2016

Technology in Teacher Preparation

Barbara Martin
Illinois State University, bmmartin9@aol.com

TECHNOLOGY IN TEACHER PREPARATION

Barbara Martin

80 Pages

Due to the importance of technology to student learning, technology has become a vital part of teacher education programs across the country. In order to fully understand technology integration in teacher education, it is important to examine faculty perceptions of technology integration as well as current practices. This study examined faculty attitudes toward technology integration in one Midwestern university and how this faculty infused technology into their education courses in an effort to train teacher candidates to be successful digital educators.

KEYWORDS: Teacher Preparation, Technology, TPaCK

TECHNOLOGY IN TEACHER PREPARATION

BARBARA MARTIN

A Dissertation Submitted in Partial
Fulfillment of the Requirements
for the Degree of

DOCTOR OF EDUCATION

School of Teaching and Learning

ILLINOIS STATE UNIVERSITY

2016

TECHNOLOGY IN TEACHER PREPARATION

BARBARA MARTIN

COMMITTEE MEMBERS:

Barbara Meyer, Chair

Steven B. Mertens

Amanda Quesenberry

ACKNOWLEDGMENTS

The writer wishes to thank several people for the guidance and support throughout my graduate program. First I would like to thank the mentors throughout my professional experience who nudged me to continue my growth and inspired me to accomplish my dreams. Many of these mentors saw potential in me that I did not know existed and guided me as role models.

Next, I would like to express my sincere gratitude to my dissertation chairperson, Dr. Barbara Meyer and my committee who spent countless hours pushing me to improve. They all nurtured and supported me professionally well beyond expectations throughout this rigorous marathon. Each brought a wealth of knowledge and support to this process as well as wonderful guiding questions that helped to keep me moving in the right direction.

Also, I would like to thank my department at Southern Illinois University Edwardsville for the continued nurturing and support. Their reassurance provided such a caring scaffold that was instrumental to my advancement toward the dissertation goal.

Finally, while many people inspired and encouraged me throughout this process, none were as influential as my family and friends who lived with me through this experience. I would like to express my sincere gratitude to these important people for their continuous encouragement and backing throughout the dissertation journey.

B.M.

CONTENTS

TABLES

Table | Page

FIGURES

CHAPTER I

INTRODUCTION

Technology has been gradually infused into the everyday lives of educators and thus has become a vital part of teacher education programs across the country. Despite the fact that today's teacher candidates are technologically fluent with everyday technologies, many still struggle with how to successfully implement technology into instruction. To explain this discrepancy, many recent studies have examined barriers that students perceive are causing the lack of technology confidence (Clark, Zhang & Strudler, 2015; Frazier, Sadera & Robinson, 2012; Richardson, 2012). In order to fully understand technology integration in teacher education, it is also important to examine faculty perceptions of the marriage between technology and pedagogy in teacher education. This study examined how faculty in one Midwestern university infused technology into their education courses in an effort to train teacher candidates to be successful digital educators.

Some might argue that technology in education is a new trend; however, a close examination of educational history would uncover the first use of technological tools in classrooms almost a century ago. In fact, in 1925 teachers began using filmstrips in classrooms for various instructional purposes and the use of technological tools in education has continued to grow at a rapid rate since that time (Gagne, 2013).

In 1925 when teachers began using tools in the classroom, they tools were most often used instructionally. In 1972, with the creation of the Scrantron student answering systems, technology in education began to shift from an instructional teaching instrument to tools of student use. In retrospect, this addition of student technology use broadened the educational technology scope significantly as the tools were no longer solely used by instructors (Gagne, 2013). With the advent of personal computers, the Internet and interactive whiteboards, technology began to be comfortably embedded into the life of students and educators across the nation. In fact, Jones, Bunting, and de Vries (2013) illustrate this growth by describing how technology has evolved from tools to knowledge, to a characteristic of humanity. In other words, the evolution of technology, which was once tool-based, has now become a thread through our cultural and societal identities.

Instructional technology approaches have evolved along with the educational technology trends, and the role of the teacher has shifted from lecturer to facilitator of knowledge, assisting with moving from teacher centered to student centered instruction (Marzilli, Delello, Marmion, McWhorter, Roberts, & Marzilli, 2014). As technology has evolved, students have become more comfortable with new tools and fostered independent learning skills. As a result, teachers have embraced the transition from the "sage on the stage" to a more scaffolded approach of "guide on the side" assisting students as they seek knowledge through self-directed learning opportunities. Holland and Holland (2014) discuss the importance of this shift as they illustrate the best approach to tablet learning, but can apply to any technology tool. "To have tablet learning work well, power has to shift from instructors and managers to the learners themselves. It is a self-directed or do-it-yourself (DIY) approach to learning" (p. 19).

In today's classrooms, students are engaged in real-world applications and self-guided learning opportunities that are supported by the technology tools that empower them as future digital citizens. They are learning to navigate in a technological world as they maneuver through their academic journeys.

Not only is educational technology assisting students in taking the educational reigns through their academic voyages, it is providing individualized learning opportunities for each student. In the world of differentiated instruction, technology provides the ability to meet the needs of various types of learners. For example Holland and Holland (2014) discuss how digital tools now have such a wide range of abilities to adjust learning opportunities for students achieving at all academics levels, and in need of special accommodations, such as, varied font or read aloud text, language control, auto commands, interactive or even collaborative capabilities. All of these mechanisms have the potential to further differentiate learning opportunities and put the students in the driver's seat of their own learning adventure. Illustrated in this manner, it is clear how technology is embedded comfortably in education, thus causing an evolution of the field, the profession, and the potential learning opportunities available to students.

In response to this, teacher preparation programs are beginning to recognize the importance of preparing teacher candidates to use technology in their future instruction. Programs are beginning to provide teacher candidates with ample preparation in shifting instructional approaches and vast knowledge about innovative educational technologies. In a meta-analysis of the value and use of technology in K–12 education (Valdez et al., 2004), the North Central Regional Laboratory found that "technology innovations are increasing the demand for reform in teaching and learning approaches that, in turn, are having a significant impact on technology use expectations" (p. iii).

New teacher education graduates should be as literate as the digital natives they are intending to teach and should be confident in embracing the ever-changing world of technology in education as this will play an integral role in future classrooms. Nationally, educators agree that there is vital importance in teacher candidates developing 21st century technology skills. "We have entered a crucial time when fundamental shifts in the economy, changing nature of the workforce, demographic shifts, educational competitiveness, globalization of society, and computerization of the workplace make the technological preparation of teachers an urgent problem we can no longer afford to marginalize" (Lambert & Gong, 2010, p. 55).

Despite a national movement to integrate technology into teacher preparation courses, some programs have not taken the time to rigorously evaluate if the students are successfully being technologically prepared. The International Society for Technology in Education (ISTE) identifies standards for administrators and educators regarding the use of technology in the classroom. These include such things as inspiring student learning, modeling digital age work and developing authentic learning experiences for students. The ISTE standards emphasize the role of the teacher as a facilitator of knowledge construction (ISTE, 2007).

To successfully integrate digital technologies into instructional practices, teacher candidates must be trained throughout their undergraduate experiences on technology implementation resources and strategies. The National Educational Technology Standards for Teachers (NETS.T) were created by ISTE to provide this instructional support in technology integration. The NETS.T framework for teacher candidates communicates goals for teacher education curriculum and articulates objectives for successful technology implementation. With this framework in mind, schools across the country are developing and delivering curriculum embedded with technology (ISTE, 2007).

Educators interested in successful technology implementation and integration into k-12 classrooms, as well as teacher education programs, have begun to also consider another framework called TPaCK (Technology Pedagogy and Content Knowledge model). TPaCK is a framework for describing and understanding the goals for technology use as a model that introduces the interrelationships among the three basic components of knowledge (i.e., technology, pedagogy, and content) (Koehler & Mishra, 2009). This model has become a very valuable tool in examining how integrated technology can seamlessly strengthen instructional strategies as well as content knowledge in curriculum. Just as the ISTE and NETS standards, the TPaCK framework communicates expectations for successfully integrating technology into education.

Other universities across the nation are approaching the successful implementation of technology into the curriculum in a different manner. In a 2004 publication, Cohen described an education department on a mission to develop curriculum embedded with technology in order to prepare tomorrow's teachers for digital integration. Cohen (2004) discusses the department's initial goals to develop specific curriculum maps for implementing technology into pre-service teacher training, thus serving as a specified framework for technology integration. Cohen (2004) stated, "In order to realize the promise of ISTE's NETS•T, it is critical for education faculty to work together to build their own "maps" driven by an evolving sense of why technology matters to them, and why it should matter to their students as education professionals" (p. 9). While the approaches may differ across the country, the end goal was certainly the same.

Most recently the Council for Accreditation of Educator Preparation (CAEP), the governing body solely in charge of accreditation of teacher preparations across the nation, has begun vocalizing the importance of technology integration across the teacher preparation curriculum. In the teacher preparation standards, CAEP has articulated that "technology is a critical area that will require new learning and substantial innovation by preparation providers" (CAEP, 2014). The organization also emphasized the importance of technology integration be "imbedded in every aspect of educator preparation" and chose to recognize it throughout the recommended standards as opposed to provide an isolated section for technology standards (CAEP, 2014).

Problem Statement

With the integration of technology into the daily lives of educators and students, it is vital that teacher preparation programs across the nation respond (Kyei-Blankson, Keengwe, & Blankson, 2009). In fact, the National Research Council (2010) recognizes this need to address technology integration in both content (e.g., undergraduate science and math courses) and instructional pedagogy courses. To address this, many teacher preparation programs have considered a shift from skill-focused technology courses to technology-infused pedagogy. Today's teacher education programs are encouraged to provide pre-service teachers with ample preparation in shifting to instructional approaches enriched with innovative educational technologies.

In an effort to better understand recent shifts within teacher preparation programs, this study was designed to examine faculty perceptions on current levels of technology integration within courses. Specifically, the purpose of this study was to evaluate the faculty perception of technology integration through the conceptual lens of technological, pedagogical, and content knowledge (TPaCK).

Purpose Statement

The purpose of this study was to examine faculty attitudes about technology integration in education courses at a Midwestern University. The variables in this study included: a) demographic information, b) frequency of technology use within courses taught, c) attitudes concerning technology integration, and d) integration of technology practices. The participants in the study were all tenure-track education faculty members at a Midwestern University.

Significance of Study

This study is among the few that examine faculty perspectives about technology integration in higher education. While some studies exist that measure faculty attitudes toward technology integration in higher education (Marzelli et al., 2014), only one (Garrett, 2014) measured the technological, pedagogical, content (TPaCK) as conceptual framework foundation. In contrast, this study examined faculty attitudes about technology integration in teacher education courses taught within a College of Education in one Midwestern university and attempted to explain how specific demographic variables impact these perceptions.

The results can be used to identify faculty support needs, such as technology support, professional development opportunities, as well as instructional and curricular needs. The results could potentially strengthen faculty members' understanding of how to effectively integrate technology, build confidence, and support specific faculty instructional needs.

Research Questions

- RQ 1: What are faculty attitudes about technology integration in one Midwestern university as measured through TPaCK?
- RQ2: To what extent do teacher educators perceive they are integrating technology into the teacher education courses as measured through TPaCK?
- RQ3: Is there a relationship between faculty attitude and perceived level of technology integration in education courses? Does this change with demographic differences?

Theoretical Framework

Researchers who study technology use in education have historically struggled to find a theoretical foundation (Graham, 2011; McDougall & Jones, 2006; Roblyer, 2005; Roblyer & Knerzek, 2003). One reason for this seeming struggle lies in the difficulty of staying current with the continuous evolution of educational technologies. Another reason is due to the shift in focus from the sole use of technology in education to a focus on specifically how the technology can support instruction. In short, because technology in education has been a swiftly moving target, it has been difficult to establish a theoretical foundation prior to the creation of TPaCK.

TPaCK has provided the field of educational technology with a much needed conceptual foundation. In order to validate its strength as a foundational piece, it is important to critically examine TPaCK's history. The term TPaCK first surfaced in 2006 after Mishra and Koehler published a model that described each of the constructs in relation to technology integration. The TPaCK framework builds upon Shulman's (1986) model of pedagogical content knowledge (PCK) by adding the component of technological knowledge. The TPaCK framework is often depicted using a Venn diagram with three overlapping circles, each representing a form of knowledge. The framework includes three constructs of knowledge: pedagogical knowledge (PK), content knowledge (CK), and technological knowledge (TK). At the core of the TPaCK model, the ideal technology integration is illustrated where all three constructs combine into a technology, pedagogy and content knowledge construct (Figure 1).

