A QUANTITATIVE STUDY OF HIGHER EDUCATION FACULTY SELF-ASSESSMENTS OF TECHNOLOGICAL, PEDAGOGICAL, AND CONTENT KNOWLEDGE (TPACK) AND TECHNOLOGY TRAINING

by

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ABSTRACT

Growing use of technology in the 21st century, the age of the millennial learners, has introduced instructional challenges for higher education faculty. Technology deficiency is prevalent among the Baby Boomers and Generation X population. Yet, at a growing rate for the millennial population, technology tools are at the forefront of extracurricular and educational activities. This abundance of technology requires faculty to hone their skills in multifaceted approaches to combat technology skill deficiencies within higher education institutions. As a result, it is projected that faculty across all disciplines will become lifelong learners, not only within their specialization, but also with instructional technology tools geared toward enhancing learning (Wetzel, Foulger, & Williams, 2009). However, this is also an indication that higher education administrators need to provide support initiatives that will encourage faculty to enhance their existing pedagogy through the integration of technology (Lye, 2013).

This study assessed the perception of the technological, pedagogical, and content knowledge (TPaCK) of faculty at a southeastern research university using the researcher-developed HE-TPACK instrument (n = 128). HE-TPACK is a valid and reliable revision of the original TPACK instrument that allows the measurement of higher education faculty TPACK. The research described faculty perceptions on each of the eight HE-TPACK domains and determined whether there was a difference in HE-TPACK based on discipline type, gender and academic ranking of the faculty. Descriptive statistics revealed that a majority of all participating faculty agreed with the statements in six domains (technology training, pedagogy knowledge (PK), pedagogy content knowledge (PCK), technological pedagogical knowledge

(TPK), technological content knowledge (TCK), and technological, pedagogical, and content knowledge (TPaCK)) and strongly agreed with statements in two domains (technology knowledge (TK) and content knowledge domains (CK)). This finding indicates that faculty perceive they are knowledgeable in seven HE-TPACK domains and that they believe technology training is important.

A multiple linear regression analysis was conducted to identify differences in HE-TPACK due to educational discipline types, gender and academic rank. Based on academic rank, results revealed significant differences in the pedagogical knowledge (PK), content knowledge (CK), pedagogical content knowledge (PCK), and the technological, pedagogical, content knowledge (TPaCK) domains. There were no differences based on gender and educational discipline types.

The findings suggest that future practice should validate the HE-TPaCK scoring through observations and evaluations. Additional validation would strengthen the understanding of technology integration used by faculty. In addition, the findings suggest that future research evaluate the HE-TPaCK differences between tenured and non-tenured faculty. To improve response rate, future research should seek to reduce the number of items on the HE-TPACK survey by removing items from select domains.

DEDICATION

I dedicate this dissertation to my parents, Nancy K. and the late Arnold L. Garrett, and also my grandparents. This accomplishment is a representation of my gratitude for the trials and tribulations you endured through personal, professional, and educational segregation as imposed by the Jim Crow laws and during the Civil Rights era. In addition, I would like to dedicate this oeuvre to my brothers, Patrick and Douglas Garrett for naming me, Kristi, meaning a follower of Christ, because it is through His guidance that I prevailed.

I am the dream and hope of the slave. I rise. I rise. I rise.

–excerpt from Still I rise poem by Maya Angelou

LIST OF ABBREVIATIONS AND SYMBOLS

a	Cronbach's index of internal consistency
df	Degrees of freedom: number of values free to vary after certain restrictions have been placed on the data
F	Fisher's *F* ratio: a ration of two variances
M	Mean: the sum of a set of measurements divided by the number of measurements in the set
Mo	Mode: the response value that occurs most often
SD	Standard Deviation: the variation measure in mean distribution
p	Probability associated with the occurrence under the null hypothesis of a value as extreme as or more extreme than the observed value
r	Pearson product-moment correlation
t	Computed value of *t* test
<	Less than
=	Equal to

ACKNOWLEDGMENTS

I thank my Creator for allowing me the ability to obtain this Ph.D. After years of running the race as fast as I could, pursuing this Ph.D. forced me to take in the scenery along my racing trail. To my surprise, the scenery has been better than I could have imagined. Like the story of the hare and the tortoise, the race is not about speed, but staying focused, self-motivated, and determined to finish the race.

I also thank my family and friends for cheering me through the race. Many thanks to my racing coach, Dr. Angela Benson, who trained me well. I also thank Dr. Jamie Mills, Dr. Margaret Rice, Dr. Becky Atkinson, and Dr. Claire Major for the support they provided throughout this process. Thanks to professional coaches, Drs. Dennis and Cynthia Sunal, for the numerous opportunities to handle their technology needs for the Office of Research on Teaching in the Disciplines (ORTD). In addition I would thank another professional coach, Dr. Richard Rice, for the opportunity to work with the Alabama Superintendents' Academy as the technology coordinator. Exposure into your fields provided me with a wealth of knowledge that I will continue to apply to future ventures.

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CHAPTER I:

INTRODUCTION

The evolving face of education greatly impacts the need for qualified faculty who cannot only teach, but also develop curriculum with instructional technology tools for use in synchronous and asynchronous courses (Southern Association of Colleges and Schools, 2010a, 2010b). There are vast numbers of instructional technology tools available for educational purposes, yet research by Golde and Dore (2001) has suggested that instructors lack the technical skills to effectively utilize these tools to enhance student learning.

According to Yang and Liu (2004), faculty must become involved in continued learning in order to be more effective teachers. Support mechanisms should be designed for lifelong learners, in this case faculty members, to hone existing skills and develop new knowledge and skills that can be translated into effective learner-centered instructional strategies. However, instructional technology tools have a negative connotation with some faculty members. Some research (Austin, 2003; Hearns & Anderson, 2002; Jones, 2011) has suggested that faculty autonomy, workload, and pedagogical interest are jeopardized when the use of technology as a learning mechanism is introduced.

Technology as instructional mechanisms does not replace the role of the faculty. Instead, it is an integral component to the learning process just as pedagogy and subject content (Golde & Dore, 2001). A challenge of incorporating technology into pedagogy revolves around the need to understand *how and in what* capacity to implement technology as an instructional tool. An initial approach to finding a solution would be to assess the technological knowledge of faculty, which would aid in analyzing the type of academic support necessary for successful implementation of the technology.

This lack of technological skill development traces back to doctoral programs (Austin, 2003; Golde & Dore, 2001), where doctoral students rarely reach beyond the boundaries of their discipline in order to gain exposure to other disciplines for potential collaboration or interdisciplinary knowledge (Golde & Dore, 2001; Stein & Short, 2001). This pedagogical preparation places boundaries on the pedagogical innovativeness of faculty members' ability to enhance student learning.

Since the typical pedagogical boundaries in low and high consensus (educational) disciplines consist of limited technological usage, faculty members are reluctant to develop instructional technology competencies without performance incentives (Austin, 2003; Golde & Dore, 2001). This suggests that the inclusion of instructional technology tools could impose a major change to faculty workload and autonomy. As a result, this highlights the need for academic support for continuous developmental training in addition to performance incentives to encourage the successful implementation of technology with existing pedagogy and content for student learning (Austin, 2003; Golde & Dore, 2001; Mezirow, 1991; Southern Association of Colleges and Schools, 2010b; Trower, Austin, & Sorcinelli, 2001; White & Myers, 2001).

Change to a faculty member's pedagogical routine can be hard to adapt to especially for those who have been teaching the same way throughout their teaching career. Mishra and Koehler (2006), the forefathers of the technological pedagogical content knowledge (TPaCK) framework, and also the theoretical framework for this study, suggested that implementing change to existing pedagogical content knowledge (PCK) with technology should be an interlinking of technology, pedagogy, and content (see Figure 1.1). It is through this interlinking where faculty members will discover new instructional strategies conducive to teaching millennial learners (Mangold, 2007) within low and high consensus (educational) disciplines.

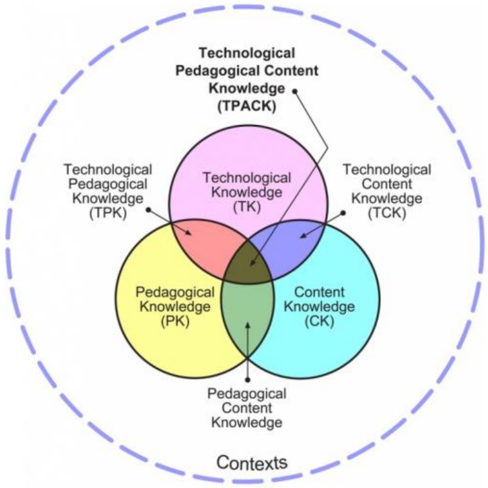

Figure 1. Technological Pedagogical and Content Knowledge Model obtained from www.tpack.org

While faculty within both low and high consensus (educational) disciplines share a common mission for teaching to enhance learning, it is important to note that disciplines vary in technological exposure, knowledge, skills, and self-interest (Mishra & Koehler, 2006; Wetzel, Foulger, & Williams, 2009). In addition, some faculty members within the same discipline or department have cognitive abilities that are not the same as others in the same department or discipline (Clark, 1995; Curry, 1993). Thus, the cognitive ability to execute at higher thinking levels may better equip faculty members to incorporate technology with their existing PCK (Clark, 1995; Curry, 1993; Major & Palmer, 2006-; Mishra & Koehler, 2006; Shulman, 1987).

Viewing faculty members' TPaCK based on low and high consensus (educational) disciplines could expose common connections of technological knowledge (Biglan, 1973a; Clark, 1995; Curry, 1993; Major, & Palmer, 2006; Mishra & Koehler, 2006; Shulman, 1987). With this in mind, other factors, such as areas of faculty interest, rewards and incentives, along with institutional expectations and support carry considerable influence on faculty members' desire and perception of their ability to effectively implement instructional technology into asynchronous and synchronous environments (Biglan, 1973a, 1973b; Clark, 1987; Clark, 1995; Major, & Palmer, 2006; Mishra & Koehler, 2006; Shulman, 1987). Accordingly, continuous education becomes a norm that helps faculty members stay abreast of the latest technology tools, which provides TPaCK growth (Mezirow, 1991; Shysh, 2000) for existing and future faculty members.

Statement of the Problem

Based on findings from the Pew charitable trust report, 41.4% of doctoral students surveyed were interested in incorporating technology into the classroom, 33.5% were confident and comfortable with incorporating technology, but only 14.1% indicated they were prepared by their respective programs to incorporate technology (Golde & Dore, 2001, p.24). This means 52.4% of the doctoral students surveyed felt they were not prepared by their programs to incorporate technology into curricula learning. This finding suggests the need for further investigation into faculty preparation for technology integration.

Purpose of the Study

The purpose of this study was to assess the perception of technological, pedagogical, and content knowledge (TPaCK) of tenured and non-tenure faculty at the main campus of a southeastern research university. More specifically, this study compared and contrasted the technological, pedagogical, and content knowledge (TPaCK) of faculty use of technology tools in asynchronous and synchronous learning environments as methods to enhance student learning (Golde & Dore, 2001) based on educational disciplines, academic ranking, and gender.

Significance of the Study

Recognizing potential gaps between existing PCK and technological, pedagogical, content knowledge (TPaCK) has been highlighted in K-12 settings; however, the same does not hold true for higher education. In higher education, the increased use of technology as instructional tools has created a need for adjustments to Shulman's pedagogical content knowledge (PCK) framework (Shulman, 1987). This shift requires faculty members to effectively integrate technology with their existing PCK. Consequently, this often impedes on faculty members' existing workload, thus resulting in PCK being improperly merged with instructional technology tools.

This study was among the first to evaluate the technological, pedagogical, content knowledge (TPaCK) of faculty members in higher education institutions. It provided faculty members an opportunity to reflect on their technology knowledge as it applies to their existing pedagogical content knowledge (PCK). Due to this study assessing the technological, pedagogical, and content knowledge at a Research I university, the findings should not be considered generalizable to faculty at other higher education institutions.

Results from this study can be used to identify faculty support needs, such as professional development, that could enrich faculty members' understanding of how to effectively integrate technology as an instructional mechanism. In addition, the findings could help researchers and policy makers design studies specific to each discipline, academic ranking, and gender to further assess the environmental and attitudinal impact on TPaCK among faculty. Higher education administrators and policy makers could gain insight into the type(s) of incentives and institutional support that would encourage the use of technology for instructional purposes.

Research Questions

The research questions that this study addressed were as follows:

1. What are faculty self-assessments of TPaCK as measured by the HE-TPaCK survey; and
2. Is there a difference in faculty self-assessments of technological, pedagogical, and content knowledge (TPaCK) based on educational discipline, gender, and academic, as measured by the HE-TPaCK survey?

Methods

This study assessed the technological, pedagogical, and content knowledge (TPaCK) of faculty at a southeastern research university. This study will serve as model that can be used to conduct similar studies at other research universities (Creswell, 2007).

The TPaCK survey, which was developed by researchers, Lux, Bangert, and Whittier (2011), was modified for appropriate use within a higher education setting. The modified version of the original TPaCK instrument consisted of 56 survey items consisting of 49 five-point Likert scale items and seven demographic items. An electronic version of the modified TPaCK (referred to hereafter as HE-TPaCK) survey was used for this study due to the large number of faculty members at the study site using the Qualtrics online system. Data were analyzed and reliability of the modified survey will established using SPSS® version 18 software.

Assumptions

Several assumptions were made in conducting this research. First, it was anticipated that faculty participants provided a true representation of faculty at research universities. Second, the large number of faculty members at this southeastern research university was assumed to be more suitable for a quantitative approach in this study in order to compare and contrast the technological, pedagogical, and content knowledge of faculty use of technology with existing pedagogy and content. Lastly, it was assumed that faculty members provided unbiased and truthful responses (Golde & Dore, 2001).

Limitations of the Study

The following were identified as limitations for this study:

1. This study was limited in scope by the departmental colleges and schools within the unit of analysis in which this study was conducted. The locus of interest at this flagship university did not contain an exhausted array of disciplines that are represented at other research universities;
2. The use of a modified version of the original TPaCK survey could reduce instrument validity due to the technology training section having low validity;
3. Using a quasi-experimental design based on the tenured and non-tenured subgroups may have confounded the results (Finks, 2009). The tenured faculty members may have been more likely to give candid responses, which may have revealed lower TPaCK self-assessment. This could have been due to the assumed relaxed performance expectation from obtaining tenured status. Conversely, the non-tenured faculty members may have exhibited an abnormally higher self-assessment of their TPaCK to overcompensate their true TPaCK as a self-evaluation booster. The tenured and non-tenure subgroups have similar faculty requirements and expectations as related to teaching, research, and service. However, it is important to note that there are differences in their pedagogical knowledge, skills, and abilities in regards to the use of technology; and

4. Convenience sampling posed a limitation due to the dependence on participants' willingness and availability to complete the survey.

Delimitations of the Study

The following were identified as delimitations for this study:

1. This study was limited to only faculty who teach at a four-year flagship university in the southeast. It does not take into consideration faculty at Historically Black Colleges and Universities (HBCUs), land grant universities, two and/or four-year community colleges, private colleges, or for profit institutions; and
2. A large anonymous target population limited the ability to collect data with the same participants from this initial study for future studies. However, providing anonymity increased the probability that participants would provide candid responses without the distress of being identified.

Definition of Terms

Asynchronous refers to any learning environment that is accessible continuously with limited interaction with the instructor. This type of learning environment allows the learner to engage in learning at his/her convenience (Reiser, 2001a, 2001b).

Content Knowledge (CK) is the level of knowledge of a faculty member pertaining to a particular curriculum or discipline (Koehler, 2011).

Heuristic Technological Knowledge refers to the experimental and practical (i.e., trial and error) methods faculty may use to gain knowledge on various technology tools (Lee & Reigeluth, 2003). Faculty members' various levels of background knowledge on technology tools allows them to form educated guesses on how the technology tools can be used to enhance student learning.

High Consensus (Educational) Disciplines are categorized as hard disciplines that involve more practical disciplines. These disciplines are normally task specific based on quantitative based examples and/or models (Biglan, 1973b). The high consensus disciplines at this unit of analysis are applied mathematics, biology, chemistry, computer science, educational research, microbiology, physics, accounting, applied statistics, banking and finance, geology, mathematics, management information systems, operations management, tax accounting, telecommunication and film, aerospace engineering, chemical engineering, civil engineering, computer science, construction engineering, electrical engineering, engineering science and mechanics, environmental engineering, materials/metallurgical engineering, mechanical engineering, metallurgical engineering, and materials science (see Appendix A).

Instructional Technology is the epistemological study of pedagogy and technology. This entails using practical application to promote an effective learning environment based personal and/or professional experiences in conjunction with best practices used in educational and corporate environments (Golde & Dore, 2001).

