reminded that we have not endorsed your survey and research study. Survey links cannot be forwarded by our staff. Our district staff directory is available online at [http://www.example.com](http://www.example.com). Please be reminded that our staff has the right to decline participation in your study. If you have any questions, please contact me at your earliest convenience.

Best wishes!

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APPENDIX B

INFORMED CONSENT LETTER

Dear Participant

My name is Katherine Degar. I am a doctoral candidate in the College of Education at the University of South Carolina. I am conducting a research study as part of the requirements of my degree in Learning Design and Technologies and I would like to invite you to participate.

I am studying how TPACK-focused, online, asynchronous professional development can impact intermediate teachers’ technology self-efficacy, attitudes about technology integration, and intention to integrate technology. If you decide to participate, you will be asked to complete some surveys about your technology acceptance, participate in the discussion forums, complete the teacher reflections, and meet with me for an interview about 45 minutes.

In particular, you will be asked questions about professional development and your technology integration. You may feel uncomfortable answering some of the questions. You do not have to answer any questions that you do not wish to answer. The interview will be audio recorded so I can accurately transcribe what is discussed. The tapes will only be reviewed by members of the research team and destroyed upon completion of the study.

Participation is confidential. Study information will be kept in a password-protected folder on my personal computer. The results of the study may be published or presented at professional meetings, but your identity will not be revealed. I will ask that you and all other group members respect the privacy of everyone in the group.

I will be happy to answer any questions you have about the study. You may contact me at [redacted] and [redacted] or my faculty advisor, Dr. Hengtao Tang, at 803-777-7257 and htang@mailbox.sc.edu.

Thank you for your consideration. If you would like to participate, please complete the Google form located on the North Lake Intermediate Professional Development Google Classroom.

With kind regards,

Katherine Degar
Reasons for Feedback

Feedback Information
You try...

Write 2-3 questions you could use in the next two weeks using the question stems provided by the TEAL Center (Why, What caused, How did it occur, What if, How does it compare, or What is the evidence)

Students, write your response!

Questioning with Pear Deck

Using the Pear Deck Interactive Questions, all students have the opportunity to engage with and answer teacher questions. This helps to encourage creativity and critical thinking. "When you ask a question with Pear Deck, each student answers on their own screen. These answers are automatically saved in your Sessions, so you can display them in real time" (Pear Deck)

There are five interactive question types that can be used to engage students in Pear Deck. Learn more here. To learn how to add questions to an existing Google Slides, click here.

Teacher Opportunity to Create Content-Specific Questions
How-To for Questions and Pear Deck

Feedback Essentials...Feedback should be:

- Goal-Referenced
- Tangible & Transparent
- Actionable
- User-Friendly
- Timely
- Ongoing & Consistent

Click on the link in the title for more info

Feedback Essentials
https://www.ascd.org/el/articles/seven-keys-to-effective-feedback
Let's look again. Place a thumbs up next to each feedback if it meets the criteria.

A friend tells me, "You know, when you put it that way and speak in that softer tone of voice, it makes me feel better."

A reader comments on my short story, "The first few paragraphs kept my full attention. The scene painted was vivid and interesting. But then the dialogue became hard to follow; as a reader, I was confused about who was talking, and the sequence of actions was puzzling, so I became less engaged."

A baseball coach tells me, "Each time you swung and missed, you raised your head as you swung so you didn't really have your eye on the ball. On the one you hit hard, you kept your head down and saw the ball."

Goal-Referenced, Tangible & Transparent, Actionable, User-Friendly, Timely, Ongoing & Consistent

Feedback Examples

Are you using any of these practices currently?

Effective Feedback
* Is tied to specific essential learning targets.
* Is focused and limited -- making it easier for students to take action.
* Is structured as a question -- giving students chances to make decisions about how to proceed.
* Is ungraded and followed up by a chance to try again.

Ineffective Feedback
* Is vague, general, or tied to personal traits instead of essential learning targets.
* Is overwhelming -- making it difficult for students to know where to begin.
* Is structured as an imperative statement -- turning feedback into an act of compliance instead of an opportunity to reflect.
* Is graded, returned and forgotten as the student moves on to a new task.