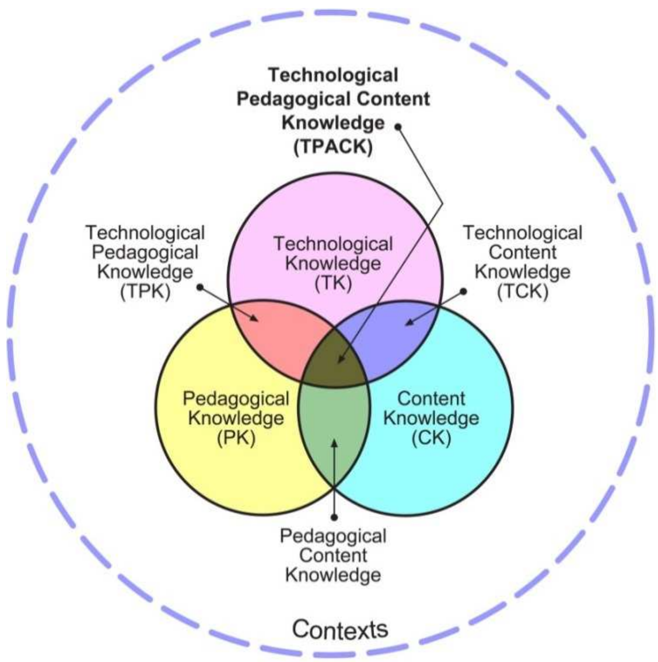

Figure 1. TPACK framework (Koehler & Mishra, 2009)

Definitions

The following topic-specific terminology will be used throughout the study. Below is a brief introduction to the terms, their background and any related acronyms. This information is provided to build a foundation upon which the study will be explained.

ISTE Standards:

- In 1997 the International Society for Technology in Education (ISTE) created standards for administrators and educators regarding the use of technology in the classroom. These needs include such things as inspiring student learning, modeling digital age work and developing authentic learning experiences for students (Wiebe & Taylor, 1997).
- These ISTE standards emphasize the importance of the teacher as a facilitator of knowledge construction and aim to foster continued improvement in the field of education (Wiebe & Taylor, 1997).

CAEP

- The Council for Accreditation of Educator Preparation (CAEP), the governing body solely in charge of accreditation of teacher preparations across the nation, has begun vocalizing the importance of technology integration across teacher preparation curricula. In the most recent revision of teacher preparation standards, CAEP has articulated that "technology is a critical area that will require new learning and substantial innovation by preparation providers" (CAEP, 2014, p. 22). The organization also emphasized the importance that technology integration be "imbedded in every aspect of educator preparation" and chose to recognize it throughout the recommended standards as opposed to providing an isolated section for technology standards (CAEP, 2014).

TPaCK

- TPaCK is a framework for describing and understanding the goals for technology use. The model introduces the relationships and overlapping between all three basic components of knowledge (technology, pedagogy, and content) (Koehler & Mishra, 2009). TPaCK emphasizes a teacher's understanding of how technologies can be used effectively as a pedagogical tool and illustrates the rich overlap among the pedagogy, content and technology knowledge bases (Figure 1).

CHAPTER II

LITERATURE REVIEW

Introduction

This review of literature examined research on the topic of technology integration in education in an effort to understand the topics already addressed and current published themes, as well as the existing theoretical frameworks. Literature examined ranged from technology in k-12 schools as well as higher education to gain a thorough understanding of how technology is successfully integrated by a variety of teachers. The following sections illustrate the various themes that were identified within the literature on technology integration.

Digital Natives

Today's k-12 students are considered to be part of the population called "digital natives" (Prensky, 2001, 2012). "Digital natives" have been using technologies in their daily lives for as long as they can remember. Thus, k-12 students are frequently savvy with various types of media and can navigate through various technology obstacles unfazed (Lei, 2009). They use cellphones, computers and tablets on a daily basis and demonstrate a fluid confidence in these operations.

It is no surprise that technology has also become very prevalent in our k-12 schools. New technologies are being used to invigorate classrooms across the nation (Holland & Holland, 2014). In fact, the Organization for Economic Cooperation and

Development (OECD, 2004) report asserts that the past 20 years have brought modern technologies to nearly all schools in most modern countries. This clearly illustrates the reality that children and schools are using technology daily. Not only is this a reality, but it is also an expectation. Paige, Hickok, Ginsburg, and Goodwin (2003) state that "According to the U.S. DOE United States Department of Education, technology is now considered by most educators and parents to be an integral part of providing a high-quality education" (p. 3).

Across the nation educators have realized the importance of teacher preparation programs addressing the development of 21st century technology skills in teacher candidates (Marzilli, Delello, & Marmion, et al. 2014; Neiss, 2011; Pellegrino, Goldman, Bertenthal, & Lawless, 2007). "We have entered a crucial time when the technological preparation of teachers is an urgent problem we can no longer afford to marginalize" (Lambert & Gong, 2010, p. 55). Graduates of teacher education programs need to have mastered a wide range of technological skills in order to be fully prepared to meet the needs of the k-12 students who are fully confident in maneuvering through technology-integrated learning (Teo, Chai, Hung, & Lee, 2008).

Professional Organizations

In response to this need, the International Society for Technology in Education (ISTE) created standards for k-12 teachers regarding the use of technology in the classroom. The standards promote the use of technology to inspire student learning, model digital age work and develop authentic learning experiences for students. They emphasize the importance of the teacher as a facilitator of knowledge construction and they aim to foster continued improvement in the field of education.

Digital natives may be tech savvy, but many universities are finding that this does not assure that teacher candidates understand how to successfully integrate technology and pedagogy. As Georgina and Hosford (2009) so clearly illustrate "technology alone may do nothing to enable the integration of technology-based pedagogies" (p. 691). To successfully integrate digital technologies into instructional practices, teacher candidates must be trained throughout their undergraduate experiences on technology implementation resources and instructional strategies (Williams, Foulger, & Wetzel, 2009).

The National Educational Technology Standards for Teachers (NETS.T) were created by ISTE to provide this instructional support in technology integration. The standards cover the following areas:

1. Facilitate and inspire student learning and creativity
2. Design and develop digital age learning experiences and assessments
3. Model digital age work and learning
4. Promote and model digital citizenship and responsibility
5. Engage in professional growth and leadership (www.iste.org)

The NETS.T framework for teacher candidates communicates goals for teacher education curricula and articulates objectives for successful technology implementation. With this framework in mind, schools across the country are developing and delivering curriculum embedded with technology. Institutions of higher education are aligning k-12 teacher certification and professional requirements with a corresponding set of professional standards (Cohen & Tally, 2004; Richardson, 2012).

Already mentioned in Chapter 1, as the governing body solely in charge of accreditation of teacher preparations across the nation, CAEP supports the integration of technology across teacher preparation curricula. In the most recent revision of teacher preparation standards, CAEP stated that "technology is a critical area that will require new learning and substantial innovation by preparation providers" (CAEP, 2014, p. 22). The organization also emphasized that the importance of technology integration be "imbedded in every aspect of educator preparation" and chose to recognize it throughout the recommended standards as opposed to providing an isolated section for technology standards (CAEP, 2014, p. 20). The technology integration expectation has been made abundantly clear, and teacher preparation programs across the nation have been responding by examining how technology is integrated into the curriculum (Kyei-Blankson, Keengwe & Blankson, 2009).

However, despite the obvious need as well as the articulated expectations, teacher candidates across the country are not graduating with confidence in technology integration skills for instruction (Kolikant, 2010; Ottenbreit et al., 2012). In fact the National Association of State Boards of Education (NASBE) report titled *Born In Another Time* (2012) concluded that, "New teachers are no more likely to blend technology into their practice than their veteran peers," which is surprising, the authors say, given that the vast majority of those entering the profession are digital natives (p. 30). Another article by Gabriel, Campbell, Wiebe, MacDonald, and McAuley (2012) states, "A growing body of literature suggests that there is a disjuncture between the instructional practices of the education system and the student body it is expected to serve, particularly with respect to the roles of digital technologies" (p. 1).

Similarly, a review of literature presents a common fallacy that confidence in daily technology use of the teacher candidates translates into the ability to teach effectively with technology (Ertmer & Ottenbreit, 2010; Koliant, 2010; Lawless & Pellegrino, 2007). This common conclusion encourages us to more closely examine teacher candidate preparation to develop technology skills in teacher preparation programs. More specifically, how are teacher preparation programs helping teacher candidates bridge their foundational technology skills with the ability to fluidly integrate technology into their instruction. The question has evolved from whether or not teacher candidates have technology skills to whether or not they can seamlessly integrate those technology skills with effective teaching.

In a meta-analysis of the value and use of technology in K–12 education (Valdez, McNabb, Foertsch, et al., 2004), the North Central Regional Laboratory found that, "technology innovations are increasing the demand for reforms in teaching and learning approaches that, in turn, are having a significant impact on technology use expectations" (p. iii). New teacher candidates should be as confident as the "digital natives" they are intending to teach and embrace the ever-changing world of technology in education as this will play an integral role in their future classrooms.

While it seems that most teacher preparation programs would agree with this argument, many are still operating under an older, skill-oriented framework that provides technology instruction in a stand-alone course (Parette, Quesenberry, & Blum, 2010). Moreover, many programs have not taken the time to rigorously evaluate if the students are successfully being technologically prepared (Williams, et al., 2009).

Technology Integration Models

Through the review of literature four technology integration models were found and analyzed as potential theoretical frameworks for the study. Below each model is described along with supporting empirical research.

SAMR Model

The SAMR Model, developed by Dr. Ruben Puentedura (2009), describes technology integration through four levels. This model was developed in 2006 as part of Puentedura's work with the Maine Learning Technologies Initiative. The model was intended to encourage educators to significantly enhance the quality of education provided via technology in the state of Maine; however, no research-based publications were found at this time to suggest the SAMR technology integration model promotes successful technology integration. The four levels of the SAMR technology integration model are:

- Substitution—Technology is used as a direct substitute for what you might do already, with no functional change.
- Augmentation—Technology is a direct substitute, but there is functional improvement over what you did without the technology.
- Modification—Technology allows you to significantly redesign the task.
- Redefinition—Technology allows you to do what was previously not possible.

Levels of Teaching Innovation (LOTI) Model

The LoTi® Digital-Age Survey, based on Moersch's LoTi® Framework (1995), is self-promoted as an empirically-validated tool that creates a professional development profile for participants aligned to the NETS Technology Standards. Although there are no empirical, peer-reviewed research publications that support its use as a framework for successful technology integration, since its inception in 1994, the LoTi® Framework has been used to assess statewide technology use, plan school improvement and evaluate classroom level technology integration. Below is the continuum of technology integration levels defined by the LoTi Digital Age survey:

- LoTi Level 0: Non-Use

Instructional environment does not support or promote purposeful learning aligned to academic standards/expectations

- LoTi Level 1: Awareness

Instructional focus is exclusively direct instruction (teacher-centered). There is no evidence of content-related higher-order thinking by students. Digital/environmental resources either not used or used by the teacher alone to enhance lectures or presentations

- LoTi Level 2: Exploration

Instructional focus emphasizes content understanding through direct instruction (teacher-centered). There is no evidence of content-related higher-order thinking by students. Students use digital/environmental resources for enrichment exercises, information gathering, and other low-level cognitive tasks (e.g., remembering, understanding)

- LoTi Level 3: Infusion

Instructional focus emphasizes student higher order thinking and teacher-directed problems. Content-related higher-order thinking by students is clearly evident, but no real-world connections are made. Students use digital/environmental resources for teacher-directed, high-level cognitive tasks (e.g. applying, analyzing) targeted at concept attainment, inductive thinking, and scientific inquiry.

- LoTi Level 4a: Integration (Mechanical)

Instructional focus is student-centered, but teacher's comfort level facilitating student-driven content is low. Content-related higher-order thinking by students and real-world application of the content are evident. Students use digital/environmental resources for problem-based, personally-relevant, high-level cognitive tasks (e.g., evaluating, creating)

- LoTi Level 4b: Integration (Routine)

Instructional focus is student-centered and teacher's comfort level facilitating student-driven content is high. Content-related higher-order thinking by students and real-world application of the content are evident. Students use digital/environmental resources for problem-based, personally-relevant, high-level cognitive tasks (e.g., evaluating, creating)

- LoTi Level 5: Expansion

Instructional focus is collaborative, student-centered, and teacher's comfort level facilitating student-driven content is high. Students use complex thinking skills and collaborative expertise from the community to solve relevant problems; real-world application of student-designed solutions is evident. Students use multiple digital/environmental resources for problem-based, personally-relevant, high-level cognitive tasks (e.g., evaluating, creating)

- LoTi Level 6: Refinement

Instructional focus is collaborative, student-centered, and teacher's comfort level facilitating student-driven content is high. Students use complex thinking skills and collaborative expertise from the community to solve relevant problems; real-world application of student-designed solutions is evident. Students use unlimited access to multiple digital/environmental resources as tools to master any student-driven learning experience (e.g., content, process, and product).