Low Consensus (Educational) Disciplines are categorized as soft disciplines that generally use pure application to reach an outcome. Therefore low consensus disciplines are not foundationally based on the use of examples, hypothesis, principles and standards (Biglan, 1973b). The low consensus (educational) disciplines at this unit of analysis are African American studies, American studies, anthropology, art history, communicative disorders, creative writing, criminal justice, dance, economics, English, English as a second language (esl), environmental science, foreign language and literature, geography, health care management, history, interdisciplinary studies, international studies, Latin American studies, marine science, music, philosophy, political science, psychology, public administration, religious studies, romance languages, sociology, Spanish, speech language, pathology, studio art, theatre, women's studies, business administration, economics, management, marketing, advertising, advertising and public relations, book arts, communication and information sciences, journalism, library & information studies, public relations, counselor education, community counseling, rehabilitation counseling, early childhood education, educational administration, educational leadership, educational psychology, elementary education, elementary and middle school administration/principalship, higher education, administration, human performance, instructional leadership, music education, school psychology, secondary education, secondary school administration/principalship, special education, interdisciplinary studies, apparel and textiles, athletic training, consumer sciences, early childhood education, food and nutrition, general health studies, health education/promotion, health studies, human development and family studies, human environmental sciences, interior design, restaurant and hospitality management, law, tax law, nursing, and social work (seeAppendix A).

Pedagogical Knowledge (PK) is the level of knowledge of instructional mechanisms used to teach content in effort to enhance student learning (Koehler, 2011).

Pedagogical Content Knowledge (PCK) encompasses the pedagogy and content knowledge levels used to develop effective teaching strategies (Shulman, 1987).

Synchronous refers to a learning environment (i.e., classroom) in which there is a set time, location, and instructor to facilitate the lectures and class activities conducive to student learning (Reiser, 2001a, 2001b).

Technological Content Knowledge (TCK) seeks to use technology knowledge to enhance the content for effective student learning (Farra, 1980).

Technology Knowledge (TK) is the level of knowledge that a faculty member has gained about technology through training or heuristic use (Koehler, 2011).

Technological Pedagogical Content Knowledge (TPaCK) interlinks technology, pedagogy, and content as an inclusive unit for evolving the learning process (Koehler, 2011).

Technological Pedagogical Knowledge (TPK) utilizes technology knowledge to enhance existing pedagogy to enhance good teaching methods (Entwistle & Walker, 2000; Freeman, 2002).

Organization of the Study

This document is organized into five chapters. Chapter I provides an overview for the need to enhance faculty members' TPaCK for continuous learning of strategies to provide effective learning for tech savvy students. Chapter II provides an in depth review of the literature as it pertains to a) faculty expectations and preparation for using emerging instructional technology tools, b) high and low consensus (educational) disciplines in the instructional technology era, c) faculty members' cognitive abilities with technology, d) faculty interest and reward for using technology, and e) TPaCK for K-12 teachers. The research questions and the methodology used to conduct this study are presented in Chapter III. Chapter IV contains the data analysis results for the research questions. Chapter V provides the conclusions, implications, discussion, and further recommendations resulting from this study.

Chapter Summary

In the 21st century, instructional technology tools are rapidly evolving. Yet, the technology knowledge of faculty members has not progressed at the same rate. Accreditation councils support the use of technology to promote student learning. However, research (Golde & Dore, 2001) indicates that some faculty members are not adequately prepared to incorporate technology with their existing pedagogy content knowledge (PCK) (Shulman, 1987) based on limited technology knowledge, technology based training in doctoral programs, faculty support, and professional development.

The implementation of technology requires pedagogical change. Incorporating change is usually a daunting task; however, Mishra and Koehler (2006) suggested that including technology in the pedagogy and content developmental process reduces the resistance to change. The TPaCK assessment allows faculty to self-assess their technological, pedagogical, and content knowledge. A self-assessment as such can enlighten higher education administrators and policy makers of potential areas for improvement in order to enhance overall technological epistemology for all faculty members.

CHAPTER II:

REVIEW OF RELATED LITERATURE

The chapter provides an overview of pertinent literature related to the technological, pedagogical, content knowledge (TPaCK) of faculty members at higher education institutions. This literature review includes (a) an introduction to TPaCK, (b) a synthesis of TPaCK investigations in K-12 schools, (c) a discussion of higher education faculty expectations and preparation for using emerging instructional technology tools, (d) a review of the high and low disciplines in the instructional technology era, (e) a discussion of faculty members' cognitive abilities with technology, and (f) a discussion of faculty interests and rewards for using technology. This review was accomplished using empirical and peer reviewed articles from online journals accessible through the University of Alabama virtual library, Internet sites, and books from the University of Alabama campus libraries.

Introduction to TPaCK

Building on Shulman's (1987) pedagogical content knowledge (PCK) framework, Mishra and Koehler (2006) introduced technological, pedagogical, content knowledge (TPaCK) as a new framework that interconnects a teacher's technology knowledge with pedagogy and content knowledge. The focus of TPaCK is to view technology, pedagogy, and content as all-inclusive components necessary for successful instructional implementation. Considering the technology, pedagogy, and content components of the TPaCK model, each are often viewed separately with limited consideration of interlinking for effective interactivity (Sahin, 2011). These singular components are (Cox & Graham, 2009; Mishra & Koehler, 2006; Schmidt, Thompson, Koehler, & Shin, 2009; Sahin, 2011) as depicted in Figure 1.1. They include

1. Technology Knowledge (TK): This knowledge domain encompasses an array of artistic and scientific approaches used to achieve a desired result. Basic educational technology tools, such as the chalkboard and chalk, have allowed educators to communicate and demonstrate content to students and assess their comprehension of teaching objectives (Koehler, 2011; Koh & Divaharan, 2011; Reiser, 2001a, 2001b). In the 21st century, technology has significantly progressed from rudimentary tools to more robust computerized applications, such as digital projectors and learning management systems (Koehler, 2011; Mangold, 2007; Reiser, 2001a, 2001b). However, the trajectory for transitioning from those rudimentary to more advanced technology often supersedes educators' ability to follow suit;
2. Pedagogy Knowledge (PK): The epistemology of teaching based on personal and professional experiences through observations, reflections, and knowledge sharing (Adler, 2011; Cochran-Smith, & Lytle, 2011; Shulman, 1987; Siegel, 2006) contribute to the teaching methods developed by faculty. This component highly suggests that faculty understand the learning process in order to assist students in constructing new knowledge (Koehler, 2011; Koh & Divaharan, 2011). Faculty with a positive disposition toward teaching will be more apt to explore alternate teaching techniques (Koehler, 2011; Sahin, 2011); and
3. Content Knowledge (CK): The actual curriculum or discipline of expertise serves as the range of knowledge that a majority of faculty members will be most

comfortable (Koehler, 2011; Koh & Divaharan, 2011). Tenured and non-tenure faculty members have been deemed experts in their respective disciplines (Curry, 1993; Smeby, 1996). Therefore, they have constructed a vast understanding of their discipline and research regarding their discipline. As disciplines evolve, faculty members expand their knowledge base through conferences, professional learning communities (Lux, Bangert, &Whittier, 2011; Yang & Liu, 2004), and discipline specific forums and blogs.

The intersections of technology, pedagogy, and content are just as important as each is independently to measure knowledge (Mishra & Koehler, 2006; Sahin, 2011). The intersecting components of the TPaCK model are (Cox & Graham, 2009; Mishra & Koehler, 2006; Niess et al., 2009; Schmidt et al., 2009; Niess, 2011; Sahin, 2011) (see Figure 1.1). They include

1. Pedagogical Content Knowledge (PCK): The interlinking of discipline knowledge and teaching techniques (Shulman, 1987) allows faculty members to select the more appropriate teaching strategies that effectively promotes the content in a manner conducive to learning (Koh & Divaharan, 2011). Faculty members exhibit the *good teacher* [emphasis added] trait geared toward making content more accessible for various cognitive levels (Entwistle & Walker, 2000; Freeman, 2002; Harris & Hofer, 2011; Lux, Bangert, &Whittier, 2011; Niess, 2011). In addition, faculty member are more likely to "post hoc reflect" (van Manen, 1995, p. 6) on teaching outcomes in order to continuously improve their pedagogical practice;

2. Technological Content Knowledge (TCK): The use of technology to enhance content is the central focal point to promote active learning (Farra, 1980). As

discipline experts, faculty members are less inclined to identify technologically enhanced methods to combine with subject content that will transform content into more advanced knowledge for students (Koh & Divaharan, 2011). However, as the familiarity of various technology tools increases, faculty members learn how to intertwine technology and content through heuristic approaches in order to stay abreast of technology advancements (Lee & Reigeluth, 2003; Nickerson et al., 1985; Renkl et al., 2009). Through trial and error, many faculty members are successful at learning the technology, while others struggle to understand how to use the technology to enhance the learning content (Renkl et al., 2009). Based on the Cognitive Load Theory, novice faculty members will require more direction when implementing a new technology into their PCK (Shulman, 1987), therefore supporting the need for technology support and training for all faculty members (Paas, Van Gog, & Sweller, 2010; Renki et al., 2009); and

3. Technological Pedagogical Knowledge (TPK): Good teaching methods are at the forefront of faculty members' pedagogical practice (Entwistle & Walker, 2000; Freeman, 2002; Harris & Hofer, 2011; Koh & Divaharan, 2011; Lux et al., 2011; Niess, 2011) with the inclusion of technology. The epistemological perspective of faculty members is more diverse in identifying new techniques to enhance student learning (Harris & Hofer, 2011; Lieberman & Mace, 2008). Faculty members exhibit an enhanced "pedagogical thoughtfulness" (van Manen, 1995, p. 8) that encourages the continuous development of meaningful learning activities and assessments for active learning.

Although introduced by Mishra and Koehler (2006) as an essential framework to measure and evaluate the technology, pedagogy, and content knowledge of instructors, much debate still revolves around the clarity that teachers have of their TPaCK and the practicality of their knowledge (Rosiek & Atkinson, 2005). With limited research of TPaCK studies in higher education settings, the next section offers a critical view of TPaCK studies in primary and secondary school systems. This approach aims to offer insight into how the framework can be used to promote technologically enhanced pedagogy (Archambault & Crippen, 2009; Harris & Hofer, 2011; Koh & Divaharan, 2011; Lux et al., 2011; Niess, 2011) for learning.

Synthesis of TPaCK Investigations

A number of studies (Mishra & Koehler, 2006; Archambault & Crippen, 2009; Cox & Graham, 2009; Doering, Veletsianos, Scharber, & Miller, 2009; Wetzel, Foulger, & Williams, 2009; Abbit, 2011; Graham, 2011; Harris & Hofer, 2011; Koehler, 2011; Koh & Divaharan, 2011; Lux, Bangert, & Whittier, 2011; Lye, 2013; Niess, 2011; Messina & Tabone, 2012; Kim, Kim, Lee, Spector, & DeMeester, 2013; Rientes, Brouwer, & Lygo-Baker, 2013) have been conducted using the technological, pedagogical, content knowledge (TPaCK) model as the theoretical framework. In the following paragraphs, an overview of common themes is given to establish a pattern of the technological, pedagogical, content knowledge (TPaCK) as it relates to technology use in educational settings. These themes provide insight into the use of the TPaCK framework, which can serve as an instructional model for use in higher education settings. The two themes are 1) promoting good teaching with technology and 2) perspectives on teaching support and technology integration. It is important to note that there was very limited research identified which evaluated the TPaCK of faculty at higher education institutions. Therefore a majority of the research presented in the next sections offer a review of the literature from the K-12 perspective.

Promoting Good Teaching with Technology

Technological pedagogical content knowledge (referred to as TPaCK) (Mishra & Koehler, 2006; Shulman, 1987) is taking traditional instructional strategies to new dimensions. Instead of educators developing curricula then selecting and incorporating the technology, the TPaCK theory interlinks the technology, pedagogy, and content in order to provide an understanding of *how* [emphasis added] the three influence the delivery of the curricula for the learner as diagrammed in Figure 2.1 (Koehler, 2011; Mishra & Koehler, 2006). In regards to epistemological diversity as educators, Siegel (2006) inferred that faculty should be willing to exercise an open-minded approach to instructional development. Thus, broadening their technological knowledge base and increasing instructional strategies.

Morris (2006) stated that the continued evolution of technology challenges the higher education system to be innovative in developing instructional methods for Generation Y learners (also called Millennial Generation and Echo Boomers) reared in the emergence of technology. Technology should be analyzed and implemented based on how it can aid in the understanding of the content. Faculty should evaluate how they will use the technology to enhance learning instead of losing focus on the students' needs, which results in using popular technology that provides limited educational and instructional benefits (Morris, 2006).

With this in mind, the first theme promotes the need for the organization of learning objectives and activities with the appropriate technology tools to enhance student learning. According to Montagu (2001), college instruction needs to address the how, what, why factors in order to aid learners in developing higher order thinking. With this perspective in mind, researchers (Archambault & Crippen, 2009; Harris & Hofer, 2011; Koh & Divaharan, 2011; Lux, Bangert, & Whittier, 2011; Niess, 2011) provide substantial support for the importance of technology being adequately incorporated into instructional planning. The next paragraphs examine the influence of TPACK on promoting good teaching skills with the use of technology.

Harris and Hofer (2011) sought to understand the impact of TPaCK on the instructional planning and the epistemology change through asynchronous TPaCK-based professional development. The participants for the study were seven experienced social studies teachers in secondary schools located throughout the United States. During a five-month training period, data were collected from teacher interviews, lesson plan reviews, and teacher reflections on the integration of technology into instructional planning. The study found that factors, such as, culture, school environment, and socioeconomics influenced teacher knowledge.

Harris and Hofer (2011) also found that the state curriculum requirements and previously used instructional techniques were heavy influencing factors on the type of technology and pedagogy used for various learning activities. One out of the seven teachers expressed technology as a limiting aspect for student learning and pedagogy (Harris & Hofer, 2011). From the pedagogical content knowledge (PCK) domain, there was limited evidence that the other six teachers combined pedagogical methods suitable for the learning needs of the students (Harris & Hofer, 2011). Instead, learning activities were matched to the content with limited evidence that the teachers' technological content knowledge (TCK) was incorporated (Harris & Hofer, 2011) to enhance student learning. However, there was symmetry within the teachers' technological pedagogical knowledge (TPK), thus indicating the participants were able to select instructional tools suitable for their instructional strategies (Harris & Hofer, 2011).

Archambault and Crippen (2009) conducted a study that examined the TPaCK of K-12 teachers who taught online. The "good teaching" principle addressed in this study was the need for teachers to be able to develop an understanding for selecting technology for the appropriate pedagogy and content needs. Using the TPaCK framework, the survey used measured the teachers' knowledge in each domain.

Similar to the Harris and Hofer (2011) study, Archambault and Crippen (2009) found that a majority of the respondents rated their TPaCK knowledge as average in the technology knowledge (TK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological content pedagogical (TCP) domains (Archambault & Crippen, 2009). In the pedagogy knowledge (PK), content knowledge (CK), and the pedagogical content knowledge (PCK) domains, respondents rated their abilities as above average (Archambault & Crippen, 2009). Teachers expressed greater confidence in the pedagogy, content, and the pedagogical content knowledge domains; yet, less confidence in the domains that contained technology as a knowledge component (Archambault & Crippen, 2009).

As Archambault and Crippen (2009) pointed out, social, economic, and political reasons are factors that make teacher preparation increasingly important in asynchronous (i.e., online) environments. These factors would also impact higher education settings, thus allowing for speculation that those same factors may have an imploding effect on the integration of technology any learning environment.

Lux, Bangert, and Whittier (2011) developed a TPaCK survey to assess pre-service teachers. Lux et al. (2011) posited that teacher preparation is deficient in the use of technology for student learning. Some contributing factors that support this deficiency include lack of professional development, limited teacher involvement in the decision making process, personal beliefs regarding pedagogy and technology, and technical mishaps (Lux et al., 2011, p. 416). Lux et al. (2011) suggested that good instruction, previously referred to earlier by Archambault and Crippen (2009) as “good teaching,” involves the “understanding of technological resources that are best suited for enhancing student knowledge and skills related to specific…content” (p. 417). It is inferred that good instructional planning lays the foundation for good instruction.

Lux, Bangert, and Whittier (2011) modified the survey developed by Mishra and Koehler (2006) to measure the TPaCK of 120 pre-service teachers. They found that out of the seven TPaCK domains, there was minimal presence of the technological content knowledge (TCK) domain for the pre-service teachers (p. 422). A suggested contributing factor was that the education emphasis in teacher programs focuses on developing pedagogy and content knowledge (Lux et al., 2011). On the contrary, it is reinforced by the Lux, Bangert, and Whittier (2011) that limited TCK does not indicate a teacher deficiency (p. 427). Instead, it could symbolize an effective teacher education program (Lux et al., 2011), indicating a more blended TPaCK. It was concluded that teacher preparation programs should include the TPaCK framework in order to develop educational programs that include technology with the PCK. This training effort will encourage future teachers to be more cognizant of the rationale they select during instructional planning for using various instructional technology tools (Lux et al., 2011).

Lux, Bangert, and Whittier (2011) stated that strengths, weaknesses, and areas for improvement in K-12 and higher education settings can be obtained from the TPaCK construct (p. 419). This notion is what led Lux et al. (2011) to develop the PT-TPACK survey for pre-service teacher assessments. The aim was to gain better understanding of how to develop effective instructional planning for teacher education programs by evaluating their current knowledge (Lux et al., 2011).

The Lux, Bangert, and Whittier (2011) survey was used as the foundation for the development of the survey instrument used for this study. The results indicated by Lux et al. (2011) revealed that six out of the seven domains significantly emerged during the principal component analysis and factor loading. Based on this lack of emergence from the technological content knowledge (TCK) domain, it was concluded that the lack of teachers' ability to adequately plan instruction of content along with technology was a contributing factor (Lux et al., 2011). Lux et al. (2011) points out that good teaching arises when the learning objectives influence the technology in the TCK domain (p. 423).