Feedback Practices
How-To for Feedback and Pear Deck
## APPENDIX D

### TEACHER TECHNOLOGY SURVEY

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Items</th>
<th>Measures</th>
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<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
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<td></td>
<td>Female</td>
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<tr>
<td>Age range</td>
<td>21-25</td>
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<td>26-30</td>
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<td>66-70</td>
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<tr>
<td>Years of experience</td>
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<tr>
<td>Content area</td>
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<td></td>
<td>Science</td>
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<td>Social Studies</td>
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<td>English Language Arts</td>
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<td>Exploratory: _____________</td>
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<tr>
<td></td>
<td>Special Education</td>
<td></td>
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<tr>
<td>Perceived usefulness (PU)</td>
<td>PU1</td>
<td>Using Pear Deck improves my performance as a teacher.</td>
</tr>
<tr>
<td></td>
<td>PU2</td>
<td>Using Pear Deck in my classroom enhances my effectiveness in my job.</td>
</tr>
<tr>
<td></td>
<td>PU3</td>
<td>I find Pear Deck to be useful.</td>
</tr>
<tr>
<td>Perceived ease of use (PEOU)</td>
<td>PEOU1</td>
<td>Learning to use Pear Deck is easy.</td>
</tr>
<tr>
<td></td>
<td>PEOU2</td>
<td>It is easy to become proficient in using Pear Deck</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Constructs</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perceived self-efficacy (PSE)</strong></td>
<td>I feel confident using Pear Deck features (i.e. questions, drawing, inserting videos/websites, draggable, adding audio).</td>
</tr>
<tr>
<td>PSE1</td>
<td>I feel confident operating Pear Deck functions (i.e. feedback, reflect and review, showing answers).</td>
</tr>
<tr>
<td>PSE2</td>
<td>I feel confident using Pear Deck to support my instruction.</td>
</tr>
<tr>
<td><strong>Attitude toward using (ATT)</strong></td>
<td>I believe that using Pear Deck is a good idea.</td>
</tr>
<tr>
<td>ATT1</td>
<td>I believe that using Pear Deck will support my instruction.</td>
</tr>
<tr>
<td>ATT2</td>
<td>I am satisfied in using Pear Deck.</td>
</tr>
<tr>
<td><strong>Continuance intention to use (CITU)</strong></td>
<td>I intend to continue to use Pear Deck in the future.</td>
</tr>
<tr>
<td>CITU1</td>
<td>I will continue using Pear Deck increasingly in the future.</td>
</tr>
<tr>
<td>CITU2</td>
<td>My intentions are to continue using Pear Deck in the future, at least as active as today.</td>
</tr>
</tbody>
</table>

Constructs will be measured using a seven-point Likert scale from 1 = strongly disagree to 7 = strongly agree.
Time of Interview: Interviewee:

**Introductory Protocol**

Thank you for agreeing to participate in this research study. The purpose of this action research is to investigate how a TPACK-focused online professional development experience influences intermediate school teachers’ development of technology self-efficacy, intention to integrate technology, and changes their attitudes and beliefs about technology integration.

Thank you for agreeing to participate in this interview. This interview will last 45-60 minutes. There are no risks anticipated as a result of your participation. As a reminder, your participation is voluntary and you are free to stop this interview at any time. With your consent, this interview will be recorded and transcribed. Your information will be held confidential. You will receive a copy of the transcript and given the opportunity to correct any errors. Thank you again for your participation.

**Questions**

1. What are your main reasons for using or not using Pear Deck for classroom instruction?

2. How confident would you consider yourself in using Pear Deck in the classroom? What factors do you attribute to your self-confidence?

3. Can you describe a professional development or professional learning that has had a positive or negative affect on your self-confidence in using Pear Deck for your classroom instruction?
4. How would you describe your attitude towards using Pear Deck?

5. What do you believe would help make you more comfortable in using Pear Deck in your classroom instruction? Why?

6. Do you feel that using Pear Deck would help you accomplish your instructional goals quicker or easier? In either case, why?

7. Now that you have completed this professional development, do you plan on continuing to use Pear Deck? Has anything changed in terms of how you will use Pear Deck?

8. Did receiving personalized feedback affect your intention to use Pear Deck? If so, how?

9. What, if any, are some of the challenges in using Pear Deck? Do these affect your intention to use Pear Deck?

10. Tell me about your participation in this professional development. What were the strengths? Were there any challenges within the training? How could it have been improved?

If you have any questions or concerns, please reach out using the contact information that was provided. Thank you again for your participation in this interview.
APPENDIX F
IRB APPROVAL

| ID    | Name | State | Initial Approval Date | Current Approval Date | Review Type | PI | ExpDate | Campus | IRB |
|-------|------|-------|-----------------------|-----------------------|-------------|----|---------|--------|-----|-------|
| Pro00117756 | Exempt Approved | 12/14/2021 | 1/31/2021 | Exempt | University of South Carolina | University of South Carolina IRB Committee |

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