Technology Integration Matrix (TIM)

The Technology Integration Matrix (TIM) was created by the Florida Center for Instructional Technology (FCIT, 2005). The TIM model (Figure 2) guides participants along a technology integration continuum at the top while progressing down the side of various characteristics of the learning environments. Also created by the FCIT is the Inventory for Teacher Technology Skills (ITTS) companion tool is designed to help districts evaluate teachers' current levels of proficiency with technology and is also used as a professional development planning and needs assessment resource (FCIT, 2005). Neither model has been empirically validated or cited in current research on successful integration of technology in education.

Levels of Technology Integration

Characteristics of Learning Environment

	Entry	Adoption	Adaption	Infusion	Transformation
Active	Informatio n Passively Received	Conventional, procedural use of tools	Conventional independent use for tools: some student choice and exploration	Choice of tools and regular self-directed use	Extensive and unconventional use of tools.
Collaborative	Individual student use of tools	Collaborative use of tools in conventional ways	Collaborative use of tools: some student choice and exploration	Choice of tools and regular use for collaborati on	Collaboration with peers and outside resources in ways not possible without technology
Constructive	Informatio n delivered to students	Guided conventional use for building knowledge	Independent use for building knowledge; some student choice and exploration	Choice and regular use for building knowledge	Extensive and unconventional use of technology tools to build knowledge.
Authentic	Use unrelated to the world outside of the instruction al setting	Guided use in activities with some meaningful context	Independent use in activities connected to students lives; Some student choice and explanation	Choice of tools and regular use in meaningfu l activities.	Innovation use for higher order learning activities in a local or global context.
Goal Directed	Directions given, step-by-step task monitorin g	Conventional and procedural use of tools to plan or monitor	Purposeful use of tools to plan and monitor. Some student choice and explanation	Flexible and seamless use of tools to plan and monitor.	Extensive and higher order use of tools to plan and monitor.

Figure 2. Technology integration matrix (FCIT, 2005)

In summary the SAMR, LoTi and TIM technology integration models all provide a framework for infusing technology into education. All of these models were considered in the development of this study. However, because many of them lacked the support of sound research, the following TPaCK model was chosen as the theoretical foundation for the study.

TPaCK: Merging Technology with Pedagogy

Finally, the last model found in the review of literature is the Technology, Pedagogy and Content Knowledge (TPaCK) framework. Educators and researchers interested in successful technology implementation have begun to more closely examine the overlap between technology skills and pedagogy. The relationship between technology skills and how to effectively deliver instruction is often illustrated using the TPaCK framework.

TPaCK is a framework for describing and understanding the goals for technology use. The model introduces the relationships and overlapping between all three basic components of knowledge, technology, pedagogy, and content (Koehler & Mishra, 2009). The TPaCK model illustrates for teachers an understanding of how technologies can be used effectively as pedagogical tools. It also emphasizes the strength than can be found in the merging of pedagogy, content and technology knowledge (Figure 1).

TPaCK is based on the work of Shulman (1986) who suggested the combination of pedagogy, content, and knowledge (PCK) as the key to effective teaching practices. Rather than providing information on content and knowledge separately, Shulman illustrated strength in the overlap between the two constructs. According to Shulman (1986), teacher knowledge includes knowledge of the subject (content knowledge, CK), knowledge of teaching methods and classroom management strategies (pedagogical knowledge, PK), and knowledge of how to teach specific content to specific learners in specific contexts (pedagogical content knowledge, PCK).

To address a growing need for guidance in technology integration, Koehler and Mishra (2009) expanded Shulman's PCK model by adding an additional dimension, technology (Figure 1). At the core of TPaCK, technology, pedagogy, and content combine to illustrate the optimal goal of technology-infused curricula as suggested by ISTE NETS technology standards as well as the accreditation body CAEP. This merging point at the core of TPaCK clearly articulates the goal for both classroom teachers and higher education instructors. Thus, the creation of the TPaCK model emerged to become a valuable tool in examining how integrated technology can seamlessly strengthen instructional strategies as well as content knowledge in curricula (Brantley-Dias, Kinuthia, Shoffner, De Castro, & Rigole , 2007; Cox & Graham, 2009; Hu & Fyfe, 2010; Hsu, 2012; Koelher & Mishra, 2008; Schmidt, 2009).

Through the TPaCK lens, researchers examine strategies for successful technology integration into curriculum as well as instruction. Grahman (2011) supports the use of TPaCK as a foundation by stating "A strong TPaCK framework can also provide theoretical guidance for how teacher education programs might approach training candidates who can use technology in content-specific as well as general ways" (p. 1959). According to Angeli and Valanides (2009), these TPaCK models are founded on the common principle that effective technology integration depends on the interactions among technology, content, and pedagogy. Technology integration requires that teacher candidates understand the technology tools, combined with the specific capabilities of each tool that encourage the learning of content specific concepts.

In an effort to better understand strides that have been made in the development of technology integration, a review of literature was conducted. This review of the literature related to TPaCK produced several reoccurring themes: (1) student technology confidence; (2) leadership and modeling of technology integration; (3) assessment/evaluation of technology integration; and (4) technology instructional models. The following section will examine and synthesize these themes for successful technology integration in teacher preparation in an effort to articulate key considerations for implementation.

Student Technology Confidence

Much of the research and literature published on the topic of TPaCK is based on the building and assessment of student confidence in technology integration (Gao, Choy, Wong, & Wu, 2009; Hersh, 2013; Mayo, Kajs, & Tanguma, 2005). One might hypothesize that this theme is so prominent due to the difficulty of quantifying technology integration and the relative ease of obtaining student perception via survey responses. On the other hand, it is important to note that student confidence in technology integration does play a significant role in continued use of technological tools and strategies after one becomes a teacher (Koh & Divaharan, 2011).

In fact, Gao et al. (2009) stated that "failure to raise the teachers' competence during pre-service education may result in the pre-service teachers quickly forsaking the use of instructional computer technology in practice" (p. 725). Similar research by Hersh (2013) suggests that for successful implementation, the use of technology should be embedded in content-specific coursework and methods coursework to increase teacher confidence. Finally, Mayo et al. (2005) concluded that increased use of educational technologies resulted in increased self-efficacy of technology integration. These findings all suggest that the first step to building TPaCK in teacher preparation is through building confidence through exposure.

Leadership and Modeling of Technology Integration

While exposure to technology learning opportunities was often cited in TPaCK literature, exposure to technology modeling was equally emphasized as an integral factor of successful technology integration. In fact, TPaCK literature frequently cited education instructors as vital components in technology learning as they play an important part of technology role models for pre-service teachers (Koch, Heo, & Kush, 2012; Kopcha, 2010; Thomas, Herrring, Redmond & Smaldino, 2013).

Goktas, Yildirim, and Yildirim, (2009) articulated how important it is for teacher educators to act as role models for prospective teachers by using technologies in their own teaching. The authors illustrated how specifically instructor competency and willingness to use technologies in teaching will enrich their courses in the technology-integration process while modeling best practices for pre-service teachers. This sentiment was echoed in another article by Hsu (2012) that stated "modeling from course instructors is a critical component" of technology in teacher preparation (p. 198).

Similarly, Koch et al. (2012) found that technology modeling and program design within a teacher education program can have a significant impact on pre-service teachers, thus improving their perceptions about their ability to integrate technology. This professional goal may seem easier said than done as Gronseth, Brush and Ottenbreit-Leftwich, Stryker, Abaci, Easterling, and van Leusen (2010) suggest, "Many methods faculty fail to provide appropriate modeling, as they themselves struggle with keeping up with best practices in current technologies" (p. 30).

This point was even further supported by recent research by Kovalik, Kuo, and Karpinski. (2013). Results from their study indicated that teacher candidate observations of technology-rich elementary classrooms significantly increased pre-service teacher technology knowledge in all five standard areas of the NETS technology standards for teachers. Each of these publications supports the importance of observing technology-rich models in the elementary classroom as well as in the college classroom.

While these findings articulated the profound influence that instructor modeling can have on teacher candidates, Thomas et al. (2013) extended this concept by stating that "Leaders, deans and department heads must be an integral part of the change process for successful technology integration to take place" (p. 55). These recent publications illustrate the importance of modeling technology integration not only by education instructors but also by university leadership and administrators as these individuals articulate the expectations by which the students model their own efforts.

However, building confidence through exposure and modeling are just two of the many ways that TPaCK can be established in teacher preparation programs. As Gao and colleagues (2009) suggested, building TPaCK in teacher preparation programs takes a multifaceted effort. The authors illustrate this concept particularly well in their publication by stating the following:

> Teacher education programs need to adopt various strategies to nurture a sophisticated, constructivist view of technology integration. For example, teacher education programs need to challenge pre-service teachers by involving them in critical reflection upon their own practice, providing ongoing guidance, modelling and collaboration (p. 726).

In fact, in several recent publications researchers cited reflection as a suggested integral part of building and evaluating successful TPaCK in teacher preparation programs (Goktas et al. 2009; Pierson & Borthwick, 2010). However this is just one of the few themes that are evident among recent literature on technology integration in teacher preparation.

Assessment/Evaluation of Technology Integration

Another theme that is evident among literature in teacher preparation is the evaluation of effective technology integration. Over the past 10 years, the field of technology in education has really struggled with ways to quantify progress toward technology standards. For example, Coffman (2013) described how the only measure of whether pre-service teachers possess the technology capabilities to satisfy the ISTE NETS•T standards relied on completing the one required Educational Technology course. This shows the concern for how programs are evaluating technology standards because students are learning all the technology standards in one isolated setting instead of in an integrated manner as suggested by the fusion of the TPaCK constructs.

Due to this concern, researchers have recently been dedicated to developing reliable assessment approaches for measuring TPaCK and its constructs (Abbitt, 2011; Koehler & Mishra, 2009; Schmidt, 2009). The goal of this effort is to better understand which strengths and weaknesses as well as which professional development approaches actually increase teachers' technology knowledge.

Kyie-Blankson et al. (2009) articulated this effort well by stating "Monitoring and examining students' expectations and evaluation of faculty use of technology in instruction is necessary to provide valuable feedback to educators and administrators regarding effective technology integration in teaching and learning" (p. 211). It is clear that researchers and educators are beginning to see that the need for systematic design, evaluation, reflection and redesign in building a strong TPaCK foundation (Goktas et al., 2009).

To support and define this need further, Pierson and Borthwick (2010) created a model for meaningful assessment and reflection with TPaCK at the core (Figure 3). This model illustrates how effective and meaningful assessment of educational technology professional development (ETPD) requires that educators design in-service learning activities that can be measured using methods consistent with teaching and learning. The authors importantly note that reflection and evaluation are inseparable components of ongoing teacher action and growth.

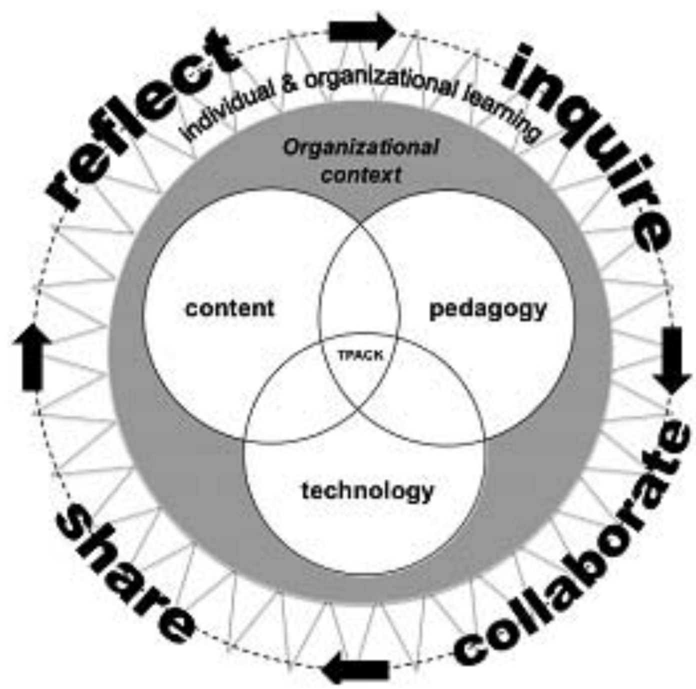

Figure 3. A contextually-situated TPaCK model (Pierson & Borthwick, 2010).