Cox and Graham (2009) explained teaching approaches for each of the TPaCK domains. For the pedagogy knowledge, content knowledge, and technology knowledge, Cox and Graham (2009) have inferred that each should aim to combine various learning activities that provide a true representation of the learning objectives using a general approach (Cox & Graham, 2009). For example, the pedagogy knowledge is independent from the content knowledge or technology knowledge used for teaching and vice versa. This means that the teacher executes their pedagogy without consideration for enhancing learning of the content using effective technology.

Cox and Graham (2009) suggested that technology content knowledge (TCK) is independent of pedagogy. Technology pedagogy knowledge (TPK) is independent of content (Cox & Graham, 2009). In the same instance, pedagogy content knowledge is independent of technology (Cox & Graham, 2009). With this in mind, the instructional planning goal is to utilize technology for specific content in TCK and for specific pedagogy strategies in TPK. As a result, the gap is bridged between the three separate domains.

As technology, content, and pedagogy knowledge are intertwined and form new domains, the learning activities reflect a more cognizant approach to good teaching (Archambault &

Crippen, 2009). From the instructional planning perspective of good teaching, the stance on technology pedagogy knowledge (TPK) is that teachers are able to motivate and enhance learning through their instructional style (Cox & Graham, 2009). In addition, as content is represented through the use of technology in the TCK domain, the use of the technology becomes transparent as part of the content (Cox & Graham, 2009).

The technology, content, and pedagogy knowledge permeate the once distinctive borders as teachers become more familiar and comfortable in each of the single domains (Cox & Graham, 2009). An interesting observation from Cox and Graham (2009) is "that elementary teachers have stronger TPK and less TCK while college professors have stronger TCK" (p.69).

Studies by Archambault and Crippen (2009), Harris and Hofer (2011), Lux, Bangert, and Whittier (2011), and Niess (2011) reported that the interlinking of TPaCK for the teacher participants' professional development training assisted them in developing the ability to use technology-based instructional planning to enhance the content, which they reasoned as being a contributing factor to being better teachers. Contrary to this TPaCK stance, the teacher participants in each study did not demonstrate a clear connection on how to use technology as an instructional method for some content, thus opting to not use the technology in their instructional planning.

Niess (2011) provided insight into the TPaCK development of in-service and pre-service teachers that identified types of teacher preparation beneficial to enhancing limited to nonexistent technology knowledge for K-12 teachers. The study (Niess, 2011) indicated that as instructional planning began, it [instructional planning] required strategic thinking from teachers in order to enhance their teaching competency while also enhancing student learning. Niess

(2011) explained that the development of TPaCK should be flexible, thus allowing accommodations for the needs of pre-service and in-service teachers.

Although higher education suffers from the lack of TPaCK research, Lye (2013) conducted a TPaCK study at a private higher education institution in Malaysia. Lye (2013) examined the use of the TPaCK model to aid in online faculty training. Faculty were required to complete at least one training module per year. As a result, faculty participants indicated instructional designing (also referred to as instructional planning) and poor technical support as challenges (Lye, 2013).

From a positive perspective, Lye (2013) reported that faculty participants felt class engagement with the training activities and the encouragement of teamwork were benefits (p. 303). This reiterates the need for readily available faculty support. In addition, Lye (2013) reported that the faculty felt they did not have adequate time to properly implement technology into their instructional designing due to existing teaching loads.

Messina and Tabone (2012) found that higher education institutions serve as an entity that provides scientific support (p. 1018). This indicates the importance of doctoral programs providing training for future faculty that aims to enhance their pedagogical skills with the use of technology. From this study (Messina & Tabone, 2012), results revealed that out of 110 participants the content knowledge (CK), pedagogy knowledge (PK), and pedagogical content knowledge (PCK) had means of 4.53, 4.32, and 4.28 respectively (p. 1021). With a Likert scale of strongly agree = 5 to strongly disagree = 1, this indicates high self-perceived knowledge in those domains. However, the means for technology knowledge (TK) = 2.90, technological content knowledge (TCK) = 3.48, technological pedagogical knowledge (TPK) = 3.53, and technological pedagogical content knowledge (TPaCK) = 2.88 (Messina & Tabone, 2012, p.

1021). These means indicate relatively mediocre self-perceived knowledge associated with the use of technology.

With the concept of universities severing as scientific supporters (Messina & Tabone, 2012, p. 1018), it is important to highlight that existing faculty have practical knowledge that they have gained through pedagogical experience (Cochran-Smith & Lytle, 2011, p. 255). Yet a growing number of faculty lack the technological experience to hone their pedagogical skills for 21st century learners. Results from the Messina and Tabone (2012) study indicated that *only* [emphasis added] 30% of the participants had assisted in the integration of pedagogy, technology and content (p. 1022).

Messina and Tabone (2012) concluded that there is not a one size fit all instructional planning guide when it comes to integrating technology with pedagogy and content. Instead, teachers should learn to be flexible with instructional goals by trying different instructional tools in order to expand their overall TPaCK (Messina & Tabone, 2012). As a result, this approach should foster good teaching principles.

Although not TPaCK specific, what is known about instructional planning in higher education, according to Ausband (2006), suggests that instructional planning is an interdepartmental effort that allows all roles to become more knowledgeable in integrating technology into curriculum. In doing so, colleges and universities would need to re-evaluate their instructional technology and curriculum design programs in order to properly prepare students and close the gap between curriculum and technology (Ausband, 2006).

Perspectives on Teaching Support and Technology Integration

In some of the studies addressed above (Harris & Hofer, 2011; Messina & Tabone, 2012; Lye, 2013), there were also perspectives shared from study participants and researcher observations that played a pivotal role in teachers' integration of technology. For instance in the higher education TPaCK study, Lye (2013) concurred that "there is no single technolog[ies] (sic) solution that can be applied to every academic staff, every subject, or even every teaching and learning methods" (p. 296). In this instance, the lack of support from the higher education administrators when trying to obtain the necessary instructional technology (Lye, 2013, p. 304) can negatively impact faculty attitudes.

Participants from the Messina and Tabone (2012) study initially indicated that they believed all teachers generally have solid knowledge of the teaching process (p. 1025). However, when asked to evaluate their ability to teach with technology, the participants indicated low confidence when connecting technology with content and pedagogy (Messina & Tabone, 2012, 1023). It is important to note that during the technology training in this study, teachers felt encouraged through teamwork and collaboration with other teachers (Messina & Tabone, 2012).

Graham (2011) introduced an interesting observation that suggests that technology integration is often fused as the combination of technological pedagogical knowledge (TPK) and technological pedagogical and content knowledge (TPaCK) (p. 1958).   This evolved from the field of educational technology where technology knowledge (TK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPaCK) focused on the technical skills necessary for content and pedagogy application (Graham, 2011). Graham's (2011) observation highlights how different perspectives are generated from the combinations of technology, content, and pedagogy knowledge.

Graham (2011) proposed that there are two perspectives on viewing TPaCK growth. The first perspective considers the increase in a teachers' overall TPaCK as evidence of teaching growth (Graham, 2011, p. 1957). The second considers an increase in *any* [emphasis added] of the domains as evidence of teaching growth (Graham, 2011, p. 1957). These teaching growth perspectives leaves room to ponder which perspective is viable.

Graham (2011) implied that the individual domains should be distinguishable from TPaCK. As a result, Graham's (2011) research cited that Lux (previously mentioned) has been among the few researchers to establish acceptable discriminant validity (p. 1957). Distinguishable domains would allow faculty to identify strengths and weaknesses in each domain. It would also assist faculty in determining where their technology knowledge is better intertwined with their pedagogy and content. According to Graham (2011), it would be beneficial for university instructors and teachers to know "whether it is more or less effective to move from TPK to TPCK or just to begin with TPCK (p. 1959).

Niess (2011), along with Koh and Divaharan (2011) suggested that the interconnecting of circles shown in the TPaCK model (see Figure 2.1) is blurred instead of having distinctive lines that encircle each domain. The encircled connection between technology, pedagogy, and content is different for pre-service and in-service teachers (Niess, 2011, p. 305). In-service teachers have gained instructional and content knowledge experience, whereas pre-service teachers are in the learning process in their educational program (Harris & Hofer, 2009). As a result, it is expected for pre-service and in-service teachers to have different attitudes and perspectives, likewise for higher education faculty and future faculty.

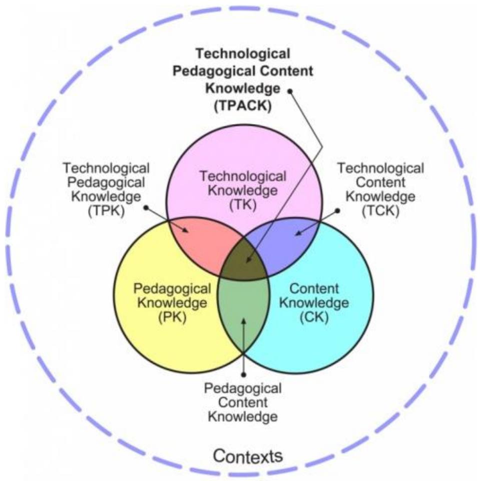

Figure 2. Technological Pedagogical and Content Knowledge Model obtained from www.tpack.org

Recognizing that in-service teachers' pedagogy content knowledge (PCK) has taken shape through education and teaching experiences, Niess (2011) explained that as teachers are exposed to technology resources, their PCK is refined into TPaCK. This represents the need for blurred circles between technology, pedagogy, and content. Through this merge, Lux et al. (2011) and Niess (2011) pointed out that professional development programs allow teachers with varying teaching experience to better communicate their new or enhanced TPaCK.

Koh and Divaharan (2011) conducted a study with seventy-four (74) K-12 online teachers using a three-phase TPaCK process (Niess, 2011) called TPaCK-Developing Instructional Model. In this study, Koh and Divaharan (2011) mentioned that the TPaCK development process requires change in teachers' attitude, increase in technology competency, and creative pedagogical knowledge. The TPaCK process described by Niess (2011), Koh and Divaharan (2011, p. 36) addressed the need for teachers to develop acceptance of the technology, while enhancing their technology proficiency, and learning adequate technology integration methods.

It is in the beginning phase of TPaCK development where pedagogical methods used in teacher professional development encourages positive change in the attitudes of the teachers (Koh & Divaharan, 2011). In addition, teachers' technology competency is deemed essential in order to develop an acceptance of the technology (Lux, Bangert, & Whittier, 2011; Koh & Divaharan, 2011). As teachers continue to use technology within their instructional strategies, their personal observations using the technology tools supports the development of self-confidence and promotes the development of other innovative uses. As the technology knowledge became more proficient in phases 2 and 3, teachers were able to explore new learning strategies that foster a student-centered atmosphere (Koh & Divaharan, 2011).

The research of Koh and Divaharan (2011) has supported the notion that as the confidence of teachers' increases, motivation to use technology with existing pedagogical and content knowledge is more probable, which establishes the interlinking of the TPaCK domains. The teacher participants from the study revealed that the TPaCK development training was beneficial due to peer interaction and knowledge sharing (Koh & Divaharan, 2011). Secondly, the participants explained that their increased technological competency from the training was a contributing factor to the enhancement of their pedagogy (Koh & Divaharan, 2011).

Pajares (1992) stated that a person's behavior is greatly influenced by his/her beliefs (p. 326). With this in mind, it is important to note that faculty have preconceived beliefs about their ability to effectively integrate technology with their existing pedagogy and content. In K-12 settings, Parjares (1992) reported that "… educational beliefs of preservice teachers play a pivotal role in their acquisition and interpretation of knowledge and subsequent teaching behavior and that unexplored entering beliefs may be responsible for the perpetuation of antiquated and ineffectual teaching practices (p. 328). From this perspective, it is evident that faculty in higher education settings contribute to the beliefs of pre-service teachers and doctoral students.

Kim, Kim, Lee, Spector and DeMeester (2013) also addressed the teacher beliefs regarding technology integration (p. 82). Their study stated professional development and continued support plays an integral part in effective technology integration (Kim et al., 2013). Even with solid TPaCK, adequate support is vital because teachers have varying knowledge of how to effectively integrate technology (Kim et al., 2013, p. 76). As a result, depending on the teachers' beliefs regarding the effectiveness of teaching with technology impacts their teaching behavior (Kim et al., 2013).

Results from the Kim et al. (2013) study indicated a significant correlation between teacher beliefs and technology integration, but not the actual causation of the relationship (p. 82). Researcher observations revealed that the actual teacher practices also correlated to their beliefs (Kim et al., 2013, p. 81). In order to foster change in teacher beliefs, Kim et al. (2013) suggested "we ought to allow experience that can be built up to challenge teachers' current beliefs but ultimately optimize their beliefs for student learning" (p. 82). Collaboration with other teachers through networking, technology integration practice and reflections will encourage new beliefs to be formulated (Kim et al., 2013, p. 83).

Continuous technology integration support encourages incremental change to teacher beliefs (Kim et al., 2013). However, as Kim et al. (2013) pointed out, trainers and practitioners should be cognizant of the current needs of teachers in order to change the mindset regarding technology integration (p. 83). This requires active involvement and support from the school administrators to make decisions on the appropriate technologies (Kim, Kim, Lee, Spector, & DeMeester, 2013).

Based on Parjares' (1992) perspective of teacher beliefs and behaviors, higher education faculty with an interest in cultivating their pedagogy by integrating various forms of technology are fostering an interest in technology integration for their students (i.e., pre-service teachers). On the other hand, faculty with minimal interest in integrating technology into their pedagogy are limiting students' exposure to necessary technical skills. Abbit (2011, p. 134) concurred with Pajares' (1992) statement that "knowledge and beliefs are inextricably intertwined" and that "beliefs are instrumental in defining tasks and selecting the cognitive tools with which to interpret, plan, and make decisions regarding such tasks" (p. 325).

Abbit (2011) examined the relationship of pre-service teachers' TPaCK and self-efficiency of integrating technology. Abbit (2011) determined that attitudes and beliefs influence the behaviors and decisions of teachers. Abbit (2011) indicated that having technology knowledge does not guarantee teacher confidence when integrating with pedagogy and content knowledge. Instead, depending on the teacher's success with implementing the technology in conjunction with the level of effort needed to complete the instructional goal is a major impacting factor on their attitudes (Abbit, 2011, p.136).

Participants were given a pre- and post- assessment that allowed them to self-assess their self-efficiency and TPaCK (Abbit, 2011). Results indicated that TPaCK and self-efficiency did increase between the pre- and post- assessment (Abbit, 2011, p. 139). In addition, the TCK domain had the largest increase and the TK domain had the smallest increase (Abbit, 2011, p. 139). From the post-assessment, there were strong correlations between self-efficiency and the PK, TK, TCK, TPK, and TPaCK domains (Abbit, 2011, p. 139).

Doering, Veletsianos, Scharber, and Miller (2009) conducted a TPaCK-based program for eight (8) in-service teachers to examine how online professional development impacted the participants TPaCK. Teachers were given a pre- and post-TPaCK survey to self-assess their knowledge domains (Doering et al., 2009). Results indicated that the participants' self-assessments changed between the pre- and post- survey (Doering et al., 2009). Doering et al. (2009) indicated that there was a majority of positive changes in domain knowledge, with the exception of some negative changes (p.330). The positive domain changes occurred in the technology knowledge (TK) and the technological content knowledge domains (TCK) (Doering et al., (2009). It is interesting to note that three out of the eight participants indicated a decrease in their pedagogy knowledge (Doering et al. 2009).

Teacher interviews revealed that the teachers felt empowered and more confident with the on-site support that they received during the professional development (Doering, Veletsianos, Scharber, & Miller, 2009, p. 330).   For those teachers whose self-perception decreased in the pedagogy knowledge (PK) domain indicated that their understanding of the technology did not enable them to teach with the technology. Doering et al. (2009) indicated that the professional development training provide an opportunity to enhance the coalescing of the technology, pedagogy, and content domains. However, awareness of existing knowledge prepares teachers to better plan technology integration, especially with professional development support (Doering et al. 2009).

In another online professional development study for higher education faculty, Rientes, Brouwer, and Lygo-Baker (2013) used the TPaCK model and Teacher Beliefs and Intentions survey to gain an understanding of beliefs and intentions toward professional development training. Rientes et al. (2013) found that professional development needs to be embedded into the daily practices of faculty as a way of impacting their beliefs (p. 123).

In the Rientes et al. (2013) study, there were 73 participants who completed the pre- and post- test and results revealed that participants did increase their daily practical use of technology, content, and pedagogy skills developed in training toward a teacher-centered approach. However, the participants were not convinced that some of the teaching styles covered in training improved knowledge transmission between faculty and students (Rientes et al., 2013, p. 129).

The participants also indicated that the professional development gave them more confidence to integrate and balance technology along with content and pedagogy (Rientes, Brouwer, & Lygo-Baker, 2013, p. 127). Rientes et al. (2013) stated that demonstrating the impact of professional development is a challenge. However, like Doering et al. (2009), Rientes et al. (2013) advocated the need for professional development that allows higher education faculty continued support after the completion of training (p. 125).