Technology Instructional Models in Teacher Preparation

The final theme that was observed through the review of literature on technology in teacher preparation programs was the delivery of information to pre-service teachers. According to a 2006 Educational Technology in Teacher Education Programs for Initial Licensure study by the National Center for Educational Statistics, 100% of all Title IV degree-granting four-year institutions with teacher preparation programs in the United States provide instruction on technology integration (Kleiner, Thomas, Lewis, & Greene, 2007). While standards have consistently provided a guideline for what students need to know, universities have chosen the delivery of technology in teacher preparation courses in two separate ways, stand-alone or integrated approach (Kay 2006; Teclehaimanot, Mentzer, & Hickman, 2011; Torre, 2013; Wentzler, 2008).

More research on teacher preparation programs has encouraged instructors to incorporate technologies into their courses in order to strengthen student confidence, build contextual knowledge, and model technology integration (Wetzel, Foulger, & Williams, 2008). However, because many universities have not moved to full technology integration, and teacher education courses might not be integrating technology to the extent that they should, there is a heavy reliance upon the traditional, stand-alone technology courses to provide all of the technology knowledge needed by pre-service teachers.

In fact, in a national study by Gronseth et al. (2010), 80% of faculty members responsible for technology experiences indicated all or some of their programs required a standalone educational technology course. In the same study, when asked to describe changes they would make in their programs, more than half of the educational technology faculty expressed a desire to have more systemic technology integration, particularly in field experiences and methods courses. Similarly, Mouza and Klein (2013) state, “Often, pre-service teachers learn about technology, content, and pedagogy in separate coursework, giving them an incomplete picture of how technology can support student learning” (p. 149).

Polly, Mims, Shephard and Inan (2010) substantiate the same point in a publication that states “In the past decade, many teacher education programs have attempted to develop preservice teachers’ technology integration skills through an introductory course in educational technology” (p. 863). Polly et al. (2010) maintain that while teacher candidates’ technology skills are developed in these courses, they do not result in effective use of technology that impacts learning in their future classrooms. For example, students often learn about technology tools such as PowerPoint™ but not necessarily how to seamlessly integrate technology with pedagogy and content. Brush and Saye (2009) support this claim also by discussing the disconnect between teacher candidates learning about technology tools but not necessarily how to infuse them into instruction. Polly et al. (2010) suggest that teacher education programs need to shift the focus from the mastery of specific technology skills to developing knowledge “related to the intersection of technology and pedagogy” (p. 868). For example, students might learn how to fuse the two programs, PowerPoint™ and Zaption™, into an interactive learning presentation where several learning styles are addressed, students are engaged in question and answers experiences, all while they are learning new content specific information and teachers are tracking the learning through assessment. In a stand-alone technology class, students learn the tools but in a class infused with technology, students are learning about the tools, the pedagogical benefits of the tools as well as content specifics that can be addressed with the tools.

In another study that analyzed technology perceptions in teacher preparation programs, Sutton (2011) found that students articulated a misalignment with the program expectations of technology integration into coursework. Paradoxically, students noticed a lack of emphasis on technology training outside the one required technology course. So frequently noticed is this phenomenon that it has created its own name: “Technocentric.” Seymour Papert (1987) coined the term to identify overemphasis on the tools of the technologies rather than the learning that they can support, “technocentrism” defines the stand-alone traditional technology courses that are stifling the depth suggested by the TPaCK model.

As an alternative to stand-alone courses, Hersh (2013) suggested that the use of technology should be embedded in content-specific and methods coursework to increase teacher candidate confidence in their technology implementation skills. Collier, Weinburgh and Rivera (2004) echoed the same sentiment when they stated that “a key recommendation for teacher educators is to consider that technology literacy no longer be acquired through a series of discrete, perhaps isolated courses, but integrated in and across the curriculum content” (p. 466). Hsu (2012) examined the impact of educational technology courses on pre-service teachers’ development of knowledge of technology integration in a teacher preparation program and recommended the following:

1. Professional development activities should be offered regularly to pre-service teachers so they can stay current on emerging technology as well as technology commonly available in their placement schools.

2. Educational technology faculty, methods course faculty and school teachers should collaborate to develop technology-integrated teacher education curricula that help pre-service teachers develop technology content knowledge (TCK).
3. Examine the impact of professional development activities on pre-service teachers' development of TPaCK.

Another suggestion from recent literature by Kovalik et al. (2013) found that when teacher preparation courses were redesigned with all five standard areas of NETS-T in mind, pre-service teachers made significant progress in technology knowledge. To support the previously mentioned Pierson and Borthwick model, the importance of student reflection to technology growth was again cited. Specifically Mouza and Klein (2013) suggested projects such as case studies that allow pre-service teachers to engage in reflection on their own practice, thus providing participants begin to notice the interacting connections that form the ultimate goal of successful TPaCK integration.

Hu and Fyfe (2010) shared another illustration when their teacher preparation program recently updated the curriculum. The more modern integrated approach to technology instruction shared how students quickly began to show evidence of TPaCK development. In the study Hu and Fyfe (2010) shared findings that suggested the new curriculum helped boost the pre-service teacher's confidence in their abilities in choosing the right technology tools to enhance the teaching approaches for a lesson and for students' learning.

Similarly, Ertmer and Ottenbreit (2010) stated, "To achieve the kinds of technology uses required for 21st century teaching and learning, we need to help teachers understand how to use technology to facilitate meaningful learning, defined as that which enables students to construct deep and connected knowledge, which can be applied to real situations" (p. 257).

Conclusion

Through the review of literature on technology integration in teacher preparation, it is evident that while today's teacher candidates are confident and competent in the use of technology in their daily lives, technology skills are not translating to effective technology integration into the classroom. Research on the topic suggests that through the TPaCK lens, teacher preparation programs can build an understanding of the relationship between technology and pedagogy by modeling technology integration across education methods courses. Unlike the other technology integration models reviewed, TPaCK is empirically supported by peer reviewed research publications, and integrates technology pedagogy and content knowledge providing an appropriate theoretical framework for this study.

Suggested improvements have focused on building confidence through exposure, instructor and administrative modeling, effective evaluations and technology embedded curriculum. All of these strategies have potential to strengthen teacher education programs and prepare pre-service teachers for 21st century instruction. Perhaps Gao et al. (2009) illustrated the complexity of improving technology integration in teacher preparation best when they stated, "The development of technology based pedagogy is an active, on-going process situated in multiple contexts. It is therefore imperative for teacher education programs to adopt various strategies to guide, model and support pre-service teachers' development of technology based pedagogy, until it becomes an integral part of their professional growth" (p. 727).

CHAPTER III

RESEARCH DESIGN

Design Rationale

In an effort to examine the relationship between faculty attitudes toward technology integration and the level of perceived technology integration practices, this non-experimental study collected quantitative data using surveys of faculty. According to Creswell (2003), “Surveys provide a numeric description of attitudes or trends of a population by studying a sample of that population” (p. 153). Specifically, the study quantitatively collected data on faculty attitudes about technology integration through the use of a survey comprised of questions built upon the TPaCK constructs in order to examine trends of the teacher preparation faculty population. The final section of the survey was dedicated to four open-ended questions that were coded for TPaCK constructs in an attempt to further inform the research questions.

The study focused on how the attitudes of university faculty might impact and align with the development of TPaCK in teacher preparation courses. Data were collected and analyzed to examine the extent to which teacher educators perceived they were integrating technology into the teacher education courses as measured through TPaCK and the relationship between faculty demographics and the perceived levels of technology integration in courses taught.

Open-ended questions were added to the survey to collect qualitative details about the extent to which technology was integrated into their teacher preparation courses. Before the study was conducted, a pilot study was run to examine the effectiveness of the survey tool.

Statement of the Problem

Many studies have found that teacher preparation students graduate with a lack of technology confidence (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Hersh, 2013; Lambert & Gong, 2010). In order to fully understand technology integration in teacher preparation, this study examined faculty perceptions of the relationship between technology and pedagogy in teacher education through the TPaCK lens.

Purpose of Study

The purpose of this research study was to examine the perceived levels of technology integration in one Midwestern teacher preparation program through the lens of TPaCK in an effort to better understand the extent technology has integrated and faculty attitudes about technology integration.

Research Questions and Hypotheses

Based on the TPaCK theory and literature previously reviewed, the following research questions and hypotheses have been developed as a foundation of the study.

RQ1: What are faculty attitudes about technology integration in one Midwestern university as measured through TPaCK?

H_{01}: Faculty attitudes toward technology integration in education courses will not vary.

H_{R1}: Faculty attitudes toward technology integration in education courses will vary based on level of technology integration.

RQ2: To what extent do teacher educators integrate technology into the teacher education courses as measured through TPaCK?

H_{02}: Frequency of faculty technology integration in education courses will not vary.

H_{R2}: Frequency of faculty technology integration in education courses will vary based on level of technology integration.

RQ3: Is there a relationship between faculty attitude and perceived level of technology integration in education courses? Does this change with demographic differences?

H_{03}: Faculty will have similar levels of perceived technology integration.

H_{R3}: Faculty who communicate a strong importance about technology integration in education courses will have a higher perceived level of technology integration.

Setting

The study was conducted at Midwest State University (MSU; pseudonym), a university with the population of approximately 20,000 undergraduate students. Geographically, MSU is located in a smaller urban area midway between two large metropolitan cities. MSUs' 4 year graduation rate (71.8%) ranks among the top 10 percent of all U.S. universities and nearly 99% of tenured/tenure track faculty hold a terminal degree.

MSU's College of Education is the oldest college in the university and enrolls more than 3,000 doctoral, master's, and undergraduate students. MSU's College of

Education has been continuously accredited by the National Council for Accreditation of Teacher Education (NCATE) since 1954. At the time of this study, 87% of the state's public school districts employ at least one MSU alumni. MSU prepares undergraduates in early childhood elementary, middle, secondary, bilingual, and special education, and offers 41 teacher education degree programs.

Pilot TPaCK Survey

The initial phase of the study was a pilot of the survey developed to measure the attitudes of technology integration in teacher preparation. The purpose of piloting the survey was to test the reliability and validity to assure that the survey measured the intended information.

For the pilot, the survey was emailed to all 60 non-tenure track (NTT) teacher preparation instructors within two departments at MSU. There were 35 NTT instructors in the MSU School of Education and 23 NTT instructors in the MSU Department of Special Education. The NTT instructors were asked to participate in the piloted study because they closely reflected the intended audience (TT faculty) of the larger study. The data collection timeframe for the pilot study was one month.

Modifications to the pilot survey were minimal, including the removal of one survey question (Could you please share some of the topics and activities from your course that have helped your students develop technology skills?) due to redundancy. Several participants mentioned the redundancy or did not answer this question so it was removed. The other survey modification was the addition of the following two questions, added for greater clarity and aligned with the theoretical framework:

- Faculty members who integrate technology more frequently in their courses have a better understanding of how technology can improve student learning. Agree/disagree?
- In your opinion, is it more important to integrate content-specific or general technologies in teacher preparation courses? Please explain.

Study Sample

After the survey was revised based on analyzing the data from the pilot study, the survey was emailed to all 60 full-time, tenure/tenure track MSU faculty members within the College of Education. Faculty who teach secondary content-specific, teacher education courses for k-12 programs are housed in their content department so faculty from those departments were not included in the study. Also, only faculty members who teach undergraduate teacher education courses were invited to participate in the survey because students enrolled in graduate level teacher education courses are often certified and/or practicing teachers who might have received a different style and/or method of instruction from faculty.

Both the pilot and larger study utilized convenience sampling methods. According to Mack, Woodson, MacQueen, Guest and Namey (2005), convenience sampling is defined as a strategy for drawing populations that are both accessible and willing to participate in a study.

TPaCK Survey on Technology in Teacher Preparation

The survey was developed through a process of reviewing all current research on the topic of technology integration in teacher preparation programs. Several studies utilizing surveys that measured student confidence or attitudes about technology in teacher preparation programs (Koh & Divaharan, 2011; Teo, Chai, Hung, & Lee, 2008) and classroom teachers' confidence or attitudes toward technology integration were examined (Kim, Kim, Lee, Spector, & DeMeester, 2013). However, very little previous research examined faculty perceptions or attitudes of technology integration. The survey that most closely aligned with the research topic was published in a recent dissertation (Garrett, 2014) asking faculty to self-assess TPaCK. While Garrett's survey was used to generate ideas, none of the specific survey questions were replicated for this study because they did not fully align with the study's research questions.

Baruch and Holtom (2008) postulated that the most important factor in any survey administration strategy is the analysis of the population being studied. "To complement individual, organizational or industry-specific analysis, researchers should also be aware of state-of-the-art techniques for best reaching their intended respondents" (Baruch & Holtom, 2008, p. 1158). Due to the technology topic of the survey and the intended participants, data collection took place via an online survey in place of paper surveys.

All proposed studies that use living humans as subjects are required to first receive Institutional Review Board (IRB) approval before participants can be invited to participate. The IRB approval assures the protection of human subjects and guarantees that the study is aligned with ethical research practices. The research study was approved by the IRB prior to any data collection for both the pilot and the larger study.

Informed consent is necessary for all research methods and is an ethical obligation of the researcher in all studies involving human subjects. According to Mack et al. (2005), informed consent is one of the most important tools for ensuring respect for persons during research and guarantees that people can decide in a conscious, deliberate way whether they want to participate. Informed consent was obtained via the first page of the online survey where participants were provided information about their participation in the study, and if they agreed to participate, clicked on the survey option to "Continue" to the survey. If they opted not to participate, they clicked on the option to "No, I do not wish to participate in this survey." By clicking on "Continue," the participant consented to participate in the online survey.

This study was conducted to gather information about the extent to which faculty believe they integrate technology into their education courses. The online survey (Appendix A) comprised five sections. Section 1 identified demographic information such as faculty ranking, tenure status, instructional experience, and estimate current use of technology in the instruction. Section 2 of the survey consisted of 10 frequency questions that examined the course level, how often the course meets, and how often technology was integrated. Section 3 asked participants to share attitudes about technology integration. Section 4 of the survey had questions that examined integration practices based upon TPaCK constructs. Section 5 consisted of several open-ended questions that asked participants to share examples of integration practices.

Survey Section 1 (Questions 1-5) collected demographic information about faculty members. This information was used to address RQ3- Is there a relationship between faculty attitude and perceived level of technology integration in education courses? Does this change with demographic differences? Faculty were asked their gender, what department they teach in, how long they have been teaching, and how many courses they typically teach.

Survey Section 2 (Questions 6-8) asked the respondent to rate their perceptions of technology use per course. This section addressed RQ2 – To what extent do teacher educators perceive they are integrating technology into the teacher education courses as measured through TPaCK? Faculty were asked to answer these questions for each course they taught. The information collected in this section was used to assess the perceived levels of technology integration within courses. The three questions in this section asked faculty how many times the courses meet per week and how many times a week they integrate technology into their courses.

Survey Section 3 (Questions 9-14) asked participants to evaluate their attitudes toward technology integration by rating five statements using a 5-point Likert scale ranging from 1 "strongly disagree" to 5 "strongly agree." Specifically the questions in Section 3 were aligned with the higher level TPaCK constructs; technology pedagogy knowledge (TPK), technology content knowledge (TCK), and TPaCK. The data collected in this section were used to address RQ3 – Is there a relationship between faculty attitude and perceived level of technology integration in education courses?

Section 4 (Questions 15-19) of the survey consisted of five questions using a frequency metric (never, once a semester, monthly, weekly or daily) that also aligned with TPaCK constructs and examined to what extent faculty perceived they were integrating technology. The five questions were developed to address the overlapping constructs of the TPaCK model and measured faculty attitudes about the interactions of technology, pedagogy and content knowledge. For example, the questions in this section asked faculty whether they agreed or disagreed with statements such as "I select specific technologies that are best suited for addressing learning objectives in my discipline."

Finally, Section 5 of the survey consisted of four open-ended questions that asked participants to share specific technologies used in teacher preparation courses as well as their attitudes about technology integration. Open-ended questions were included to obtain more comprehensive information, as well as to help better understand the actual use of technology in the courses. The responses were coded to look for commonalities. For example, the first question asked participants to share specific examples of technology integration used in their courses.

Data Collection

In an effort to increase survey response rates, the study employed a variety of questioning strategies. As Rogelberg and Stanton (2007) suggest, researchers should consistently follow "well-known response facilitation approaches" (p. 196) by doing the following: a) pre-notify participants, b) publicize the survey, c) design the survey carefully, d) manage survey length, e) provide ample response opportunities, f) monitor survey response, g) establish survey importance, h) foster survey commitment and i) provide survey feedback. To this extent, participants were notified multiple times via email about the survey opportunity as well as the importance to the research community.

To increase survey response rates, faculty members were sent an email reminder after one week. As Dillman (2007) suggests in regards to survey administration, "Multiple attempts are essential to achieving satisfactory response rates" (p. 13). The online survey was available for four weeks.

Baruch and Holtom (2008) suggest that researchers can expect significantly below 100% response rates on survey data collection. In fact they found that response rates for published academic studies "from 1975 to 1995 declined from 64.4 percent to 48.4 percent" (p. 1141). With these rates in mind, a 50% response rate from the emailed survey was expected to provide a sufficient level of data for analyses. For the pilot survey, 8 out of 60 non-tenure track faculty participated (14%) while 28 out of 60 tenure-track and tenured faculty completed the larger study survey, resulting in a 51% response rate for the larger study. Both departments were equally represented in the response rates.

By using both the quantitative and open-ended questions, the survey represented the perspective of the faculty attitudes and practices of technology integration in the population sampled.

CHAPTER IV

RESULTS

The purpose of this study was to examine the potential insights into instruction related to the implementation and use of technology in teacher preparation programs nationally. A survey was used to collect data on tenure track faculty's perceived level of technology integration, attitudes towards integration as well as investigate the potential relationship between the attitudes and levels of integration. In order to achieve this examination, a chi-square analysis was conducted. The findings and conclusions are shared in the proceeding paragraphs.

Data Analysis

This study examined how demographic variables such as gender, tenure status, employment position might impact attitudes toward technology use and frequency of technology integration in teacher preparation courses. Therefore, the first step when analyzing data was to collect frequencies on all the data to report the results for each of the survey questions. Next, statistical analyses were conducted to compare the data collected for each group in order to examine trends in faculty attitude and perception of technology integration.

Due to the types of demographic and categorical variables included on the survey, bivariate, chi-square analyses were initially conducted for each of the hypotheses mentioned in Chapter 3. Chi-square tests are non-parametric statistical tests used when the data cannot be assumed to reflect a normal distribution and when they are measured at either the nominal or ordinal level, similar to the variables chosen for this study (Howell, 2011). Chi-square analysis is often used when researchers are interested in the number of participants or events that fall within specified categories (Howell, 2011).

In order to examine the relationship between faculty attitudes about technology integration and the frequency of perceived technology integration in teacher preparation courses, the chi-square analysis was conducted. The chi-square test was chosen to analyze the association between the faculty attitudes and frequency of technology integration by conducting a cross-tabulation analysis. This analysis is used when researchers want to know if frequency responses of one categorical variable relate to another categorical variable. Survey questions from Section 2 represented frequency of technology integration and survey questions from Section 3 represented faculty attitudes.

Next, the relationship between faculty attitudes towards technology integration and the level of perceived technology integration in teacher preparation courses (RQ3) was examined by initially running the chi-square test. The chi-square test statistic measures the association between faculty attitudes and level of technology integration by conducting a cross-tabulation analysis. Again, this analysis is often used when researchers want to compare frequency responses of one categorical to another categorical variable. Survey questions from Section 4 represented level of technology integration through TPaCK and survey questions from Section 3 represented faculty attitudes.

Finally, in order to examine the relationship between level of perceived technology integration as measured by TPaCK and demographic information (RQ3), a chi-square test was conducted. The chi-square test statistic was used to measure the association between levels of technology integration and demographic information by conducting a cross-tabulation analysis. Survey questions from Section 4 represented level of technology integration through TPaCK and survey questions from Section 1 represented demographic information.

All three hypotheses were initially examined by conducting chi-square analyses of the item-level questions and no significant relationships were observed. At this point, it was decided to construct a scale score for the attitude and practice variables by calculating the mean scores for each survey respondent. Scale scores could be analyzed as interval-level data through the use of independent sample *t*-tests, analyses of variance (ANOVAs), and correlations (Table 1). As De Vaus (2013) suggests, creating a scale by combining multiple indicators in a category helps tap into the complexity of a concept. For example, instead of just measuring one facet of faculty attitude towards technology integration, a scale score summarizes the attitude variables into one scale score.

Table 1

Technology in Teacher Preparation Variables

Test #	Independent Variables	Dependent Variables	Statistical Test
Research Question 1			
1	Gender (Categorical)	Attitude Mean (Interval)	Independent Samples *t*-test
2	Department (Categorical)	Attitude Mean (Interval)	Independent Samples *t*-test
3	Tenure status	Attitude Mean (Interval)	Independent Samples *t*-test
4	Current position (Ordinal)	Attitude Mean (Interval)	Analysis of Variance (ANOVA)
5	Courses/semester	Attitude Mean (Interval)	Pearson Correlation
6	# years teaching full time	Attitude Mean (Interval)	Pearson Correlation
Research Question 2			
7	Gender (Categorical)	Practices Mean (Interval)	Independent Samples *t*-test
8	Department (Categorical)	Practices Mean (Interval)	Independent Samples *t*-test
9	Tenure status	Practices Mean (Interval)	Independent Samples *t*-test
10	Current position (Ordinal)	Practices Mean (Interval)	Analysis of Variance (ANOVA)
11	Courses/semester	Practices Mean (Interval)	Pearson Correlation
12	# years teaching full time	Practices Mean (Interval)	Pearson Correlation
Research Question 3			
13	Attitude Mean (Interval)	Practice Mean (Interval)	Pearson Correlation

The final level of data analysis was qualitative and used descriptive, deductive coding, otherwise known as topic coding, to the label the data collected from the open-ended questions at the end of the survey. Descriptive coding provided a categorical topic label to assist the researcher in organizing and making conclusions (Saldana, 2015). According to Mack et al. (2005) "the coding of data involves interacting with data, using techniques to develop those concepts into terms of their properties and dimensions" (p. 66).

By deductively analyzing data from the more general theoretical umbrella to the more specific, hypotheses are able to be tested with specific conclusions. In the case of this study, the data was examined initially under the overarching TPaCK theoretical framework and then coded for the more specific TPaCK constructs through qualitative analysis.

Specifically, descriptive coding involved reviewing the answers given to the open-ended question and encoding them for TPaCK constructs such as TP, TC, PC, TPCK and O. According to Saldana (2015), the term "encoding" is used when coding labels are predetermined and applied as opposed to analyzing a passage and creating labels based on this analysis which is called "decoding." If survey data showed evidence of a technology-knowledge construct addressed in the course (i.e., general technology tools such as PowerPoint), a "TK" was coded by writing "TK," In the case of surveys showing evidence of a content specific technology-knowledge construct (i.e., content specific technology tools) a "TCK" was coded. When survey data showed evidence of all three knowledge constructs, a "TPaCK" was coded. Finally if data fell outside of the TPaCK constructs, an "other" code of "O" was assigned. The potential labels given are: TK (technology knowledge), PK (pedagogy knowledge), CK (content knowledge), TCK (technology and content knowledge), PCK (pedagogy and content knowledge), TPK (technology and pedagogy knowledge), TPCK (technology, pedagogy and content knowledge) and O (other). Once the codes were applied, the data was summarized and compared to the conclusions established.

As Saldana (2015) reminds us "Coding is a cyclical act. Rarely is the first cycle of coding data perfectly attempted" (p. 8). With this in mind, the manual qualitative coding and analysis was reviewed by two of the dissertation committee members and also a third qualitative researcher for validity. All three professionals were given the TPaCK constructs used along with background information on the theory as well as each of the TPaCK construct labels. Each professional was asked to review the application of the codes for agreement. Through this review process it was determined that no significant changes were suggested.

Findings and Results

The following section addresses the findings and results for the study by research question.

Research Question 1: What are faculty attitudes about technology integration in one Midwestern university as measured through TPaCK?

To address this research question, an independent-samples *t*-test was conducted to assess the differences in mean scores of attitudes towards technology integration by gender. The results of the *t*-test indicated there was not a significant difference at the $p < .05$ level for female ($M = 1.49$ $SD = .89$) and male ($M = 2.08$, $SD = 0.73$) when $t(23) = -1.55$, $p = 0.13$. These results suggested that there were no statistically significant differences in the means of attitudes towards technology integration by gender in this sample.