Wetzel, Foulger and Williams (2009) highlighted the importance of faculty staying abreast of new technologies in order for pre-teachers to learn the importance of learning new technology innovations. The researchers (Wetzel et al., 2009) pointed out the importance of becoming lifelong learners for pre-service teachers, especially with integrating technology (p. 68). Wetzel et al. (2009) used adopted the communal constructivism pedagogical approach that involved student collaborations in order to create new knowledge (p. 68). This approach allows students to cultivate their own understand that is beneficial to their pedagogical style (Wetzel et al., 2009).

Using the TPaCK framework as a guide, participants worked in small groups and each person was given a technology to learn and teach to their group (Wetzel, Foulger, & Williams, 2009). This approach allowed the participants to explore new methods of teaching with the technology tools in addition to becoming experts of the tool (Wetzel et al., 2009). The participants also used social networking tools to discuss and share their new knowledge that encouraged communication beyond the classroom, thus furthering their use of instructional technology tools. A large majority (94.7%) of the participants felt strongly that the small group learning was beneficial (Wetzel et al., 2009).

Participants indicated that they felt comfortable within the small groups and enjoyed the challenge of helping each other learn the technology tools (Wetzel, Foulger, & Williams, 2009). Although the social networks that were created and used to share information was embraced, the participants had not considered continued use of those tools *after* [emphasis added] the completion of the training (Wetzel et al., 2009). This perspective is evident that teacher education and doctoral programs need to address the importance of lifelong learning as new instructional technology tools evolve.

Shiue (2007) examined how instructional technology effects motivation, self-efficacy, collaboration, and knowledge sharing among K-12 teachers. The teachers in this study felt that instructional technology lacked usefulness and ease of use to incorporate into teaching strategies due to inadequate training that could have a positive effect on the teacher's perception and attitude. A five-point scale survey was used to measure the teachers' perception of usefulness, ease of use, and behavioral intentions to use instructional technology in their classes. Results showed that professional development did not have a major influence on the attitudes of teachers (Shiue, 2007). It was implied that professional development geared toward improving the ease of use and the attitude of teachers should provide practical application of instructional technology strategies that will give teachers an opportunity to build their skills (Shiue, 2007).

Abbit's (2011) study sparked the interest for this study to examine how technology training impacts faculty TPaCK. As previously mentioned, the TPaCK portion of the survey was revamped from the Lux et al. (2011) study. Since training and support recurred throughout the literature, the survey for this study was also designed to allow participants to self-assess the technology training provided at their higher education institution. To construct the technology training section of the survey, the survey developed by Georgina and Olson (2008) was used as the foundation.

With the influx of new technology in higher education settings, Georgina and Hosford (2009) indicated that the focus has been on the hottest technology tools on the market, yet there is limited to nonexistent attention to quality faculty training to properly use tech tools. Georgina and Hosford (2009) stated that there has been an assumption that faculty are equipped with incorporating technology with their pedagogy.

According to Georgina and Olson (2008), technology literacy is defined as the ability to "design, develop, control, use and assess technological systems and processes" (p. 1). As it relates to faculty, there are no guidelines on how to assess the quality of technology proficiency (Georgina & Olson, 2008). As a result, Georgina and Hosford (2009) pointed out that "faculty must be trained in the use of [technology] tools—not just given access to the tools" (p. 690).

Georgina and Hosford (2009) acclaimed the effectiveness of peer-to-peer training, which allows faculty to share instructional strategies with other faculty. Georgina and Hosford (2009) also suggested that "individual departmental cultures should be considered before training begins" (p. 691). This suggests that technology training is better received among faculty with common disciplines (Georgina & Olson, 2008, p. 2).

Georgina and Hosford (2009) reiterated that the use of technology during elementary school years increases the need for faculty to enhance their pedagogy with technology for millennial learners (p. 695). Using an online survey, results from the Georgina and Hosford (2009) study revealed that only 7.2% of the participants attended training sponsored by their university, which can probably be attributed to the preference to use traditional classroom teaching with limit or no use of technology. Georgina and Hosford (2009) stated that faculty should be included in the decision making process regarding technology selections and academic recognition, such as promotions and tenure considerations (p. 691). Also, university support in the form of reduced teaching loads would also free up time for faculty to participate in training (Georgina & Hosford, 2009).

Introduced by Mishra and Koehler (2006) as an essential framework to measure and evaluate the technology, pedagogy, and content knowledge of instructors, much debate still revolves around the clarity of the TPaCK of teachers. This synopsis of good teaching through TPaCK offers insight into how the framework can be used to promote technologically enhanced pedagogy with the use of faculty support (Archambault & Crippen, 2009; Harris & Hofer, 2011; Koh & Divaharan, 2011; Lux et al., 2011; Niess, 2011).

Faculty Expectations and Preparation for Instructional Technology Use

Now transitioning attention to higher education, the literature highlights the profound dilemma of the lack of faculty preparation that begins while faculty members are in doctoral programs (Austin, 2003; Golde & Dore, 2001; Lux, Bangert, &Whittier, 2011). Doctoral students rarely reach beyond the boundaries of their discipline in order to gain exposure to other disciplines for potential collaboration or interdisciplinary knowledge (Archambault & Crippen, 2009; Golde & Dore, 2001; Stein & Short, 2001) that can diversify their teaching and scholarship competencies. In a report initiated by the PEW charitable trust (Golde & Dore, 2001), nearly half of the doctoral students surveyed indicated that they would have considered taking classes external to their disciplines. This signifies a potential need for higher education institutional programs to strongly encourage doctoral students to venture into other disciplines that would be beneficial in faculty roles and lead to potential career advancement (Archambault & Crippen, 2009; Stein & Short, 2001). One major discipline that can be highly beneficial for faculty is exposure to instructional technology. However, with the existing workload expectations of faculty, there is a limited margin of time to accommodate pedagogical alterations (Golde & Dore, 2001; Harris & Hofer, 2011).

Like faculty scholarship and research initiatives, incorporating technology into teaching requires guidance and continuous practice in order to improve those skills. Based on the survey results of doctoral students in the PEW charitable trust report, 41.4% were interested in incorporating technology into the classroom, 33.5% were confident and comfortable with incorporating technology, but only 14.1% (Golde & Dore, 2001, p.24) indicated they were prepared by their respective programs to incorporate technology (Archambault & Crippen, 2009; Koh & Divaharan, 2011). This means 52.4% of the doctoral students surveyed felt they were not prepared by their programs to incorporate technology into curricula learning, which significantly implies the need for academic support to aid in fostering practical opportunities for novice and experienced faculty to hone their technological skills.

Instructional technology tools are not within the normal pedagogical boundaries of many disciplines; therefore, the use of these tools should be incorporated into departmental expectations established for non-tenure and tenured faculty. However, departmental leaders should be cognizant of the possibility that faculty may sense a loss of autonomy in selecting instructional styles for use in asynchronous and synchronous environments (Austin, 2003). Thus providing clarity and sufficient feedback of expectations is critical for the professional development of non-tenure and tenured faculty (Archambault & Crippen, 2009; Austin, 2003; Lux, Bangert, & Whittier, 2011; Niess, 2011).

The Distance and Correspondence Policy developed by the Southern Association of Colleges and Schools (SACS) (2010a) provides guidelines for educational institutions geared toward the evaluation and professional development (Archambault & Crippen, 2009; Lux et al., 2011) of faculty who design, develop, and teach using asynchronous environments. This governing body recognizes the importance of technologically qualified faculty. With that said, antiquated academic policies and expectations may need to be revamped in order for non-tenure and tenured faculty to achieve professoriate success as technology tools are used for teaching purposes (Trower, Austin, & Sorcinelli, 2001).

In addition to the distance education guidelines, the SACS Best Practices Policy (2010b) contains a section on faculty support that revolves around these premises: 1) are there continuous technological-based training programs provided to faculty; 2) are pedagogical changes evaluated when technology tools are integrated; and 3) are resources available to assist faculty in becoming proficient in the use of technology? This external body (Southern Association of Colleges and Schools, 2010a, 2010b) has identified the necessity of qualified faculty to effectively teach using instructional technology tools. In order to maintain accreditation from agencies such as SACS, higher education institutions are held accountable for ensuring these guidelines are met. However, the PEW charitable trust report (Golde & Dore, 2001) indicates a lack in technological training in doctoral programs, which allows for speculation that a majority of existing faculty have not received adequate technological training (Archambault & Crippen, 2009; Lux et al., 2011; White & Myers, 2001). Therefore, the accountability factor enforced by the accreditation agencies on the higher education institutions is extended to its faculty members to interlink technology tools and the existing pedagogy as the new best practice to effective learning in the 21st century.

Hicks (2006) and Sahin (2011) suggested that educational institutions hold faculty responsible for integrating instructional technology tools into their pedagogy. However, this level of accountability on faculty would require academic support for continuous developmental training geared toward the successful implementation of technology with existing pedagogy and content for student learning (Austin, 2003; Golde & Dore, 2001; Harris & Hofer, 2011; Mezirow, 1991; Southern Association of Colleges and Schools, 2010b; Trower et al., 2001; White & Myers, 2001). The academic support and training provided to faculty should aim to actively engage faculty members in order to foster acceptance of change for technology advancement (Archambault & Crippen, 2009; Niess, 2011; Koh &Divaharan, 2011; White & Myers, 2001).

In effort to reduce resistance to change, Niess (2011), Koh and Divaharan (2011), and White and Myers (2001) have suggested including faculty members in the change process positions them as change facilitators. As instructional technology tools become more prevalent in higher education institutions, support and training that provides constructivist based learning opportunities will allow knowledge sharing with peers (D'Andrea, 1999; Hein, 1996; Modla & Wake, 2007; Ruey, 2009; Stes, Coertjens, & Van Petegem, 2010). This form of faculty learning community promotes active learning and allows faculty to share their heuristic experiences with technologically enhanced pedagogy (Lee & Reigeluth, 2003; Nickerson, Perkins, & Smith, 1985; Renkl, Hilbert, Schworm, 2009).

Research has suggested there should be a noticeable increase in the learning process from the faculty perspective, in order to deem instructional technology tools beneficial from the perspective of faculty members (Harris & Hofer, 2011; Sahin, 2011). This could motivate faculty to use alternate teaching strategies that utilize technology tools (Koh & Divaharan, 2011). During this process, the interest level of faculty could potentially increase, thus increasing the likelihood that faculty will seek additional opportunities to implement technology with content and existing pedagogy (Major, & Palmer, 2006).

In primary and secondary education systems (often referred to as K-12), in-service training reveals that technology training is often provided for teachers separately from pedagogy and content training (Sahin, 2011; White & Myers, 2001). TPaCK pioneers, Mishra and Koehler (2006) along with researchers Harris and Hofer (2011), have strongly advocated that technology, pedagogy, and content are *not* independent components in the teaching process, but instead should be viewed inclusively as a systematic unit. With this systematic unit, faculty members could benefit from instructional and technology planning to help identify essential technology criteria geared toward effective student learning (Harris & Hofer, 2011; National Education Association of the United States, 1999; Newby, Stepich, Lehman, & Russell, 1996; Niess, 2011).

Instructional technology tools provide alternate methods to visually demonstrate ideas and concepts discussed in class (Newby et al., 1996). This visual demonstration could be as simple as using Microsoft PowerPoint and concept mapping software or as advanced as creating video demonstrations (Ellington, Gordon, & Fowlie, 1998; Jones, 1980). Nonetheless, these tools allow the instructor to validate the learning concept for the student (Niess, Ronau, Shafer, Diskell, Harper, Johnston, Browning, Ozgun-Koca, & Kersaint, 2009) while enhancing their pedagogical techniques (Major & Palmer, 2006).

Niess (2011) stated that one approach to promoting the use of instructional technology tools in conjunction with pedagogy and content would be for faculty members to re-learn the content using technology. However with heavy demands on teaching, research, and service (Association of American Universities, 2010), faculty members do not have sufficient time to re-learn content using technology. An alternate solution would be constructivist (or hands-on) training and tech support that would allow faculty to build on their existing content and pedagogy knowledge with the use of technology (Hein, 1996; Khine & Fisher, 2003; Major, & Palmer, 2006; Ruey, 2009). This hands-on approach would support the development of a strategic thinking process that could assist in addressing the *how and when* questions to identify the appropriate technology for the teaching and learning objectives (D'Andrea, 1999; Niess, 2011).

Given the likelihood that instructional technology tools will remain a prevalent educational component suggests the increased probability of faculty members evolving into lifelong learners (Jarvis, 2001; Merriam, 2008; Shysh, 2000). Continuous learning in this capacity should afford some degree of latitude for faculty members to select instructional technology tools that are of interest to them (Nickerson et al., 1985). This would allow faculty to identify technology appropriate for various teaching opportunities, thus increasing their interest in constructivist and heuristic approaches to enhance TPaCK (D'Andrea, 1999; Hein, 1996; Khine & Fisher, 2003; Lee & Reigeluth, 2003; Nickerson et al., 1985; Renkl, Hilbert, Schworm, 2009; Ruey, 2009).

Review of High and Low Consensus (Educational) Disciplines in the Instructional Technology Era

Although higher education institutions eagerly promote the use of trendy instructional technology tools, such as learning management systems for asynchronous learning or digital projectors for synchronous learning, this does not guarantee that *all* faculty share the same enthusiasm (Austin, 2003). Secondly, not *all* faculty have the same technological knowledge, skills, and abilities necessary to effectively deliver learning in either asynchronous or synchronous environments (Mishra & Koehler, 2006; Wetzel, Foulger, & Williams, 2009). Faculty members within higher education institutions share a common connection that revolves around teaching, research, and service (Association of American Universities, 2010) across all disciplines. However, research (Biglan, 1973a) has suggested that no investigation has been conducted on the cognitive differences of TPaCK between low and high consensus (educational) disciplines.

Biglan (1973a; 1973b) categorized academic disciplines based on paradigms, social connection of the discipline to research and teaching, and contribution to the system of life. Biglan (1973a) stated that each discipline falls within one of these categories. As it relates to teaching and research activities, Biglan (1973a) stated that faculty in high consensus disciplines collaborate more with other faculty members, whereas faculty in low consensus disciplines demonstrated a greater preference in pedagogy (Biglan, 1973a). Biglan's (1973a; 1973b) research on the differences among disciplines highlights the existence of distinctions between disciplines opposed to lumping disciplines together, which could introduce fallacies of data results.

The TPaCK research in K-12 settings consisted of assessments by teachers who taught subject content from each area of Biglan's categorization schema. For the high consensus areas, assessments were done on teachers from mathematics and science areas, whereas from low consensus areas, teachers from literacy and social studies area were assessed (Biglan, 1973a; 1973b; Schmidt, Baran, Thompson, Koehler, Mishra, & Shin, 2009). Shifting the use of the TPaCK survey into higher education settings, group distinctions based on high and low consensus (educational) disciplines will unmask differences that could provide insight into the types of support and incentives to promote the use of technology as instructional tools (Biglan, 1973a; 1973b). This supports the need for the continuation of research done with group distinction.

Faculty in low consensus disciplines are a prime example of those who could *potentially* have limited technological ability but have a strong interest in incorporating technology into existing pedagogy (Biglan, 1973a, 1973b; Clark, 1987; Smeby, 1996; Wetzel et al., 2009). Faculty in high consensus disciplines could potentially have more technological ability but lack interest (Biglan, 1973a, 1973b; Clark, 1987; Smeby, 1996; Wetzel et al., 2009). This leaves room to speculate that institutional incentives and support would be motivation for faculty members across both low and high consensus disciplines who may exhibit a combination beliefs and behaviors (Pajares, 1992; Jones, 2011; Koh & Divaharan, 2011).

Low consensus disciplines (i.e. soft disciplines), according to Biglan (1973b), consist of subjective based (Gorsky, Caspi, Antonovsky, Blau, & Mansur, 2010) subject matter for pure application, such as social sciences, mathematics, languages, history, philosophy, and physical sciences. Disciplines that are considered "soft" are generally non-paradigm related or not foundationally based on the use of examples, hypothesis, principles and standards (Biglan, 1973b). Faculty members in soft disciplines are generally focused on student development geared toward active and deep student learning (Harris & Hofer, 2011; Jones, 2011). Therefore, their pedagogical preference would possibly consist of strategies that encourage a student-centered environment where technology tools could promote active learning (Freeman, 2002; Harris & Hofer, 2011; Koh & Divaharan, 2011).

The objectives of low consensus disciplines revolve around the Knowledge and Comprehension domain levels (with some cross referencing into Application domain from Bloom's taxonomy) of student learning (Atherton, 2005; Clark, 1995; Gorsky et al., 2010; Harris & Hofer, 2011; Krathwohl, 2002). This entails constructing meaning and understanding of subject matter. The communication mediums for building knowledge in these disciplines can take the form of rudimentary tools, such as dry erase boards, to more advanced tools, such as digital projectors and online environments (Gorsky et al., 2010).

Faculty members from low consensus disciplines are more likely to explore a variety of instructional technology tools to aid in creating an active learning environment in order to promote higher order thinking based on Bloom's taxonomy (Clark, 1995). Their good teaching practices (Entwistle & Walker, 2000; Freeman, 2002; Harris & Hofer, 2011; Lux, Bangert, &Whittier, 2011; Niess, 2011) incorporated with technology could potentially sustain their interest while also allowing them to maintain autonomy (Austin, 2003) and gain a broader repertoire of technology enhanced pedagogy (Norton, Richardson, Hartley, Newstead, & Mayes, 2005). As a result, faculty members from low consensus disciplines will be able to contribute significantly to knowledge sharing within faculty learning communities (Yang & Liu, 2004).