Next an independent samples *t*-test was chosen to assess any differences in the means of the attitude variables about technology integration by type of department. The results of the *t*-test indicated there was not a significant difference in the mean scores by department type: School of Education (M = 1.64, SD = .97) and the Department of Special Education (M = 1.67, SD = 0.84) when $t(23) = -.10$, $p = 0.92$. These results suggest that the department does not impact faculty attitudes toward technology integration.

To measure if the group means of the faculty attitude variables were statistically different by tenure status, an independent samples *t*-test was used. The results of the *t*-test indicated there was not a statistically significant difference between the mean scores of attitude toward technology and tenure status at the $p < .05$ level because $p = .65$ (M = 1.56, SD = 0.83) and attitude (M = 1.75, SD = 0.94) conditions; $t(23) = -0.53$, $p = 0.60$. The results suggested that in this sample, tenure status did not impact faculty attitude towards technology integration.

To measure the means between faculty position (assistant, associate and full professor) and their attitudes concerning the technology integration variables, an ANOVA test was used. This statistical test was chosen because the faculty position variable had three categories so it was important to examine the means for all three categories. The relationship between current position and attitudes concerning was not statistically significant, $F_{(2, 22)} = 0.19$, $p = 0.83$. Therefore the results indicate that there is not a relationship between faculty position and their attitudes about technology integration.

Next a Pearson's correlation was conducted to understand the association between the number of years teaching and faculty attitudes about technology integration, two interval variables. The Pearson's correlation results indicated there is a weak association between the two variables, r = 0.23, n = 23, p = 0.30, and therefore not statistically significant at the $p<.05$ level. Therefore the results indicate that there was no significant relationship between the years of teaching and the how often a faculty member integrates technology.

In conclusion, the results from all the statistical tests used to measure data for RQ1 indicate that demographic variables did not impact faculty attitude about technology integration.

Research Question 2: To what extent do teacher educators integrate technology into the teacher education courses as measured through TPaCK?

Initially to address RQ2, a Pearson's correlation was conducted to understand the association between the number of courses taught and mean practice scores, two interval variables (Salkind, 2008). The results of the Pearson's correlation indicated that there was a weak association between the number of courses taught and attitude variables (r = .25, n = 19, p = .30). Therefore the results indicated that there was no significant relationship between the number of courses taught and the how often a faculty member integrates technology.

An independent samples *t*-test was chosen to assess any differences in the means of practices by gender. The *t*-test results indicated there was not a statistically significant difference between the means of practices of technology integration by gender at the $p<.05$ level because p = .16. The results suggested that in this sample, gender did impact the practice of technology integration. There was not a significant difference in the scores for the independent variable, Gender (M = 3.05, SD = 0.90) and the dependent variable, Practice (M = 2.26, SD = 1.19) conditions; $t_{(18)} = 1.68$, p = 0.11.

To measure if group means of the practice and department variables were statistically significant, an independent samples *t*-test was chosen. The *t*-test results indicated there was not a statistically significant difference between the group means of practice of technology integration by department type at the $p < .05$ level because $p = .43$. The results suggest that in this sample, department does not impact the practice of technology integration. There was not a significant difference in the scores for the independent variable, Department (M = 2.43, SD = 1.10) and the dependent variable Practice (M = 3.00, SD = .99) conditions; $t_{(18)} = -1.21$, p = 0.24.

Again, an independent samples *t*-test was chosen to assess any difference in the means of the tenure status scores and practice scores to determine if means are significantly different from one another. The independent samples *t*-test indicated there was not a statistically significant difference between the group means of practice of technology integration by tenure status at the $p <.05$ level because $p = .118$. The results suggested that in this sample, tenure status did not impact the practice of technology integration. There was not a significant difference in the scores for the independent variable, Tenure (M = 3.14, SD = 0.93) and the dependent variable, Practice (M = 2.4, SD = 1.08); $t_{(18)} = 1.64$, p = .12.

An ANOVA test was chosen to measure the difference in group means for the technology integration practices variables by current position. This statistical test was used because the current position (independent variable) had three categories so it was important to examine the means between all three groups. The ANOVA results indicated that the relationship between current position (independent variable) and practices concerning technology integration (dependent variable) was not statistically significant, $F(2, 17) = 2.69$, $p = 0.09$.

A Pearson's correlation was conducted to understand the association between the number of years teaching and practice mean. Based upon the results of the test, there was an inverse weak correlation between the two variables, $r = -0.29$, $n = 19$, $p = 0.23$ however, it was not statistically significant at the $p < .05$ level.

Research Question 3: Is there a relationship between faculty attitude and perceived level of technology integration in education courses? Does this change with demographic differences?

In order to assess the relationship between faculty attitudes concerning the use of technology in their courses and their actual use of technology practices in their courses, a Pearson's correlation was conducted. A correlational analysis was used to measure the association between the two interval-level variables: mean score of faculty attitudes toward use of technology in their courses and the mean score of faculty use of technology in their courses.

The results of the correlation indicated a strong, inverse relationship between the attitude and practice variables, $r = -.79$, $n = 21$, $p = .00$. A negative correlation coefficient indicates that as the attitude score increases, the practice score decreases. This relationship was statistically significant as the p-value was equal to 0.00.

Qualitative Analysis

Table 2 illustrates how the data was coded for the four open-ended questions about technology integration in teacher preparation courses. Answers were printed and manually coded using the various TPaCK constructs as evidence was found within the participant answers. This information was used to further inform the conclusions found within the quantitative analysis by providing additional descriptive support or evidence, all which was found in the following chapter.

Table 2
Evidence of TPaCK Constructs Within Open Ended Answers

Evidence of TPaCK Constructs Within Open Ended Answers				
	Open-Ended Question #1	Open-Ended Question #2	Open-Ended Question #3	Open-Ended Question #4
Technology Knowledge (TK)	4	0	10	3
Pedagogy Knowledge (PK)	0	0	0	0
Content Knowledge (CK)	0	0	0	0
Technology Pedagogy Knowledge (TPK)	3	0	0	0
Technology Content Knowledge (TCK)	3	8	0	4
Content Pedagogy Knowledge (CPK)	0	0	0	0
Technology Pedagogy Content Knowledge(TPCK)	5	7	5	6
Other (O)	0	2	0	3

A wide variety of statistical tests were used to analyze the survey data. While an initial Chi-Square Bivariate analysis returned no conclusions of significance, additional tests provided further information. Additional tests that were conducted were the Pearson's r Correlation, Independent Samples *t*-tests and ANOVA statistical tests. Finally a qualitative analysis was conducted to further inform the study by adding details from open-ended answers that supported the conclusions to the posed research questions. The next chapter will most closely examine the interpretation of the findings.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The main motivation of this study was to examine the current practices and attitudes of faculty about technology integration in one Midwestern teacher preparation program. While educators across the country have shared that technology integration is a vital part of education, research about technology integration confidence and practices is limited (Richardson, 2012). This study confirmed the previously found negative correlation of teacher beliefs and practices about technology integration.

Summary of Research

This quantitative study closely examined the technology integration attitudes and practices of faculty members in one Midwestern teacher preparation program. Through survey research and coding of open-ended questions created around the TPaCK theoretical framework, the following conclusions were made that support previous research on the topic of technology integration.

Discussion of Research Findings

The discussion of the research findings has been organized below by research question. Under each section, the research question is identified and a brief summary of the findings as well as how it relates to prior research is shared.

Research Question 1: What are faculty attitudes about technology integration in one Midwestern university as measured through TPaCK?

Findings of this study suggested that in the population surveyed, faculty attitudes about technology integration were all similar when groups were controlled for gender, department, tenure status, position, courses per semester or years teaching. This means that there were no statistically significant differences between study groups which can be interpreted as a positive finding.

According to Palak (2004), faculty attitudes towards technology have to be factored into the overall strategy for technology integration because these beliefs are the primary agents when they make decisions about technology. Palak's conclusion are significant because they support the importance of faculty attitudes towards technology.

The findings of this study concluded there were no significant differences in attitudes among the faculty in one teacher preparation program. There is no current research that aligns with this similar conclusion however this can be interpreted as a encouraging result because it communicates consistently positive attitudes toward technology integration within the faculty.

Research Question 2: To what extent do teacher educators integrate technology practices into the teacher education courses as measured through TPaCK?

Similar to the first research question, the study found that there were no statistically significant differences in levels of practice of technology integration across gender, department, tenure status, position, courses per semester or years teaching. This means that faculty who participated in this study practiced integration similarly while instructing in their education courses. These participants generally believed that technology was an important component of education courses and tried to practice technology integration in their courses.

This finding is consistent with some previous research on the topic of technology integration predicted by demographic information but results have yielded mixed findings. For example, Glasgow and Keim (2005) found that demographic attributes have “very little-to-no influence on technology integration” while Jackowski and Akroyd (2010) found that certain demographic information might impact levels of technology integration by faculty.

The results of this study did not conclude that demographic information could predict technology integration practices. This could be explained by the fact that tenure-track faculty have quite a range of experience as tenure can be negotiated if faculty move from one university to another. Similar to past studies, the findings concluded that across the faculty in this teacher preparation program, technology integration practices are consistent.

Research Question 3: Is there a relationship between faculty attitude and perceived level of technology integration in education courses?

The only statistically significant finding of this study was the conclusion that faculty with positive attitudes about technology integration had fewer technology integration practices. This finding aligns with a phenomenon found in several other technology integration research studies that suggests that teachers often do not integrate technology in alignment with their pedagogical beliefs (Chen, 2008; Ertmer, 2010; Judson, 2006; Levin & Wadmany, 2006).

For example, Chen examined the disconnect between teachers who communicated a strong importance in technology integration yet did not practice these beliefs. Chen likened this disconnect to the pressures that teachers felt from the high-stakes assessments when he stated, “Educational reform may encourage teachers to integrate technology to engage students in activities of problem solving, critical thinking, and collaborative learning, but a culture emphasizing competition and a high-stakes assessment system can strongly discourage teachers from undertaking such innovative initiatives” (p.73).

Similarly two additional studies (Judson, 2006; Levin & Wadmany 2006) examined teacher beliefs and found no significant relationship between practices and technology beliefs of the teachers. Although most teachers identified strongly with technology integration, they failed to exhibit these ideas in their practices.

In an effort to better understand this discrepancy, Ertmer (2005, 2006, 2010) studied this topic for over a decade and suggested that varying technology barriers such as policy, school culture, availability of equipment, training, leadership, and modeling might cause inconsistency between expressed technology-related pedagogical beliefs and implemented technology-related practices.

Similar to the findings from the current study, these researchers also found a misalignment between teachers’ beliefs and technology implementation practices. Each study sought to understand why teachers believe they should be integrating technology and that technology could have a positive impact but experience a barrier to successful integration practices. The findings from the current research study are consistent with previously published research using TPaCK (Technology Pedagogy and Content Knowledge) as a theoretical lens as they also noted this misalignment.

Implications for Practice

The online survey in this study was conducted to collect data from faculty and teacher education departments at one Midwestern university about their technology integration in teacher preparation courses. Through the lens of TPaCK, practices and attitudes were examined in an effort to better understand the extent technology is integrated and how faculty feel about technology integration in education courses. The findings of the study indicate that in the surveyed sample, faculty believed that technology integration was important and could increase student learning especially if instructors were integrating content specific technology with best pedagogy practices to achieve TPaCK. However, the qualitative analysis demonstrates that most of the technology practices of faculty who participated in the survey do not align with their beliefs. In other words, while faculty believe technology integration can have a positive impact on learning if it is content specific and used with best pedagogy practices, they are not integrating technology at this level.

The findings of this research study suggest that faculty need further professional development to integrate content specific technology paired with best instructional practices in order to achieve the rich overlap of TPaCK (Figure 1) which they consider an important component of education courses. Matherson, Wilson and Wright (2014) stated "To instruct students in the best way with technology, teachers should have knowledge of the TPaCK framework". The authors went on to say that in order to develop TPaCK skills they need to have the opportunities for "job-embedded and sustained professional development” to help integrate technology into curriculum in ways that will meet the TPACK model of instruction.

Similarly Johnson, Wisniewski, Kuhlemeyer, Issacs and Krzykowski (2012) discussed how the creation of a technology professional development opportunity called “Bootcamp” helped improve faculty anxiety toward technology use. This professional development opportunity not only reduced anxiety but also helped faculty begin to understand why technology use can aid teaching and learning. Both of these studies support the findings from the current study, which suggest that faculty need more professional development to increase evidence of their TPaCK integration practices.

Limitations

There were several limitations present in this study. One limitation was related to the study sample. Results from this study may not be generalizable to other university settings because the sample in this research study was small, and not representative of all disciplines because only Early Childhood, Elementary, Middle Level Education, Bilingual Elementary Education and Special Education were included. It did not include Secondary and K-12 programs such as Business Teacher Education, English Education, Physical Education and Math Teacher Education. Second, the use of convenience sampling poses a limitation due to the dependence on participants’ willingness and availability to complete the survey. Third, because only tenured/tenured track faculty were invited to participate, the study sample could have had similar characteristics and therefore yielded little variation in the data. Fourth, the study is primarily quantitative, and many participants did not answer the open-ended questions; therefore, there was a limited understanding of faculty integration practices and attitudes. Another limitation of the study is related to the limited research on technology in teacher preparation. Many publications used in the study to support the findings were conducted on k-12 technology integration and thus were not a direct match for supporting this research. A final limitation is that the survey tool had not been previously used and therefore was not tested for validity before the pilot.

Recommendations for Future Research

In conducting this research study, many additional questions arose. Future research from this study could include replicating this design in different geographical areas and/or institutions. Further examination of faculty perceptions of successful technology integration through the lens of the TPaCK constructs in teacher preparation courses is needed and could be obtained by conducting structured interviews and document analysis on course syllabi and assignment descriptors. Another topic that should be further explored is how planning for technology integration aligns with instructor perception of effectively addressing technology implementation within teacher preparation courses.

Throughout this study, it was evident that a thorough examination of how modeling and regular professional development could positively impact successful technology integration in university settings. Also, more research is recommended on the current barriers to provide a better understanding of how to successfully integrate technology into teacher preparation programs.

Conclusion

In conclusion, this study sought to further understand how to better prepare our future teachers by examining the integration attitudes and practices in one Midwestern teacher preparation program. Tenure-track teacher preparation faculty were surveyed in one Midwestern university to examine their technology integration practices and attitudes.

Though most of the statistical tests found no statistical differences, these results illustrated a positive characteristic of consistency in faculty beliefs toward technology integration, as well as faculty practices. In other words, the results of this study found that the faculty who participated in the survey have similar perceptions about technology integration and have similar technology integration practices.

Finally, the most surprising finding in this study was the misalignment of technology integration practices with beliefs. This finding was illustrated by data that concluded when technology beliefs increase, the integration practices decrease. While the findings were initially surprising, it was realized that there is a significant body of prior research that has found a similar misalignment with what teachers believe is best technology integration practice and their practices. This misalignment illustrates how powerful further technology professional development could be in preparing faculty to integrate technology into teacher preparation programs. With professional development and continued opportunity technology integration could improve in teacher preparation programs, thus enhancing the opportunities for successful technology integration in K-12 settings.

REFERENCES

Abbitt, J. (2011). Measuring technological pedagogical content knowledge in preservice teacher education: A review of current methods and instruments. *Journal of Research on Technology in Education, 43*(4), 281-300.

Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT–TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers & Education*, *52*(1), 154-168.

Archambault, L. M., & Barnett, J. H. (2010). Revisiting technological pedagogical content knowledge: Exploring the TPaCK framework. *Computers & Education*, *55*(4), 1656-1662.

Baruch, Y., & Holtom, B. C. (2008). Survey response rate levels and trends in organizational research. *Human Relations*, *61*(8), 1139-1160.

Brantley-Dias, L., Kinuthia, W., Shoffner, M. B., De Castro, C., & Rigole, N. J. (2007). Developing pedagogical technology integration content knowledge in preservice teachers: A case study approach. *Journal of Computing in Teacher Education*, *23*(4), 143-150.

Brush, T., & Saye, J. W. (2009). Strategies for preparing preservice social studies teachers to integrate technology effectively: Models and practices. *Contemporary Issues in Technology and Teacher Education* [Online serial], *9*(1). Retrieved from http://www.citejournal.org/vol9/iss1/socialstudies/article1.cfm

Clark, C., Zhang, S., & Strudler, N. (2015). Teacher candidate technology integration: For student learning or instruction? *Journal of Digital Learning in Teacher Education*, *31*(3), 93-106.

Coffman, V. G. (2013). *The perceived technology proficiency of students in a teacher education program*. (Doctoral dissertation). ProQuest Dissertations and Theses. (Order No. 3617732, Kent State University).

Cohen, M., & Tally, B. (2004). New maps for technology in teacher education: After standards, then what? *Journal of Computing in Teacher Education*, *21*(1), 5-9.

Collier, S., Weinburgh, M. H., & Rivera, M. (2004). Infusing technology skills into a teacher education program: Change in students' knowledge about and use of technology. *Journal of Technology & Teacher Education*, *12*(3), 447-468.

Corbin, J., & Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Thousand Oaks, CA: Sage.

Council for Accreditation of Educator Preparation (2013). CAEP commission recommendations to the CAEP board of directors. Retrieved from http://caepnet.org/standards/standards/

Cox, S., & Graham, C. R. (2009). Diagramming TPCK in practice: Using and elaborated model of the TPCK framework to analyze and depict teacher knowledge. *TechTrends, 53*(5), 60

Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches*. London: Sage.

Denzin, N.K., & Lincoln, Y. S. (2009). *Qualitative research*. London: Sage. doi: 10.1177/1468794108098034

De Vaus, D. (2013). *Surveys in social research*. Abingdon, United Kingdom: Routledge.

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys: The tailored design method* (4th ed.). Hoboken, NJ: Wiley.

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education*, *42*(3), 255-284.

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education*, *59*(2), 423-435.

Florida Center for Instructional Technology (2005). *Technology integration matrix*. Retrieved from http://fcit.usf.edu/matrix/index.php

Frazier, L., Sadera, W., & Robinson, D. (2012). Teacher candidate technology use: The what and the why. *Society for Information Technology & Teacher Education International Conference*. *2012*(1), 1781-1783.

Gabriel, M. A., Campbell, B., Wiebe, S., MacDonald, R., & McAuley, A. (2012). The role of digital technologies in learning: Expectations of first year university students. *Canadian Journal of Learning & Technology*; *38*(1), 1-18.

Gagne, R. M. (2013). *Instructional technology: Foundations*. Abingdon, United Kingdom: Routledge.

Gao, P., Choy, D., Wong, A. F. L., & Wu, J. (2009). Developing a better understanding of technology-based pedagogy. *Australasian Journal of Educational Technology, 25*(5), 714-730.

Garrett, K. N. (2014). *A quantitative study of higher education faculty self-assessments of technological, pedagogical, and content knowledge (TPaCK) and technology training.* (Doctoral dissertation, The University of Alabama, Tuscaloosa).

Georgina, D. A., & Hosford, C. C. (2009). Higher education faculty perceptions on technology integration and training. *Teaching and Teacher Education, 25*, 690-696.

Glasgow, Y., & Keim, M. C. (2005). Community college psychology faculty uses and attitudes toward computer-assisted instruction. *Community College Journal of Research and Practice*, *29*(7), 547-555.

Goktas, Y**.,** Yildirim, S. & Yildirim, Z. (2009). Main barriers and possible enablers of ICT integration into preservice teacher education programs. *Educational Technology & Society, 12*(1), 193-204.

Graham, C. R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPaCK). *Computers & Education*, *57*(3), 1953-1960.

Gronseth, S., Brush, T., Ottenbreit-Leftwich, A., Strycker, J., Abaci, S., Easterling, W., & van Leusen, P. (2010). Equipping the next generation of teachers: Technology preparation and practice. *Journal of Digital Learning in Teacher Education*, *27*(1), 30-36.

Hersh, E. C. (2013). *Change and challenge: The influence of technology integration in teacher preparation programs*. (Published doctoral dissertation). Manhattanville College, NY.

Hofer, M. (2005). Technology and teacher preparation in exemplary institutions: 1994 to 2003. *Journal of Computing in Teacher Education*, *22*(1), 5-14.

Holland, J., & Holland, J. (2014). Implications of shifting technology in education. *TechTrends*, *58*(3), 16-25.

Howell, D. C. (2011). Chi-square test: Analysis of contingency tables. In Miodrag Lovric (Ed.), *International encyclopedia of statistical science* (pp. 250-252). Heidelberg, Germany: Springer.

Hsu, P. (2012). Examining the impact of educational technology courses on pre-service teachers' development of technological pedagogical content knowledge. *Teaching Education*, *23*(2), 195-213.

Hu, C., & Fyfe, V. (2010). Impact of a new curriculum on pre-service teachers' Technical, Pedagogical and Content Knowledge (TPaCK). In C.H. Steel, M.J. Keppell, P. Gerbic & S. Housego (Eds.), *Curriculum, technology & transformation for an unknown future*. Proceedings ascilite Sydney, 185-189.

International Society for Technology in Education (2007). *The national educational technology standards and performance indicators for students*. Eugene, OR: Author.

Jackowski, M. B., & Akroyd, D. (2010). Technology usage among community college faculty. *Community College Journal of Research and Practice*, *34*(8), 624-644.

Jick, T. D. (1979). Mixing qualitative and quantitative methods: Triangulation in action. *Administrative Science Quarterly, 24*(4), 602-611.

Jones, A., Buntting, C., & de Vries, M. J. (2013). The developing field of technology education: A review to look forward. *International Journal of Technology and Design Education*, *23*(2), 191-212.

Johnson, T., Wisniewski, M. A., Kuhlemeyer, G., Isaacs, G., & Krzykowski, J. (2012). Technology adoption in higher education: Overcoming anxiety through faculty bootcamp. *Journal of Asynchronous Learning Networks*, *16*(2), 63-72.

Kay, R. (2006). Evaluating strategies used to incorporate technology into preservice education: A review of the literature. *Journal of Research on Technology in Education*, *38*, 383–408.

Keller, J. B., Bonk, C. J., & Hew, K. (2005). The TICKIT to teacher learning: Designing professional development according to situative principles. *Journal of Educational Computing Research*, *32*(4), 329-340.

Kim, C., Kim, M. K., Lee, C., Spector, J. M., & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education*, *29*, 76-85.

Kleiner, B., Thomas, N., Lewis, L., & Greene, B. (2007, December). *Educational technology in teacher education programs for initial licensure* (NCES 2008-040). Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Knezek, G., & Christensen, R. (2008). The importance of information technology attitudes and competencies in primary and secondary education. In J. Voogt and G. Knezek (Eds.), *International handbook of information technology in primary and secondary education* (pp. 321-331). New York, NY: Springer.

Koch, A., Heo, M., & Kush, J. (2012). Technology integration into pre-service teacher training. *International Journal of Information & Communication Technology Education*, *8*(1), 1-14. doi:10.4018/j icte.2012010101

Koehler, M. J., Mishra, P., & Yahya, K. (2007). Tracing the development of teacher knowledge in a design seminar: Integrating content, pedagogy and technology. *Computers & Education*, *49*(3), 740-762.

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPaCK)? *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60-70.

Koehler, M. J. & Rosenberg, J. (2014) [Graphic image of TPaCK framework]. Retrieved from http://www.TPaCK.org

Kolikant, Y.B.D. (2010). Digital natives, better learners? Students' beliefs about how the internet influenced their ability to learn. *Computers in Human Behavior, 26*(6), 1384-1391.

Kopcha, T. J. (2010). A systems-based approach to technology integration using mentoring and communities of practice. *Educational Technology and Research Development*, *58*, 1042–1629. doi:10.1007/s11423-008-9095-4

Kopinak, J. K. (1999). The use of triangulation in a study of refugee well-being. *Quality and Quantity*, *33*(2), 169-183.

Kovalik, C., Kuo, C.L. & Karpinski. A. (2013). Assessing pre-service teachers' information and communication technologies knowledge. *Journal of Technology and Teacher Education*, *21*(2)179-202.

Kyei-Blankson, L., Keengwe, J., & Blankson, J. (2009). Faculty use and integration of technology in higher education. *AACE Journal*, *17*(3), 199-213.

Lambert, J., & Gong, Y. (2010). 21st Century paradigms for pre-service teacher technology preparation. *Computers in the Schools, 27*(1), 54-70.

Lei, J. (2009). Digital natives as preservice teachers: What technology preparation is needed? *Journal of Computing in Teacher Education, 25*(3), 87-97.

Mack, N., Woodsong, C., MacQueen, K. M., Guest, G., & Namey, E. (2005). *Qualitative research methods: A data collector's field guide*. Research Triangle Park, NC: Family Health International.

Matherson, L. H., Wilson, E. K., & Wright, V. H. (2014). Need TPACK? Embrace Sustained Professional Development. *Delta Kappa Gamma Bulletin*, *81*(1), 45-52.