High consensus disciplines (i.e., hard disciplines), according to Biglan (1973b), consist of the more practical and objective (Gorsky et al., 2010) subject matter, such as nursing, architecture, education (administration related), computer science, business, accounting, engineering, and finance. Disciplines that are considered as "hard" are paradigm related, which normally are task-specific based on quantitative based examples and/or models (Biglan, 1973b; Gorsky et al., 2010). Faculty members in hard disciplines are generally focused on principles, facts, and job specific learning (Barnes, Bull, Campbell, & Perry, 2001; Jones, 2011).

The objectives of high consensus disciplines extend from the knowledge and comprehension levels into problem solving through the application, analysis, synthesis, and evaluation domain levels of Bloom's taxonomy to promote knowledge growth (Atherton, 2005; Clark, 1995; Gorsky et al., 2010; Krathwohl, 2002). This requires the use of specific input that allows the student to apply some form of systematic reasoning to achieve the desired outcome. The communication mediums for building knowledge in these disciplines can also take the form of rudimentary tools, such as dry erase boards, to more advanced tools, such as digital projectors and online environments (Gorsky et al., 2010). However, the benefit of using more advanced instructional tools may not be deemed important to effective teaching (Curry, 1993).

Faculty members from high consensus disciplines are more inclined to use only a select number of instructional technology tools in their pedagogy (Curry, 1993; Harris & Hofer, 2011). The concept of *good teaching* is to transmit information to the student in more of a teacher centered approach (Harris & Hofer, 2011; Lux et al., 2011; Niess, 2011; Norton et al., 2005). As a result, the pedagogy of faculty members' in hard disciplines will possibly have a limited technologically enhanced pedagogy (Norton et al., 2005). The communication mediums to transmit information to students may consist of soft or hard cover books, with some use of electronic books or articles in PDF form (Gorsky et al., 2010). In addition, their knowledge sharing ability will be limited, which could also contribute to a lack of interest in enhancing their technology knowledge (Renkl et al., 2009).

The faculty members' inherited discipline characteristics and departmental circumstances are contributing influences of technology interest (Jones, 2011). Research (Jones, 2011; Norton et al., 2005) has indicated that teaching intentions of faculty are significantly different among disciplines. Researchers (Chickering & Gamson, 1991; Jones, 2011; Norton et al., 2005) have found that faculty in low consensus disciplines are generally more interested in using interactive teaching techniques than faculty in high consensus disciplines. However, high consensus discipline faculty pedagogy is more focused on job training (Norton et al., 2005).

Research has shown that faculty in low consensus disciplines may be more focused on instructional preparation than on research initiatives compared to those in high consensus disciplines (Biglan, 1973a, 1973b; Chickering & Gamson, 1991; Clark, 1987; Jones, 2011; Norton et al., 2005; Smeby, 1996). The interest of faculty in low consensus disciplines to learn and incorporate technology into their instructional methods may be greater than those in high consensus disciplines. As a result, faculty members who have a greater interest in research may leave instructional technology tools to deteriorate.

According to research (Hearn & Anderson, 2002; Jones, 2011), another contributing factor to the reluctance of using technology to enhance pedagogy is that female faculty members in soft disciplines are more prone to experiencing promotion and tenure disputes compared to faculty members in hard disciplines. This allows for speculation that gender could impact the opinion of faculty members based on interest and recognition to incorporate more advanced instructional technology tools into their existing pedagogy. Instances of gender inequality should be brought to the immediate attention of higher education administration in order to identify and implement performance equality initiatives in the working environment and dismantle (St. Pierre, 2000) "gender neutral" (Shaw, 2004, p. 54) behavior.

Jones (2011) offered that soft discipline faculty members exhibit more good practice (Entwistle & Walker, 2000; Freeman, 2002; Harris & Hofer, 2011; Niess, 2011; van Manen, 1995) strategies in their pedagogy. While on the contrary, hard discipline faculty members focus on measureable outcomes, such as achieving tenure, faculty satisfaction through leadership opportunities (Hearn & Anderson, 2002; Jones, 2011). These findings suggest that faculty members' interest in incorporating technological into existing pedagogical methods correlates to institutional rewards and incentives (Koh & Divaharan, 2011).

Faculty Members' Cognitive Abilities with Technology

Reflecting on low and high consensus categorizations (Biglan, 1973a, 1973b) and Bloom's taxonomy (Atherton, 2005; Clark, 1995; Krathwohl, 2002), it is important to highlight that faculty members in the same disciplines have individual cognitive abilities (Clark, 1995; Curry, 1993). Therefore, faculty with the ability to execute at higher thinking levels may be more equipped to incorporate technology with their existing PCK (Clark, 1995; Curry, 1993; Harris & Hofer, 2011; Major & Palmer, 2006; Mishra & Koehler, 2006; Shulman, 1987). This challenges the notion that the ability to implement instructional technology tools is strictly dependent on the categorization of a faculty member's discipline (Clark, 1987; Smeby, 1996). Therefore generalizing the technological ability of faculty based solely on their discipline would be a misnomer. This generalization would also provide inadequate implications of technological support needed for faculty preparation.

Focusing on faculty member's cognitive ability, based on Bloom's taxonomy (Koehler, 2011), will better depict the competency skills needed in order to effectively utilize technology tools with existing PCK (Clark, 1995; Shulman, 1987). This will serve as a practical foundation that illustrates various phenomenons associated with the different taxonomy levels as they would impact faculty TPaCK. The six Bloom's domain levels represent an incremental approach that can be applied in any learning environment (Atherton, 2005; Clark, 1995; Krathwohl, 2002). Listed from lowest to highest are likely circumstances that faculty members encounter in each of the domain levels (Atherton, 2005; Clark, 1995; Krathwohl, 2002; Niess, 2011):

- Remembering: New technology tools are *identified* [emphasis added] by faculty members. During this learning phase, faculty are exposed to the names of new instructional technology tools through conferences, technology journals, the Internet, professional learning communities (Lux, Bangert, &Whittier, 2011; Yang & Liu, 2004), etc. These forums give notice to the *hot items* [emphasis added] on the tech market.
- Understanding: Faculty begin to *comprehend* [emphasis added] a general interpretation of technology tools use in daily activities. They are able to discuss the highlights of technology tools with peers, but with limited explanation of how to incorporate into their pedagogy. In addition, the concept of using tech tools in their pedagogy to enhance learning may remain moot (Harris & Hofer, 2011; Niess, 2011; Niess et al., 2009; Wetzel et al., 2009).
- Applying: The ability to *construct* [emphasis added] pedagogical strategies with technology tools takes shape for faculty. The instructions and/or training that faculty receive on the technology allows them to interpret the tools' use in methods that better complement their pedagogy and the content (Harris & Hofer, 2011; Mishra & Koehler, 2006; Niess, 2011; Niess et al., 2009; White & Myers,

2001). Their interpretation is exhibited in their ability to paraphrase and explain their use of the technology to enhance learning.

- Analyzing: Faculty *compare and contrast* [emphasis added] the interlinking of their pedagogy and content with various technology tools. The ability to *select* [emphasis added] the appropriate technology for content delivery enhances. Faculty members reflect on the shared experiences (Cheesebro, O'Connor, & Rios, 2007, p.136; Harris & Hofer, 2011; Koh & Divaharan, 2011; Mezirow, 1991; Niess, 2011; Shulman, 1987) based on peers' use of tech tools.
- Evaluating: Once technology tools are incorporated into a learning environment, faculty members *assess and critique* [emphasis added] the teaching strategies used with the technology. From the critique, faculty members are better prepared to summarize the pros and cons of the technology tool in the applicable teaching setting. This allows an opportunity for faculty members to utilize their decision making process (Harris & Hofer, 2011; Niess 2011; Robins & Coulter, 2005; Thompson & Strickland, 2003) to justify or oppose the use of the technology in similar future teaching realms.
- Creating: Once the art of using a technology tool is mastered by the faculty members, they are more relaxed and become more *creative* [emphasis added] with how they use technology in other teaching settings (Harris & Hofer, 2011; Niess, 2011; Wetzel et al., 2009). New ideas are formalized on pedagogical strategies to use technology to enhance learning. Faculty members are equipped to serve as expert users and share their pedagogical techniques in professional learning communities (Lux, Bangert, &Whittier, 2011; Yang & Liu, 2004), conferences,

research journals, technology forums, blogs, etc. As their interest in using technology increases, their research interest may also expand to include technology based studies (Austin, 2003; Clark, 1987; Mishra & Koehler, 2006).

Research (Lambert & Sanchez, 2007; Margerum-Leys & Marx, 2002; Sahin, 2011) has conveyed that in order for faculty to use instructional technology tools at a proficient level, they should have a multi-faceted knowledge base that consists of various technology tools in conjunction with their pedagogy (Niess et al., 2009). This supports the need for technology-based preparation for faculty at higher education institutions. In addition, this highlights the need for continuous support provided to faculty in both high and low disciplines (Mezirow, 1991; Smeby, 1996).

The cognitive trajectory is a linear process, based on Bloom's taxonomy, allowing a rather seamless transition from one level to the next (Atherton, 2005; Clark, 1995; Krathwohl, 2002). As a result as faculty progress from novice to expert technology users, their cognitive ability advances, which enables them to execute their TPaCK in a cohesive unit instead of as individual components (Major, & Palmer, 2006; Mishra & Koehler, 2006; Niess et al., 2009; Sahin, 2011). This competency growth increases the interest of faculty members to incorporate technology into their existing pedagogy (Clark, 1987; Mishra & Koehler, 2006).

Fitting the pieces together, Yarbrough (2001) conducted a study on student satisfaction of undergraduate students in technology-enhanced courses. The instructional methods that were enhanced with technology did not have a significant impact on the student outcomes. The content and student experience with subject matter were deemed the determining factors for success of both technology enhanced and traditional methods of instruction. According to Yarbrough (2001), the experience of the instructor also impacts student outcome. It was determined in this study that more effective student outcomes result from instructors with more experience and knowledge with the subject matter in addition to experience using technology for educational purposes (Yarbrough, 2001).

With all components combined, TPaCK is a comprehensive knowledge collection framework beneficial to faculty in the 21st century (Mangold, 2007; Sahin, 2011). This knowledge consortium considers each component of the TPaCK model an integral component necessary for actively evolving the learning process for students (Major, & Palmer, 2006). Without the multi-faceted intersecting, pedagogy and content would remain the central focal points in teaching, therefore leaving technology in the peripheral view and decreasing the effectiveness of learning for tech savvy students (Mishra & Koehler, 2006; Sahin, 2011).

Faculty Interest and Reward for using Technology

Although discipline categorizations and cognitive ability are key contributors to support the TPaCK preparation initiatives within higher education institutions, other factors, such as areas of faculty interest, rewards and incentives, along with institutional expectations and support carry considerable influence on faculty desire and perception of their ability to effectively implement instructional technology into asynchronous and synchronous environments (Biglan, 1973a, 1973b; Clark, 1987; Clark, 1995; Koh & Divaharan, 2011; Major & Palmer, 2006; Mishra & Koehler, 2006; Shulman, 1987).

While broadening the technological knowledge and competencies outside of their disciplines, Austin (2003) suggested that as technologies continue to advance, existing and future faculty will be expected to know how to efficiently utilize technology and not rely on technical support staff. This leaves room to speculate that the workload of faculty could be increased for those with limited (and also some expert) technological knowledge since teaching preparation takes considerable time (Harris & Hofer, 2011; Hearn & Anderson, 2002; Jones, 2011; Lye, 2013). In the likelihood that this prevails, departmental leaders and policy makers should consider revamping performance expectations for tenured and non-tenure faculty to incorporate technological requirements.

Faculty may stress at the thought of additional workloads and loss of autonomy, but to satisfy the service goal requirements at many higher education institutions, extending their knowledge base to include technological skills could generate professional opportunities with external agencies (Austin, 2003; Harris & Hofer, 2011; Stein & Short, 2001). Having a variety of skills outside of their disciplines demonstrates faculty members' epistemological awareness for the need of interdisciplinary knowledge expansion. In addition, a variety of technology skills offers a plethora of teaching techniques.

Rientes et al. (2013) highlighted that professional development for faculty in higher education is encouraged by administration in support of institutions goals (p. 123). Participants from Rientes et al. (2013) were given certificates once completing the professional development (p. 126). This reiterates the need for faculty incentives.

Teaching with Technology (2000) segmented the technology experiences at eight universities throughout the United States. The following three, located in the mid-south region of the U.S., provide insight on the institutional support efforts and pedagogy strategies for technology (Brown, 2000).

At the University of Georgia, a committee of 14, comprised of faculty and administrators, work together to develop and implement the university's support of instructional technology (Jackson & McRae, 2000). These members seek advanced pedagogical methods through the use of the Southern Association of Colleges and Schools self study assessment, which assist in the technology planning efforts to enhance teaching for both faculty and students. Simulation and learning management systems (LMS) are two technology enhanced pedagogy advancements used in the English and Science departments, respectively. One English faculty member created collaborative projects on various English topics, which required students to engage in weekly discussion (Harris & Hofer, 2011; Hilton & Adler, 2011; 2000). Another pedagogical approach used was allowing the students to create presentations on an English topic then take on the teaching role within the LMS (Hilton, 2000). This approach contributed as a training session for both faculty and students in that they reversed roles that provided insight from the other's perspective. This approach would enrich the faculty members' pedagogical techniques based on observed technology usage exhibited by the student (Cochran-Smith, & Lytle, 2011; Shulman, 1987; Siegel, 2006). In the science department, a project-based astronomy class was developed using digital technology to provide a deeper understand of the science in action (Hay, Shaw, & Hauschildt, 2000). These technologically enhanced pedagogy methods also encourage collaboration and open communication that promotes active learning (Harris & Hofer, 2011; Lee & Reigeluth, 2003; Nickerson et al., 1985; Renkl et al., 2009; Rieber, 2000).

At the University of Florida, technology training for effective use has been at the forefront of several departments at the university. One unique approach to technology training is through the use of external consulting agencies (Legg, 2000). This alternative form of training is provided in videotape and online format. In regards to technology, the pedagogical use of LMSs allows faculty members to utilize various LMS features (i.e., chat sessions) to promote active learning (Hammer, 2000; Harris & Hofer, 2011). Encouraging the use of the chat features within LMSs keeps students engaged during class sessions (Harris & Hofer, 2011). This increases the chance of class participation because the faculty member can divvy up tasks, such as lecture discussion, and task/question moderators among the students. This strategy allows faculty to create a cohesive group, which fosters an effective learning community. The teaching philosophy of the medical school aims to make virtual environments as interactive as traditional classrooms, such as through the use of video recorded lectures (Browd, 2000).

At Wake Forest University, international scholarly communities were one of the main entities pushing for the use of technology in teaching (Brown, 2000). Two chemistry professors took the challenge of enhancing student preparation for laboratory and lecture sessions in effort to improve student competency (Harris & Hofer, 2011; King & Wong, 2000). Using Internet technology, the professors created online tutorials that consisted of course related visualization to assist students in the learning process of difficult topics (King & Wong, 2000). This exhibits a more artistic form of pedagogy displayed by these high discipline faculty members. Visual images assist in low cognitive engagement in which the student begins to build knowledge and comprehension (Harris & Hofer, 2011; Krathwohl, 2002). Hall (2000) also supported the claim that visualizations help maintain student attention based on student feedback from student survey responses on the effectiveness of multimedia on the learning process.

Based on the technology support and initiatives at the University of Georgia, University of Florida, and Wake Forest (David, 2000), it is noticeable that over time faculty members develop pedagogical strategies for teaching certain curriculum based on their learning and educational experiences (Adler, 2011; Cochran-Smith & Lytle, 2011; Koh & Divaharan, 2011; Shulman, 1987; Siegel, 2006). Faculty may not have a problem learning to use new instructional technologies, but more so having an issue of learning how to effectively integrate the technology with the content and their existing pedagogy (Curry, 1993; Harris & Hofer, 2011). As new technology tools become available for educational purposes, faculty struggle with imaginative and creative technological uses for incorporating the technology for practical application (Niess et al., 2009). This increases the need for faculty support and/or professional development geared toward the developmental process of effective technological integration with existing pedagogy (Archambault & Crippen, 2009; Lux, Bangert, & Whittier, 2011; Lye, 2013; Niess et al., 2009; Niess, 2011; Paas, Van Gog, T., & Sweller, J. 2010; Renki et al., 2009; Yang & Liu, 2004).

Summary

Technology should be viewed as a medium that engages a broader public audience therefore turning a technological challenge into new opportunities (Farra, 1980). Like the basic classroom chalkboard, technology serves as a visual medium between the instructor and learner. It allows for creative content delivery to learners that contributes to increased levels of learning (Sahin, 2011).