Marzilli, C., Delello, J., Marmion, S., McWhorter, R., Roberts, P., & Marzilli, T. S. (2014). Faculty attitudes towards integrating technology and innovation. *International Journal on Integrating Technology in Education*, *3*(1), 1-20.

Mayo, N. B., Kajs, L.T., & Tanguma, J. (2005). Longitudinal study of technology training to prepare future teachers. *Educational Research Quarterly*, *29*(1), 3-15.

McDougall, A., & Jones, A. (2006). Theory and history, questions and methodology: Current and future issues in research into ICT in education. *Technology, Pedagogy and Education, 15*(3), 353–360.

Meijer, P. C., Verloop, N., & Beijaard, D. (2002). Multi-method triangulation in a qualitative study on teachers' practical knowledge: An attempt to increase internal validity. *Quality and Quantity*, *36*(2), 145-167.

Moersch, C. (1995). Levels of technology implementation (LoTi): A framework for measuring classroom technology use [Supplement material]. *Learning and Leading With Technology, 23*(4), 40-42. Retrieved from http://www.iste.org/inhouse/publications/ll/26/8/40m/supplement/index.cfm?Section=LL_23_3

National Association of State Boards of Education (2012). *Born in another time ensuring educational technology meets the needs of students today and tomorrow*. National Association of State Boards of Education. Retrieved from http://blogs.edweek.org/edweek/DigitalEducation/2013/01/a_closer_look_at_teachers_tech_1.html

Niess, M. L. (2011). Investigating TPaCK: Knowledge growth in teaching with technology. *Journal of Educational Computing Research, 44*(3), 299-317.

Onwuegbuzie, A. J., & Collins, K. M. (2007). A typology of mixed methods sampling designs in social science research. *The Qualitative Report*, *12*(2), 281-316.

Ottenbreit-Leftwich, A. T., Brush, T. A., Strycker, J., Gronseth, S., Roman, T., Abaci, S., & Plucker, J. (2012). Preparation versus practice: How do teacher education programs and practicing teachers align in their use of technology to support teaching and learning? *Computers & Education, 59*(2), 399-411.

Paige, R., Hickok, E., Ginsburg, A. L., & Goodwin, D. (2003). *Federal funding for educational technology and how it is used in the classroom: A summary of findings from the integrated studies of educational technology*. Washington, DC: U.S. Department of Education, Office of the Under Secretary, Policy and Program Studies Service.

Parette, H. P., Quesenberry, A. C., & Blum, C. (2010). Missing the boat with technology usage in early childhood settings: A 21st century view of developmentally appropriate practice. *Early Childhood Education Journal, 37*(5), 335-343.

Pellegrino, J., Goldman, S., Bertenthal, M., & Lawless, K. (2007). Teacher education and technology: Initial results from the "what works and why" project. *Yearbook of the National Society for the Study of Education, 106*(2), 52–86.

Pierson, M., & Borthwick, A. (2010). Framing the assessment of educational technology professional development in a culture of learning. *Journal of Digital Learning in Teacher Education*, *26*(4), 126-131.

Polly, D., Mims, C., Shepherd, C. E., & Inan, F. (2010). Evidence of impact: Transforming teacher education with preparing tomorrow's teachers to teach with technology (PT3) grants. *Teaching and Teacher Education, 26*(4), 863-870.

Prensky, M. (2012). In D. Stollenwerk, D. Bartlett, K. Greenberg (Eds.), *From digital natives to digital wisdom.* Thousand Oaks, California: Corwin Press.

Puentedura, R. R. (2009) *As we may teach: Educational technology, from theory into practice*. Retrieved from http://tinyurl.com/aswemayteach

Richardson, J. D. (2012). NETS*A scholarship: A review of published literature. *Journal of Research on Technology in Education* (International Society for Technology in Education), *45*(2), 131-151.

Richardson, G. (2012). What more can we do? Analyzing the impact of preservice teacher technology training on subsequent classroom technology integration. In *Society for information technology & teacher education international conference, 2012*(1), 2386-2392.

Roblyer, M. D., & Knezek, G. A. (2003). New millennium research for educational technology: A call for a national research agenda. *Journal of Research on Technology in Education*, *36*(1), 60-71.

Roblyer, M. D. (2005). Educational technology research that makes a difference: Series introduction. *Contemporary Issues in Technology and Teacher Education*, *5*(2), 192-201.

Rogelberg, S., & Stanton, J. (2007). Understanding and dealing with organizational survey nonresponse. *Organizational Research Methods*, *10*, 195–209.

Saldaña, J. (2015). *The coding manual for qualitative researchers*. Thousand Oaks, CA: Sage.

Salkind, N. J. (2012). *Statistics for people who (think they) hate statistics: Excel 2010 edition*. Thousand Oaks, CA: Sage.

Schmidt, D. S. (2009). Technological pedagogical content knowledge (TPaCK): The development and validation of an assessment instrument for preservice teachers. *Journal of research on technology in education* (International Society for Technology in Education), *42*(2), 123.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15(*2), 4-14.

Sutton, S. R. (2011). The preservice technology training experiences of novice teachers. *Journal of digital learning in teacher education* (International Society for Technology in Education), *28*(1), 39.

Teclehaimanot, B., Mentzer, G., & Hickman, T. (2011). A mixed methods comparison of teacher education faculty perceptions of the integration of technology into their courses and student feedback on technology proficiency. *Journal of Technology and Teacher Education*, *19*, 5–21. Retrieved from http://www.aace.org/pubs/jtate/

Teddlie, C., & Yu, F. (2007). Mixed methods sampling a typology with examples. *Journal of Mixed Methods Research*, *1*(1), 77-100.

Teo, T., Chai, C. S., Hung, D., & Lee, C. B. (2008). Beliefs about teaching and uses of technology among pre-service teachers. *Asia‐Pacific Journal of Teacher Education*, *36*(2), 163-174.

Thomas, T., Herrring, M., Redmond, P., & Smaldino, S. (2013). Leading change and innovation in teacher preparation: A blueprint for developing TPACK ready teacher candidates. *Techtrends, 57*(5)*,* 55-63.

Torre J. (2013) Instructional predictors of students' technology standards. *International Journal of Educational Research & Technology*. *4*(3), 37-41.

Valdez, G., McNabb, M., Foertsch, M., Anderson, M., Hawkes, M., & Raack, L. (2004). *Computer-based technology and learning: Evolving uses and expectations*. North Central Regional Educational Laboratory, Oak Brook, IL.

Wetzel, K., Foulger, T. S., & Williams, M. K. (2008). The evolution of the required educational technology course. *Journal of Computing in Teacher Education*, *25*(2), 67–71.

Wiebe, J. H., & Taylor, H. G. (1997). What should teachers know about technology? A revised look at the ISTE foundations. *Journal of Computing in Teacher Education*, *13*(4), 5-9.

Williams, M. K., Foulger, T. S. & Wetzel, K. (2009). Preparing preservice teachers for 21st century classrooms: Transforming attitudes and behaviors about innovative technology. *Journal of Technology & Teacher Education*, *17*(3), 393-418.

Wilsey, B., & Keengwe, J. (2012). Technology integration curriculum framework for effective program evaluation. *International Journal of Information & Communication Technology Education*, *8*(1), 15. doi:10.4018/jicte.2012010102

APPENDIX A:

ONLINE TPACK SURVEY PROTOCOL

Section 1. Background & Experiences

Instructions: Please select the response that best reflects your current situation.

1) Gender

○ Female ○ Male

2) Current position

○ Assistant Professor ○ Adjunct

○ Associate Professor ○ Full Professor

3) Tenure Status

○ Tenured ○ Non Tenured

4) How many years have you been a full-time faculty member?

5) How many courses do you typically teach per semester?

○ 1 ○ 3

○ 2 ○ 4

Section 2. Frequency of Technology Use Within Courses Taught

For each of the courses you typically teach, please identify how frequently you integrate technology into the course.

6) Course 1: Typical Technology Integration

6a)	Course level	Freshmen ○	Soph ○	Junior ○	Senior ○	Masters ○	Doc ○
6b)	How often does this course typically meet?	3x/wk ○	2x/wk ○	1x/wk ○	Monthly ○	Other (explain) ○	○
6c)	On average, how often do you integrate technology into your classroom courses	Never ○	1x/semester ○	1x/month ○	1x/wk ○	Every class ○	○

If you are teaching an additional course move to #7, if not move to Section 3.

7) Course 2: Typical Technology Integration

7a)	Course level	Freshmen ○	Sophomore ○	Junior ○	Senior ○	Masters ○	Doctoral ○
7b)	How often does this course typically meet?	3x/wk ○	2x/wk ○	1x/wk ○	Monthly ○	Other (Please explain) ○	○
7c)	On average, how often do you integrate technology into your classroom courses	Never ○	1x/semester ○	1x/month ○	1x/wk ○	Every class ○	○

If you are teaching an additional course move to #8, if not move to Section 3.

8) Course 3: Typical Technology Integration

8a)	Course level	Freshmen ○	Sophomore ○	Junior ○	Senior ○	Masters ○	Doctoral ○
8b)	How often does this course typically meet?	3x/wk ○	2x/wk ○	1x/wk ○	Monthly ○	Other (Please explain) ○	○
8c)	On average, how often do you integrate technology into your classroom courses	Never ○	1x/semester ○	1x/month ○	1x/wk ○	Every class ○	○

Section 3. Attitudes concerning the Integration of Technology					
Instructions: Please indicate the extent to which you agree or disagree with the following statements.					
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
9) Teaching and learning change when certain technologies are used.	○	○	○	○	○
10) I know how to be flexible with my use of technology to support teaching and learning.	○	○	○	○	○
11) In certain situations technology can be used to improve student learning.	○	○	○	○	○
12) Content decisions can limit the types of technology that can be integrated into teaching and learning.	○	○	○	○	○
13) I am aware of how different technologies can be used to provide multiple and varied representations of the same content.	○	○	○	○	○
14) I select specific technologies that are best suited for addressing learning objectives in my discipline.	○	○	○	○	○

Section 4. Integration of Technology Practices					
Instructions: How frequently do you engage in the following…					
	Never	Once or twice a semester	Monthly	Weekly	Daily
15) Integrate educational technologies to increase student learning.	○	○	○	○	○
16) Use varied instructional strategies to teach specific curriculum content topics with technology.	○	○	○	○	○
17) Choose from various technology resources depending on the situation.	○	○	○	○	○
18) Incorporate new tools and resources into content and my teaching methods to enhance learning.	○	○	○	○	○
19 My students use technology to access knowledge to improve learning in my class.	○	○	○	○	○

Section 5. Examples of Integration of Technology Practices

20) In the space below please provide a brief example of how you have integrated technology into your current teaching.

21) To what extent do you think that education students are prepared to meet the needs of the 21st century learners upon leaving your class?

22) Could you please share some of the topics and activities from your course that have helped your students develop technology skills?

23) What technology competencies do you think pre-service teachers should have mastered upon graduating?

Thank you for your participation in this survey!

APPENDIX B:

LETTER OF INTRODUCTION AND SURVEY DIRECTION

Hello,

My name is Barbara Martin. I am a graduate student in the School of Teaching & Learning at Illinois State University. I am conducting a research study under the supervision of Dr. Barbara Meyer. The research study will explore the relationship between faculty attitude and perceived level of technology integration in teacher preparation courses.

Participation in this research study is confidential and voluntary, and there is no penalty for non-participation. If you are interested in participating in this study, you may complete the survey by following this link: Should you choose to participate simply click on the link to the survey embedded in the email. If you choose not to participate simply do not click on the link and delete the email. Your participation will last approximately 15 minutes. The survey attached asks that you mark your responses on a scale, and you may provide written comment as well.

This study will benefit the program and potential future programs from the data collected and analyzed to develop a publication and presentations about the program. Further benefits will be realized as we use the data to inform the profession about technology integration and teacher preparation coursework.

There is minimal risk to you should you choose to complete the survey. There is a slight risk of a breach of confidentiality. Another risk would be due to the loss of time while completing the survey. To address these concerns, your responses to the survey will be remain confidential and data will only be shared as a group. By completing the survey, participants are consenting to the participation in the study. Please a copy of the consent form for your records.

If you have questions or concerns regarding your participation in this research, please contact: Dr. Barbara Meyer

If you have questions about your rights in this survey please contact:
Illinois State University Research Ethics & Compliance Office

Thank you in advance for your participation,

Barbara Martin
Graduate Student
School of Teaching & Learning
College of Education
Illinois State University