Technological knowledge development collaborated with faculty disciplines can lead to entrepreneurship opportunities, therefore developing relationships and networks external to higher education environments, such as university consulting at the University of Florida (Austin, 2003; Legg, 2000; Stein & Short, 2001). Pressure from internal and external communities weigh heavy on the higher education administration to ensure that adequate training and support is available to faculty members in effort to encourage the use of technology for teaching, while satisfying accreditation requirements. With the appropriate incentives, higher education institutions have faculty members who can serve as change facilitators for other faculty members (Niess, 2011; Koh & Divaharan, 2011; White & Myers, 2001) who are reluctant to enhancing their pedagogy with technology (Browd, 2000).

As the literature revealed, technology tools would be considered motivational influences to incorporate with existing PCK if faculty members perceived any of the following:

1. Improved workload efficiency (Harris & Hofer, 2011; Hearn & Anderson, 2002; Jones, 2011);
2. Increase in student learning (Harris & Hofer, 2011; Sahin, 2011);
3. Constructivist (hands-on) training (Hein, 1996; Khine & Fisher, 2003; Major, & Palmer, 2006; Ruey, 2009);
4. Faculty performance acknowledgment (Hearn & Anderson, 2002; Jones, 2011; Koh & Divaharan, 2011); and
5. Institutional incentives (Hearn & Anderson, 2002; Jones, 2011; Koh & Divaharan, 2011)

Based on these influences, higher education administrators should carefully consider revamping existing policies and procedures that will provide faculty recognition for technologically enhanced pedagogy (Southern Association of Colleges and Schools, 2010a, 2010b). In addition, it is important that administrators evaluate existing training in doctoral programs and professional development for current faculty members to ensure that adequate TPaCK training is readily available for all future faculty and existing faculty members (Southern Association of Colleges and Schools, 2010a, 2010b).

Although instructional technology tools are not within the norms for many faculty members, it is important that faculty members reflect on their personal and professional experiences with various technologies in order to develop a deeper understanding of how their use of technology along with their pedagogy impacts student learning (Harris & Hofer, 2011). This is especially important for tenured faculty members, who may not see the benefit in modifying their pedagogy to consist of technology. Instead, as lifelong learners, tenured and non-tenure faculty members should be encouraged by higher education administrators to seek various pedagogical methods that enhance their teaching to promote cognitive learning. From this approach, continuous education becomes a norm that helps faculty members stay abreast of the latest technology tools. This provides continuous opportunities for learning and growing in areas of interest (Mezirow, 1991; Shysh, 2000) for both faculty and students.

CHAPTER III:

METHODOLOGY

The purpose of this study was to allow faculty to self-assess their technological, pedagogical, and content knowledge (HE-TPaCK). More specifically, this study compared and contrasted the HE-TPaCK of faculty use of instructional technology tools in asynchronous and synchronous learning environments (Golde & Dore, 2001) based on educational disciplines, academic ranking, and gender. In this chapter, a description of the study setting, sample, instrument, design procedures, data analysis, assumptions, and limitations are discussed.

The research questions that guided this study were

1. What are faculty self-assessments of TPaCK as measured by the HE-TPaCK survey; and
2. Is there a difference in faculty self-assessments of technological, pedagogical, and content knowledge (TPaCK) based on educational discipline, gender, and academic, as measured by the HE-TPaCK survey?

Sample

The faculty at the main campus of a southeastern research university served as the unit of analysis for this study. As of the fall 2012 semester, this southeastern research university had a student enrollment of 28,026 undergraduate and 4,994 graduate students (Office of Institutional Research & Assessment at a Southeastern Research University, 2012). According to the Office of Institutional Research and Assessment (2012), there were a total of 1,731 faculty members; 596 are tenured, 271 are on the tenure-track; 168 are non-tenure positions. The remaining 698 faculty members were categorized as instructors, clinical professors, adjunct faculty, or graduate teaching assistants.

With the large number of instructors and faculty members holding teaching positions at this southeastern research university, it was expected that participants would have a wide variance in their TPaCK survey responses that was not grounded in the teaching, research, and service mission of a model research university (Association of American Universities, 2010). Therefore, tenured and non-tenure faculty were the categories chosen for this study as more appropriate participants due to the likelihood that those faculty members are more likely to uphold the teaching, research, and service mission of research universities (Association of American Universities, 2010). However, due to expected low response rate for online surveys, graduate teaching assistants (GTAs), who are future faculty, were also included as participants. The non-tenure category contained assistant professors since this group had not obtained tenure status at the time data for this study was collected. In order to extract a true representation of faculty who represent the mission of the research university, tenured and non-tenure faculty members and GTA were selected, which equals 901 potential participants.

Faculty members in the tenured and non-tenure categories are perceived to more likely be focused on maintaining the teaching, research, and service mission of higher education institution (Association of American Universities, 2010) in order to satisfactorily achieve performance expectations. As a result, the eligibility criteria of the study participants were 1) full time equivalent (nine or twelve month basis) faculty members on the main campus of a southeastern research university; and 2) academic ranking was categorized as assistant professor, associate professor, professor, or graduate teaching assistants (GTA).

Using eligibility criteria for the selection process of participants provided objective credibility of responses (Fink, 2009). This study required tenured, non-tenure, and GTA participants who were *available and willing* to complete the online survey during the allotted time frame, therefore providing a convenience sample (Fink, 2009, p. 56).

Technology Training Environment

The locus of interest offers several events and technology-based support for faculty on a continuous basis through the faculty technology support center. The support center provides instructional technology support to all faculty through small training sessions, one on one consultations, and web accessible training videos and guides. The faculty technology support center currently has seven team members identified on the center's website contact page. Their roles are listed as director, coordinator, assistant coordinator for faculty development, instructional technology support specialist, and learning management system administrator.

There are 25 one-hour workshops scheduled for May 2014 through August 2014 on the topic Blackboard, the learning management system. There are also supplemental text-based tutorials accessible on the center's website for Tegrity, Clickers, and Collaborate. Web accessible video tutorials are provided by the faculty technology support center on topics such as TurnItIn, Tegrity, Clickers, Respondus, Interactive Monitors, and lab monitoring software within BlackBoard. In addition to the workshops and tutorials, the following are current programs offered by the faculty technology support center:

a) Faculty Technology Showcase: A yearly symposium where faculty are given an opportunity to share technology based research or class projects with other faculty. The format is setup up as a one-day session. Attendance is open to all faculty, staff, and graduate students. This conference encourages communication and collaboration with the presenter(s) in a small group setting;

b) Scholars Institute Symposium: Also a yearly conference designed to exhibit technology based research, special topics panel discussions, and training sessions for faculty and doctoral students. This symposium encompasses three universities, which allows for faculty, staff, and graduate students to broaden their community of knowledge. Presenters are selected through a competitive proposal submission process; and

c) Small Group Training: Scheduled training sessions on various technology tools, such as web site development and Blackboard course development, are provided for faculty and/or students at the university. A team member from the faculty technology support center conducts the training based on the needs and/or interest of the attendees.

Instrument

The PT-TPaCK survey, developed by Lux, Bangert, and Whittier, measured the self-assessed levels of teaching and technology knowledge of one hundred twenty (120) pre-service teachers (Lux, Bangert, & Whittier, 2011). The survey consisted of 45 survey items. A four-point Likert scale was used for the next 45 survey items. Those 45 items were categorized by the TPaCK domains: technology knowledge (six items), content knowledge (six items), pedagogy knowledge (four items), pedagogical content knowledge (six items), technological content knowledge (six items), technological pedagogical knowledge (six items), and technology pedagogy content knowledge (eleven items).

The technology training (24 items) section measured faculty members' perspective of training higher education of higher education training. These items were based on a faculty perception based technology training survey developed by Georgina and Olson (2008) (Georgina & Hosford, 2009). A five-point Likert scale was used for the 24 items that aimed to measure pedagogical practice, technology skills, technology training, and faculty demographics.

Original Instrument Reliability

Historical data of the instrument aids in establishing reliability (Creswell, 2009). Content validity of the instrument was established by Schmidt, Baran, Thompson, Koehler, Mishra, and Shin (2009) for each of the eight TPaCK domains. Schmidt et al. (2009) reported reliability estimates for the original TPaCK instrument by domain; therefore, no total Cronbach alpha was established.

The instrument for this study was derived from a TPaCK survey developed by Nicholas Lux at Montana State University. The instrument developed by Lux was used primary for pre-service teachers. The idea for adding the technology training section to the instrument originated based on the technology training survey items developed by David Georgina at Minnesota State University. Written permission was obtained from Georgina and Lux to use these existing surveys as a foundation for the instrument used in this study.

In the instrument developed by Lux, Bangert, and Whittier (2011), the Cronbach alpha was established for each domain. For the Content Knowledge (CK) domain, Schmidt et al. (2009) reported the domain reliability for each of the four subjects of interest. Cronbach alphas for the domains were calculated as follows: Technology Knowledge (TK) = .75; Pedagogy Knowledge (PK) = .77; Content Knowledge (CK) = .77; Pedagogical Content Knowledge (PCK) = .65; Technological Pedagogical Knowledge (TPK) = .84; and Technology Pedagogy Content

Knowledge (TPaCK) = .90 (Lux, Bangert, &Whittier, 2011). The Technological Content Knowledge (TCK) domain did not emerge as a significant domain, therefore Lux, Bangert, and Whittier (2011) did not report the internal consistency. Based on the Cronbach alpha analysis from Carmen and Zellers (1979), Litwin (1995), and Nunnally (1978), the scores from the PT-TPaCK survey represents a true score variance for each domain, therefore deeming this a highly reliable instrument.

The Cronbach alpha was established for the instrument developed by Georgina and Olson (2008) (Georgina & Hosford, 2009) for three of the four sections. The first section, Technological Literacy had a Cronbach alpha of .951. The Technology Training section had a Cronbach alpha of .584, and the Pedagogy section had a Cronbach alpha of .819. Although the Technology Training section was low, there were not any apparent survey items removed.

Modified Instrument

Mishra and Koehler (2006) established the TPaCK model as an essential framework to measure and evaluate the technology, pedagogy, content knowledge of teachers. TPaCK studies in primary and secondary schools have offered insight into how the framework can be used to promote technologically enhanced pedagogy. Some of the key areas highlighted in the literature explored how TPaCK assessments revealed the need for further analysis of TPaCK for instructional planning (Harris & Hofer, 2011), the attitude and environment impact on K-12 teachers' TPaCK (Koh & Divaharan, 2011; Niess, 2011), and K-12 teachers self-perception of their TPaCK (Archambault & Crippen, 2009; Lux, Bangert, & Whittier, 2011).

According to Archambault and Crippen (2009), TPaCK self-assessing allows teachers to reflect on their use of instructional tools in order to uncover gaps and weaknesses in instructional planning for use in various learning environments (Harris & Hofer, 2011; Koh & Divaharan, 2011; Niess, 2011). Therefore since the roles of both teachers and faculty are to promote learning, the TPaCK survey is believed to be appropriate for any educational setting. With this reasoning in mind, the original instrument was modified to accommodate the faculty at a higher education institution in the southeast.

This study used a modified version of the PT-TPaCK survey (Lux, Bangert, & Whittier, 2011) in a higher education setting. The modified TPaCK instrument consisted of 53 survey items (see Appendix B). From this point forward, the modified survey is referred to as HE-TPaCK.

A five-point Likert scale was used to measure participant responses for the domain specific survey items. The Likert scale ranges consisted of strongly agree, agree, neither agree or disagree, disagree, and strongly disagree. Each range categorization was assigned a numerical value from five to one. Those ranges corresponded with the Likert scale as follows: strongly agree = 1, agree = 2, neither agree or disagree = 3, disagree = 4, and strongly disagree =5. The scale for negative-coded survey items were as follows: strongly agree = 5, agree = 4, neither agree or disagree = 3, disagree = 2, and strongly disagree =1. Lower scores indicated the participants' proficient ability to incorporate technology, pedagogy, and content to enhance student learning.

It is important to note that the PT-TPaCK survey used a Likert scale as follows: strongly agree = 5, agree = 4, neither agree or disagree = 3, disagree = 2, and strongly disagree = 1. This resulted in higher mean averages in the findings of the PT-TPaCK study. The Likert scale for HE-TPaCK was based the researcher's preference using Qualtrics; thus does not indicate anomalies with the PT-TPaCK. As a result, the HE-TPaCK survey produced lower modes and means, which correlates to higher self-assessed knowledge as the PT-TPaCK means.

The HE-TPaCK survey collected demographic information (six items) from the study participants pertaining to their gender, years of faculty experience, tenure status, academic ranking, and the department in which their discipline resides. The HE-TPaCK survey items were grouped and displayed based on the seven domain areas and the technology training section. Each domain was comprised of survey items specific to the knowledge and competency abilities associated with the components of the domain. The domain areas were:

1. technology knowledge (TK) domain contained six items. A sample TK item stated: I am familiar with a variety of hardware, software and technology tools that I can use for teaching;
2. pedagogy knowledge (PK) domain contained four items. A sample PK item stated: I know how to assess student learning;
3. content knowledge (CK) domain contained six items. A sample CK item stated: I have a comprehensive understanding of the curriculum I teach;
4. pedagogical content knowledge (PCK) domain contained six items. The PCK item stated: I understand that there is a relationship between content and the teaching methods used to teach that content;
5. technological content knowledge (TCK) domain contained six items. The TCK item stated: I understand how the choice of technologies allows and limits the types of content ideas that can be taught;
6. technological pedagogical knowledge (TPK) domain contained six items. A sample item stated: I understand how teaching and learning change when certain technologies are used;

7. technological pedagogical content knowledge (TPaCK) domain contained eleven items. A sample item stated: I understand how digital technologies can be used to represent content in a variety of formats; and

8. technology training section contained four items. A sample item stated: Technology training would enhance my teaching.

HE-TPaCK Validity

In order to determine if the HE-TPaCK instrument measured what was intended, internal consistency of this modified instrument was established using Cronbach alpha while the validity was assessed through content validation. In support of this effort, 22% of the survey items were negatively worded to support construct validity. Content validity was established by five expert reviewers. Each of the expert reviewers were trained professionals in the areas of TPaCK and/or technology training. All of the items were evaluated by a measurement expert for wording, grammar, ambiguity or any other technical flaws (Crocker & Algina, 1986, p. 81). Those expert reviewers performed an instrument review to ensure that each item on the instrument adequately measured the TPaCK and technology training concepts, as suggested by Crocker and Algina (1986, p. 218). The expert reviewers provided a content evaluation that included feedback on the design and development of the instrument items. Comments from those reviews were incorporated into the instrument and redistributed to the expert reviewers for final review and content consensus. This review process helped establish content validity of the HE-TPaCK survey in order to ensure that it served as a useful measurement (Crocker & Algina, 1986, p. 218).

HE-TPaCK Reliability

In order to measure the degree of consistency within each of the domains and the Technology Training section, reliability was established through Cronbach alpha (see Table 1). The four items in the Technology Training (TT) domain had a Cronbach alpha of .57. The Pedagogical Knowledge (PK) domain had a Cronbach alpha of .86 for four items. The Technology Knowledge (TK) had six items that yielded a Cronbach alpha of .74. The six items in the Content Knowledge (CK) domain had a Cronbach alpha of .82. The Pedagogical Content Knowledge (PCK) domain also had a Cronbach alpha of .82 based on six items. The Technological Pedagogical Knowledge (TPK) domain had six items that yielded a Cronbach alpha of .81. The six items in the Technological Content Knowledge (TCK) domain had a Cronbach alpha of .78. Lastly, the Technological Pedagogical Content Knowledge (TPaCK) domain had eleven items that yielded a Cronbach alpha of .92. All survey items were kept for each domain and the Technology Training section.

Table 1

Cronbach's Alpha Summary

Domain	Cronbach's Alpha	Number of Items
Technology Training (TT)	.566	4
Pedagogical Knowledge (PK)	.863	4
Technology Knowledge (TK)	.739	6
Content Knowledge (CK)	.822	6
Pedagogical Content Knowledge (PCK)	.822	6
Technological Pedagogical Knowledge (TPK)	.805	6

Technological Content Knowledge (TCK)	.776	6
Technological Pedagogical Content Knowledge (TPaCK)	.922	11

Procedures

An electronic version of the TPaCK survey was used for this study due to the large number of faculty and graduate teaching assistant (GTAs) members at the study site. This electronic version was redesigned using the Qualtrics online system. This web-based surveying tool is available for use to all students and faculty for data collection purposes. Survey items from the original TPaCK Microsoft Word document were modified and entered into the Qualtrics system. Once distributed, participants were presented with an electronic informed consent form and asked to acknowledge the delivery of the form. Their electronic acceptance of the survey served as acknowledgment that survey participation is voluntary.

An IRB application was submitted for validation with the human rights protocol established by the higher education institution in which this study was conducted. Approval from the Institutional Review Board (IRB) was granted and the web email containing a link to the Qualtrics online survey was distributed to all faculty email addresses available on their respective department web pages. The online survey was designed to prohibit participants' ability to not answer a survey item before advancing to the next survey item. This restriction mechanism eliminated incomplete survey data being included in the data collection.

In the Qualtrics System, the instrument was designed to allow one survey completion from each Internet Protocol (IP) address. In the event that a faculty member attempted to complete an additional survey from the same computer, Qualtrics should have restricted access. However, it is assumed that the study participants would *only* complete one survey. The survey instrument was available to the study participants for three weeks during the Spring 2013 semester and another three weeks during fall 2013 semester. The invitation to participate email for spring 2013 was distributed during the last week of the semester. An additional email reminder was distributed at the end of week two. The invite to participate email for fall 2013 was distributed during the third week at the beginning of the semester. An additional email reminder was distributed after the fourth week of the semester. Once the data collection period has expired, data will be downloaded into SPSS file and analyzed using SPSS® software version 18.

Sample Size

Fink (2009) argued that 70% survey response rates are deemed adequate for online surveys (p. 63). However, considering that for this study participation was voluntary, it was expected that the response rate would be less. In an effort to achieve the desired response rate, the unequally proportioned subgroups based on discipline, gender, and academic ranking was used to provide descriptive inferences of the study population for research question 1. Since there was a low response rate (14%), the sample size was calculated based on > = 80% power to detect the effect of the sample for the multiple linear regression research question (Maxwell & Delaney, 2004, p. 124). In the formula, the discipline, gender, and academic ranking groups represent the number of categorical levels where a =2. At least sixty-four (64) subjects per group (consensus, gender, and academic ranking) were needed using power = .80, d = .5 for medium effect, and alpha = .05, per Table 3.10 (Maxwell & Delaney, 2004, p.124). Based on this effect size, the desired sample was not achieved. However, the multiple linear regression analysis was conducted with the available sample. As a result, the academic ranking group had to be grouped as tenured and non-tenured. The tenured group consisted of associate professors and professors.

The non-tenured category consisted of assistant professor, GTAs, instructors, and clinical instructors.

Data Analysis

Data from the modified 56-item HE-TPaCK survey were analyzed for descriptive statistics and reviewed for potential random entry errors for research question 1. The five-point Likert scale was used to measure participant responses for all survey questions. The average score from the five-point Likert scale from each domain was the dependent variables for all analysis performed. Research question 2 investigated the relationship between consensus disciplines, gender, and academic ranking on faculty members' HE-TPaCK average scores using the Technology Training section average as a covariate. Table 2 outlines the research questions and the data management plan that was used for statistical evaluation.

Table 2

HE-TPaCK Data Management Plan

Research Question	Measure(s)	Independent or Grouping Variables	Dependent Variable	Analysis
1	HE-TPaCK survey		Average of TPaCK responses per domain	Descriptive Statistics
2	HE-TPaCK survey	Covariate: Technology Training Consensus Disciplines • High • Low Gender • Male • Female Academic Ranking • Others • Assistant Professor • Associate Professor • Professor	Average of TPaCK responses per domain	Multiple Linear Regression

Assumptions of the Study

Several assumptions were made in conducting this research. First, it was anticipated that faculty participants provided a true representation of faculty at research universities. Second, the large number of faculty members at this southeastern research university was assumed to be more suitable for a quantitative approach in this study in order to compare and contrast the technological, pedagogical, and content knowledge of faculty use of technology with existing pedagogy and content. Lastly, it was assumed that faculty members provided unbiased and truthful responses (Golde & Dore, 2001).

Limitations of the Study

The following were identified as limitations for this study:

1. This study was limited in scope by the departmental colleges and schools within the unit of analysis in which this study was conducted. The locus of interest at this flagship university did not contain an exhausted array of disciplines that are represented at other research universities;
2. The use of a modified version of the original TPaCK survey could reduce instrument validity due to the technology training section having low validity;
3. Using a quasi-experimental design based on the tenured and non-tenured subgroups may have confounded the results (Finks, 2009). The tenured faculty members may have been more likely to give candid responses, which may have revealed lower TPaCK self-assessment. This could have been due to the assumed relaxed performance expectation from obtaining tenured status. Conversely, the non-tenured faculty members may have exhibited an abnormally higher self-assessment of their TPaCK to overcompensate their true TPaCK as a self-

evaluation booster. The tenured and non-tenure subgroups have similar faculty requirements and expectations as related to teaching, research, and service. However, it is important to note that there are differences in their pedagogical knowledge, skills, and abilities in regards to the use of technology; and

4. Convenience sampling posed a limitation due to the dependence on participants' willingness and availability to complete the survey.

Summary

This chapter described the procedures executed for this study. The study developed an instrument that allowed faculty at the study site to self-assess their technological, pedagogical, and content knowledge (TPaCK). This self-assessment compared and contrasted the TPaCK of faculty use of instructional technology tools in asynchronous and synchronous learning environments (Golde & Dore, 2001) based on educational consensus disciplines, academic ranking, and gender. In addition, study participants also self-assessed the technology training offered at the study site.

CHAPTER IV:

ANALYSIS OF DATA

The purpose of this study was to allow faculty to self-assess their technological, pedagogical, and content knowledge (TPaCK) and evaluate the faculty perception of the technology training available at a southeastern research university. In detail, this study compares and contrasts the TPaCK of faculty use of instructional technology tools in asynchronous and synchronous learning environments based on educational disciplines, years of faculty experience, academic ranking, and gender. The research design consisted of an online survey that was administrated using Qualtrics and data analyzed using SPSS® software version 18. This chapter presents the findings from the *Modified HE-TPaCK and Technology Training Survey* (see Appendix C). The following research questions guided this study:

1. What are faculty self-assessments of TPaCK as measured by the HE-TPaCK survey; and
2. Is there a difference in faculty self-assessments of technological, pedagogical, and content knowledge (TPaCK) based on educational discipline, gender, and academic, as measured by the HE-TPaCK survey?

Sample

The sample consisted of 128 faculty and graduate teaching assistants. Demographics based on gender, academic ranking, academic status, years of experience, and educational disciplines were collected from each study participant. The sample consisted of 38.28% male (n = 49) and 61.72% female (n = 79). The sample indicated that 15.63% were professors (n = 20);

25.78% were associate professors (*n* = 33); 15.63% were assistant professors (*n* = 20); 6.25%were instructors (*n* = 8), 1.56% were adjuncts (*n* = 2); 7.81% were clinical instructors (*n* = 10); and 27.34% were graduate teaching assistants (*n* = 35).

Due to low participation in each of the academic rankings, the academic ranking category had to be grouped as tenured and non-tenured. The tenured group consisted of associate professors and professors. The non-tenured category consisted of assistant professor, GTAs, instructors, and clinical instructors. There were 54.69% (*n* = 70) of the participants who indicated they were tenured or on non-tenure. The tenured sample represented 37.5% (*n* = 48) of the total sample and the tenure-track sample represented 17.19% (*n* = 22) of the total sample. There were 45.31% (*n* = 58) of the participants that were neither tenured nor tenured-track.

From this sample 2.34% (*n* = 3) indicated having zero years of experience; 30.47% (*n* = 38) indicated having 1 to 4 years of experience; 14.84% (*n* = 19) indicated having 5 to 9 years of experience; 10.94% (*n* = 18) indicated having 10 to 14 years of experience; 10.94% (*n* = 14) indicating having 15 to 19 years of experience; 30.47% (*n* = 43) indicated having 20 or more years of experience.

The 128 study participants represented eight colleges and schools at the locust of interest. The College of Arts and Sciences represented 18% (*n* = 24); College of Commerce and Business represented 15% (*n* = 20); College of Communication and Information Sciences represented 3.7% (*n* = 5); College of Education represented 35% (*n* = 47); College of Engineering represented 6.7% (*n* = 9); College of Human Environmental Sciences represented 2.2% (*n* = 3); Capstone College of Nursing represented 15% (*n* = 20); and School of Social Work represented 4.4% (*n* = 6). In this sample (n = 128), there were 34 participants who self-identified as Graduate Teaching Assistants when asked about academic ranking; these participants selected the college or school in which their academic program was categorized as on the survey. Figure 3 depicts the total responses for each college or school. Table 3 provides a visual representation of all demographic items.

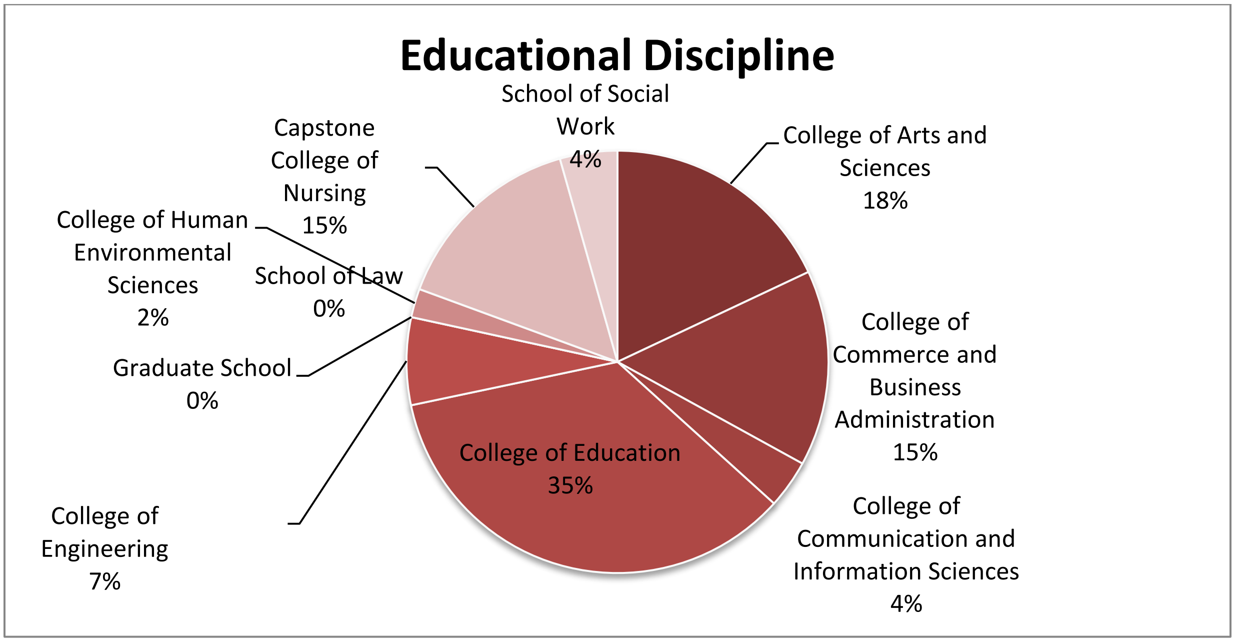

Figure 3. Educational Disciplines

Table 3

Descriptive Statistics

	Responses	n	%
Gender	Male	49	38.28
	Female	79	61.72
		20	19
Academic	Professor		
Ranking	Associate Professor	33	26
	Assistant Professor	20	15.5
	Instructor	8	6.25
	Adjuncts	2	1.5
	Clinical Instructors	10	8.5
	Graduate Teaching Assistants	35	28.6
Academic Status	Tenured	48	37.50
	Tenured-Track	22	17.19
	Neither	58	45.31
Years of	0	3	2.34
Experience	1 to 4	39	30.47
	5 to 9	19	14.84
	10 to 14	14	10.94
	15 to 19	14	10.94
	>= 20	39	30.47
Educational	College of Arts and Sciences	24	18
Discipline	College of Commerce and Business Administration	20	15
	College of Communication and Information Sciences	5	3.7
	College of Education	47	35
	College of Engineering	9	6.7
	Graduate School	0	0
	College of Human Environmental Sciences	3	2.2
	School of Law	0	0
	Capstone College of Nursing	20	15
	School of Social Work	6	4.4
Consensus Status	High	21	16.41
	Low	107	83.59

Finally, participants were asked about their previous technology training, by responding to the number of training session they had attended in the past year. As depicted in Table 4, participants indicated that 42.19% (n = 54) had not attended *any* technology training within the last year. Thirty-three percent (n = 33) attended 1 to 3; 8.59% (n = 11) attended 4 to 6; 0.78% (n = 1) attended 7 to 9; and, 3.13% (n = 4) attended ten or more technology training sessions within the last year.

Table 4

Yearly Technology Training

Training Sessions Attended	*n* = 128	%
0	54	42.19
1-3	33	25.78
4-6	11	8.59
7-9	1	0.78
10+	4	3.13

Research Question 1

The first research question was "What are faculty self-assessments of TPaCK as measured by the HE-TPaCK survey?" Using a five-point Likert scale, participants were asked to select a value that best indicated their self-perception of their ability to incorporate technology, pedagogy, and content to enhance student learning. The Likert scale ranges consisted of strongly agree, agree, neither agree or disagree, disagree, and strongly disagree. Each range categorization was assigned a numerical value from five to one. Those ranges corresponded with the Likert scale as follows: strongly agree = 1, agree = 2, neither agree or disagree = 3, disagree = 4, and strongly disagree =5. The scale for negative coded survey items was: strongly agree = 5, agree = 4, neither agree or disagree = 3, disagree = 2, and strongly disagree =1.

It is important to note that the original PT-TPaCK survey used a Likert scale as follows: strongly agree = 5, agree = 4, neither agree or disagree = 3, disagree = 2, and strongly disagree =

1. The Likert scale for HE-TPaCK, which reverses this numbering, was based the researcher's preference.

For descriptive statistics, the Mean (*M*), Mode (*Mo*) and standard deviation (SD) were obtained for each of the subscales for the HE-TPaCK survey instrument and are presented in Table 5. The mode was included to illustrate the close scoring between Likert categories verses only viewing the average of each domain.

Table 5

Descriptive Statistics

Domain Scales	*Mo*	*M*	*SD*
Technology Training	2.00	2.41	.72
Pedagogy Knowledge (PK)	2.00	1.90	.72
Technology Knowledge (TK)	1.83	2.02	.54
Content Knowledge (CK)	1.17	1.58	.47
Pedagogy Content Knowledge (PCK)	2.00	1.76	.50
Technology Pedagogy Knowledge (TPK)	2.00	1.99	.60
Technology Content Knowledge (TCK)	2.00	2.08	.61
Technology Pedagogy Content Knowledge (TPaCK)	2.00	2.12	.61

Technology Training

Survey items, 8, 9, 10, and 11 asked participants to rate their perspective of technology training available at the locus of interest. The mean for this subscale was 2.41 and overall mode was 2.00 (see Table 5). This indicates that the majority of the participants agreed that technology training is an important contribution for teaching. For example, 28.1% (*n* = 128) strongly agreed and 42.2% (*n* = 54) agreed that technology training would enhance their teaching. However, 28.2% (*n* = 128) agreed that technology training should not be a requirement for faculty. Table 6 presents the descriptive statistics for all survey items for this subscale.

Table 6

Technology Training Frequency Percentage (n=128)

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
8. Technology training would enhance my teaching.	28.1	42.2	15.6	13.3	0.8
9. It is the University's responsibility to train me to use technologies that will enhance my teaching.	19.5	50.0	14.1	14.1	2.3
10. The University should not make technology training a requirement for faculty.	11.7	28.1	17.2	27.3	15.6
11. Technology training should be offered in each academic department at my University.	27.3	39.8	16.4	14.8	1.6

Pedagogy Knowledge (PK) Domain

Survey items 12, 13, 14, and 15 asked participants to rate their pedagogy knowledge as faculty. The mean for this subscale was 1.90 and the overall mode was 2.00 (see Table 5). This indicates that the majority of the participants are familiar with pedagogical practices that are conducive for teaching and assessing student learning. Approximately 35.1% (n = 45) of the responses strongly agreed that they have a clear understanding of pedagogy and 50.4% (n = 66) of the participants agreed that they can assess student learning. However, it is important to note that more than half (52%) indicated that they do know how to motivate students (n = 67). Table 7 presents the descriptive statistics for all survey items for this subscale.

Table 7

Pedagogy Knowledge (PK) Domain Frequency Percentage (n=128)

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
12. I have a clear understanding of pedagogy (e.g., designing instruction, assessing students' learning).	35.1	44.3	10.7	6.9	.8
13. I am familiar with a wide range of practices, strategies, and methods that I can use in my teaching.	36.6	45.8	6.1	9.2	0
14. I know how to assess student learning.	32.8	50.4	11.5	3.1	0
15. I know how to motivate students to learn.	28.9	52.3	12.5	5.5	.8

Technology Knowledge (TK) Domain

The technology knowledge (TK) domain consisted of items, 16, 17, 18, 19, 20, and 21. The mean for this subscale was 2.02 and the overall mode was 1.83 (see Table 5). This indicates that the majority of the participants are confident in their ability to use technology as a teaching apparatus. More specially, 57% (*n* = 73) agreed they are familiar with a variety of hardware, software and technology tools to use for teaching. Also, 50.8% (*n* = 65) agreed that they know how to troubleshoot technology problems. Table 8 presents the descriptive statistics for all survey items for this subscale.

Table 8

Technology Knowledge (TK) Domain Frequency Percentage (n=128)

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
16. I am familiar with a variety of hardware, software and technology tools that I can use for teaching.	20.3	57.0	7.0	14.8	.8
17. I know how to troubleshoot technology problems when they arise.	14.1	50.8	16.4	14.1	4.7
18. I do not know how to use technology in my everyday life.	.8	1.6	2.3	39.8	55.5
19. I recognize that technology use can have positive and negative effects.	46.1	51.6	1.6	.8	0
20. I cannot decide when technology can be beneficial to achieving a learning objective.	1.6	7.0	16.4	57.8	17.2
21. I can decide when technology may be detrimental to achieving a learning objective.	10.2	64.8	19.5	4.7	.8

Content Knowledge (CK) Domain

The Content Knowledge Domain consisted of items 22, 23, 24, 25, 26, and 27. The mean for this subscale was 1.58 and the overall mode was 1.17 (see Table 5). This indicates that the majority of the participants strongly agreed in their knowledge pertaining to the curriculum and content they teach. Overwhelmingly, 57.8% of the participants (*n* = 74) agreed strongly that they can make connections between different topics in their discipline. Followed by 53.1% (*n* = 68) agreed strongly that they can explain the value in knowing various concept in their discipline. Table 9 presents the descriptive statistics for all survey items for this subscale.

Table 9

Content Knowledge (CK) Domain Frequency Percentage (n=128)

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
22. I have a comprehensive understanding of the curriculum I teach.	51.6	45.3	1.6	1.6	0
23. I understand how knowledge in my discipline is organized.	52.3	40.6	3.1	2.3	1.6
24. I am familiar with the common preconceptions and misconceptions in my discipline.	35.2	56.3	7.8	.8	0
25. I can explain to students the value of knowing concepts in my discipline.	53.1	45.3	1.6	0	0
26. I can make connections between the different topics in my discipline.	57.8	41.4	0	.8	0
27. I stay abreast of new research related to my discipline in order to keep my own understanding of my discipline updated.	37.5	57.0	3.1	1.6	.8

Pedagogy Content Knowledge (PCK) Domain

Participant responses for items 28, 29, 30, 31, 32, and 33 yielded a mean of 1.76 and mode of 2.00 (see Table 5). This indicates that the majority of the participants agreed of mixing pedagogy strategies with content to create various interpretations of curriculum. For example, 42.2% (*n* = 54) of the participants strongly agreed and 68 of the participants (53.1%) agreed that they can provide multiple representations of content in the form of analogies, examples, demonstrations, and classroom activities. In addition, 48% of participants (*n* = 62) strongly agreed and 46% (*n* = 59) agreed to having the ability to understand that there is a relationship between content and the teaching methods used to teach that content. Table 10 presents the descriptive statistics for all survey items for this subscale.

Table 10

Pedagogy Content Knowledge (PCK) Domain Frequency Percentage (n=128)

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
28. I understand that there is a relationship between content and the teaching methods used to teach that content.	48.4	46.1	3.9	1.6	0
29. I can anticipate students' preconceptions and misconceptions.	21.1	56.3	17.2	4.7	.8
30. I can address students' preconceptions and misconceptions.	35.2	56.3	7.0	1.6	0
31. I understand what topics or concepts are easy or difficult to learn.	35.9	56.3	5.5	2.3	0
32. I can provide multiple representations of content in the form of analogies, examples, demonstrations, and classroom activities.	42.2	53.1	3.1	1.6	0
33. I can adapt material to students' abilities, prior knowledge, preconceptions, and misconceptions.	36.7	50.8	9.4	3.1	0

Technology Pedagogy Knowledge (TPK) Domain

The technology pedagogy knowledge (TPK) domain consisted of survey items 34, 35, 36, 37, 38, and 39. The mean for this subscale was 1.99 and the overall mode was 2.00 (see Table 5). This indicates that the majority of the participants agreed with the statement regarding their ability to integrate technology with their pedagogy. For instance, 24.2% (*n* = 31) strongly agreed and 60.9% (n = 78) agreed that they understand how teaching and learning change when certain technologies are used. Over half (66.4%) of the participants (n = 85) agreed that they know how to be flexible with their use of technology to support teaching and learning. Table 11 presents the descriptive statistics for all survey items for this subscale.

Table 11

Technology Pedagogy Knowledge (TPK) Domain Frequency Percentage (n=128)

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
34. I understand how teaching and learning change when certain technologies are used.	24.2	60.9	10.2	3.9	.8
35. I do not understand how technology can be integrated into teaching and learning to help students achieve specific pedagogical goals and objectives.	.8	9.4	5.5	54.7	29.7
36. I do not know how to adapt technologies to support teaching and learning.	1.6	7.8	12.5	54.7	23.4
37. I know how to be flexible with my use of technology to support teaching and learning.	18.8	66.4	8.6	5.5	.8
38. I cannot reconfigure technology and apply it to meet instructional needs.	3.9	14.1	18.8	43.0	20.3
39. I understand that in certain situations technology can be used to improve student learning.	50.0	49.2	.8	0	0

Technology Content Knowledge (TCK) Domain

Survey items for the technology content knowledge (TCK) domain consisted of 40, 41, 42, 43, 44, and 45. The mean for this subscale was 2.08 and the overall mode was 2.00 (see Table 5). This indicates that the majority of the participants agreed that they understand the need for technology to be properly integrated with content. Over half (66.4%) of the participants (*n* = 85) agreed that they are aware of how different technologies can be used to provide multiple and varied representations of the same content. In addition, 66.4% (*n* = 85) feel that they have the ability to select specific technologies that are best suited for addressing learning objectives in my discipline. Table 12 presents the descriptive statistics for all survey items for this subscale.

Table 12

Technology Content Knowledge (TCK) Domain Frequency Percentage (n=128)

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
40. I cannot select and integrate technological tools appropriate for use in specific disciplines (or content).	.8	9.4	14.1	53.9	21.9
41 I understand how the choice of technologies allows and limits the types of content ideas that can be taught.	17.2	64.1	15.6	2.3	.8
42. I do not understand how some content decisions can limit the types of technology that can be integrated into teaching and learning.	2.3	6.3	17.2	57.8	16.4
43. I am aware of how different technologies can be used to provide multiple and varied representations of the same content.	25.8	66.4	6.3	6.3	1.6
44. I cannot select specific technologies that are best suited for addressing learning objectives in my discipline.	2.3	6.3	10.9	64.1	16.4
45. I understand that I need to be flexible when using technology for instructional purposes.	34.4	60.9	2.3	2.3	0

Technology Pedagogy Content Knowledge (TPaCK) Domain

Survey items 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, and 56 make up the Technology Pedagogy Content Knowledge (TPaCK) domain. The mean for this subscale was 2.12 and the overall mode was 2.00 (see Table 5). This indicates that the majority of the participants agreed that they have ability to merge the use of technology with content and their existing pedagogy. Over half (65.6%) agreed that they can teach methods that are technology-based in order to teach content and provide opportunities for learners to interact with ideas (n = 84). In addition, 64.8% (n = 83) understand how digital technologies can be used to represent content in a variety of formats. Table 13 presents the descriptive statistics for all survey items for this subscale.

Table 13

Technology Pedagogy Content Knowledge (TPaCK) Domain Frequency Percentage (n=128)

Survey Item	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
46. I can effectively integrate educational technologies to increase student opportunities for interaction with ideas.	15.6	62.5	14.1	7.8	0
47 I have different opportunities to teach specific curriculum content topics with technology.	16.4	51.6	21.1	10.2	.8
48. I can use appropriate instructional strategies to teach specific curriculum content topics with technology.	19.5	64.1	11.7	4.7	0
49. I cannot determine when a technology resource may fit with one learning situation in my discipline, and not with another.	1.6	12.5	10.9	60.2	14.8
50. I can flexibly incorporate new tools and resources into content and my teaching methods to enhance learning.	19.5	58.6	14.1	7.0	.8
51. I understand how digital technologies can be used to represent content in a variety of formats.	22.7	64.8	10.2	2.3	0
52. I can use teaching methods that are technology-based to teach content and provide opportunities for learners to interact with ideas.	21.1	65.6	7.8	3.9	1.6
53. I understand what makes certain concepts difficult to learn for students and how technology can be used to leverage that knowledge to improve student learning.	14.8	54.7	21.9	7.8	.8
54. I do not understand how to integrate technology to build upon students' prior knowledge of curriculum content.	22.7	48.4	18.0	10.2	.8
55. I know how to operate classroom technologies and can incorporate them into my particular discipline to enhance student learning.	25.8	58.6	8.6	6.3	.8
56. I know how to integrate the use of educational technologies effectively into curriculum-based learning.	15.6	60.9	15.6	7.0	.8

Research Question 2

The second research question was "Is there a difference in faculty self-assessments of technological, pedagogical, and content knowledge (TPaCK) based on educational discipline, gender, and academic, as measured by the HE-TPaCK survey?"

Multiple Regression Analysis

A multiple linear regression analysis was conducted to determine the extent to which gender, consensus, and academic ranking (independent variables) were related to the seven TPaCK domain averages (dependent variables). In order to make inferences back to the population for multiple linear regression, the following assumptions require that 1) the regression of the dependent variables on the independent variables are linear; 2) the independent variables are fixed and measured without error; and 3) the residuals are unbiased, normally distributed, independent, and the variances of the residuals are equal at each level of the independent variables. Regression diagnostics were conducted to determine if any data points were outlying or influential. The Studentized Residual (SRESID) observations were used to evaluate outliers and influence on specific estimates was evaluated using the Standardized DFBETA for the intercept, gender, consensus, and academic ranking. The results revealed there were a few observations that were recurring outliers and influential across multiple domains. However, none of the observations were deleted because those observations are believed to accurately reflect the participants' understanding of the survey item, therefore a true representation of the participants' self-assessment. Multiple regression analyses were conducted for the independent variables consensus, gender, and academic rank for each of the seven domains. In addition, Technology Training was included in all of the models as a control variable.

Pedagogy Knowledge (PK) Domain

The first multiple regression analysis investigated the relationship between Pedagogical Knowledge (PK) and all independent variables, gender, consensus, and academic ranking. All of the variables explained a statistically significant variation in PK, $F(4, 123) = 4.802$, $p = .001$. Approximately 10.7% of the variance in the PK domain can be explained by gender, consensus, and academic ranking. Next, each independent variable was examined to determine its relationship with Pedagogical Knowledge. The results for academic ranking indicated a significant difference in PK between tenured and non-tenured professors, $t(128) = 4.276$, $p = .001$, controlling for gender, consensus, and technology training. The average PK for tenured faculty ($n = 53$) was 1.604 while the average for non-tenured ($n = 75$) was 2.110. The 95% confidence interval for this difference was .284 and .773 for lower and upper bound, respectively. The results for Gender and Consensus did not reveal a statistically significant relationship for the PK domain.

Technology Knowledge (TK) Domain

The multiple regression analysis investigated the relationship between Technology Knowledge (TK) and all independent variables, gender, consensus, and academic ranking. All of the variables did not explain a statistically significant variation in TK, $F(4, 123) = 1.196$, $p = .316$. Approximately 0.6% of the variance in the TK domain can be explained by gender, consensus, and academic ranking. Next, each independent variable was examined to determine its relationship with Technology Knowledge. The 95% confidence interval for the difference based on gender was -.190 and .230; consensus -.240 and .314; and academic ranking was -.190 and .201 for lower and upper bound, respectively. The results revealed no statistical significance relationship for the TK and all other independent variables.

Content Knowledge (CK) Domain

The multiple regression analysis investigated the relationship between Content Knowledge (CK) and all independent variables, gender, consensus, and academic ranking. All of the variables did not explain a statistically significant variation in CK, $F(4, 123) = 2.219$, $p = .071$. Approximately 3.7% of the variance in the CK domain can be explained by gender, consensus, and academic ranking. Next, each independent variable was examined to determine its relationship with Content Knowledge. The results for academic ranking indicated a difference in CK between tenured and non-tenured professors, $t(128) = 7.495$, $p = .004$, controlling for gender, consensus, and technology training. The average CK for tenured faculty ($n = 53$) was 1.447 while the average for non-tenured ($n = 75$) was 1.682. The 95% confidence interval for this difference was .076 and .406 for lower and upper bound, respectively. The results for Gender and Consensus did not reveal a statistically significant relationship for the CK domain.

Pedagogy Content Knowledge (PCK) Domain

The multiple regression analysis investigated the relationship between Pedagogical Content Knowledge (PCK) and all independent variables, gender, consensus, and academic ranking. All of the variables did not explain a statistically significant variation in PCK, $F(4, 123) = 1.991$, $p = .10$. Approximately 3.0% of the variance in the PCK domain can be explained by gender, consensus, and academic ranking. Next, each independent variable was examined to determine its relationship with Pedagogical Content Knowledge. The results for academic ranking indicated a difference in PCK between tenured and non-tenured professors, $t(128) = 6.980$, $p = .025$, controlling for gender, consensus, and technology training. The average PCK for tenured faculty ($n = 53$) was 1.664 while the average for non-tenured ($n = 75$) was 1.834.

The 95% confidence interval for this difference was .027 and .384 for lower and upper bound, respectively. The results for Gender and Consensus did not reveal a statistically significant relationship for the PCK domain.

Technological Pedagogical Knowledge (TPK) Domain

The multiple regression analysis investigated the relationship between Technological Pedagogical Knowledge (TPK) and all independent variables, gender, consensus, and academic ranking. All of the variables did not explain a statistically significant variation in TPK, $F(4, 123) = 1.005$, $p = .408$. Approximately 0% of the variance in the TPK domain can be explained by gender, consensus, and academic ranking. Next, each independent variable was examined to determine its relationship with Technological Pedagogical Knowledge. The 95% confidence interval for the difference based on gender was -.209 and .253; consensus -.376 and .233; and academic ranking was -.014 and .416 for lower and upper bound, respectively. The results revealed no statistical significant relationship for the TPK and all other independent variables.

Technological Content Knowledge (TCK) Domain

The multiple regression analysis investigated the relationship between Technological Content Knowledge (TCK) and all independent variables, gender, consensus, and academic ranking. All of the variables did not explain a statistically significant variation in TCK, $F(4, 123) = 1.225$, $p = .304$. Approximately 0.7% of the variance in the TCK domain can be explained by gender, consensus, and academic ranking. Next, each independent variable was examined to determine its relationship with Technological Content Knowledge. The 95% confidence interval for the difference based on gender was -.179 and .294; consensus -.034 and .406; and academic ranking was -.272 and .352 for lower and upper bound, respectively. The results revealed no statistical significant relationship for the TCK domain and all other independent variables.

Technological Pedagogical Content Knowledge (TPaCK) Domain

The last multiple regression analysis investigated the relationship between Technological Pedagogical Content Knowledge (TPaCK) and all independent variables, gender, consensus, and academic ranking. All of the variables did not explain a statistically significant variation in TPaCK, $F(4, 123) = 1.750$, $p = .143$. Approximately 2.3% of the variance in the TPaCK domain can be explained by gender, consensus, and academic ranking. Next, each independent variable was examined to determine its relationship with Technological Pedagogical Content Knowledge. The results for academic ranking indicated a difference in TPaCK between tenured and non-tenured professors $t(128) = 4.276$, $p = .012$, controlling for gender, consensus, and technology training. The average TPaCK for tenured faculty ($n = 53$) was 1.950 while the average for non-tenured ($n = 75$) was 2.234. The 95% confidence interval for this difference was .062 and .498 for lower and upper bound, respectively. The results for Gender and Consensus did not reveal a statistically significant relationship for the PCK domain.

Summary

In summary, this chapter presented the results of the self-assessment of faculty HE-TPaCK at a southeastern research university. A large majority of the participants indicated that they have the knowledge to incorporate technology along with their pedagogy and content. There was also strong agreement that technology training is important and should be provided by the university in order to adequately use technology to enhance teaching. Findings from the multiple regression analysis revealed that academic ranking (tenured versus non-tenured) was statistically significant in the Pedagogy Knowledge (PK), Content Knowledge (CK), Pedagogical Content Knowledge (PCK), and the Technological, Pedagogical, Content Knowledge (TPaCK) domains.

CHAPTER V:

DISCUSSION OF RESULTS

This study allowed faculty at a southeastern research university to self-assess their technological, pedagogical, and content knowledge (TPaCK). More specifically, this study compared and contrasted the TPaCK of higher education faculty based on educational disciplines, academic ranking, and gender.

Theoretical Framework

This study used the Technological Pedagogical and Content Knowledge (TPaCK) model as its framework. The TPaCK model (Mishra & Koehler, 2006) was originally designed to assess the technology, pedagogy, and content knowledge of K-12 teachers. For this study, a modified TPaCK survey, called HE-TPaCK, was developed to allow faculty at higher education institutions to self-assess their ability to integrate technology with their existing pedagogy and content knowledge. The HE-TPaCK was constructed from an existing surveys on TPaCK (Lux, Bangert, & Whittier, 2011) and researcher-developed items related to technology training (Georgina & Olson, 2008). Construct validity and Cronbach's alpha were used to validate the survey. The HE-TPaCK survey is comprised of nine sections: demographic items, Technology Training, Technology Knowledge (TK), Pedagogy Knowledge (PK), Content Knowledge (CK), Pedagogical Content Knowledge (PCK), Technology Content Knowledge (TCK), Technology Pedagogical Knowledge (TPK), and Technological, Pedagogical, Content Knowledge (TPaCK). Excluding the demographic items on the survey, each of the remaining eight (8) sections addressed concepts related to the associated domain name.

Research Question 1

What are faculty self-assessments of TPaCK as measured by the HE-TPaCK survey? This study found that a majority of the participants agreed or strongly agreed with the items in all survey domains, including technology training. This finding indicates that the faculty have a positive perception of their knowledge in each HE-TPaCK domain and feel that technology training is important. This finding also suggests that faculty may have overestimated their knowledge (Lux et al., 2011).

Technology Training

A majority of the participants agreed that technology training is an important contribution for teaching. The finding was consistent with Pajares' (1992) finding that faculty believe that technology training would be beneficial to their pedagogy enhancement. With those beliefs influencing their behavior, faculty are inclined to value technology training and other support offered by their university. It is important that technology training be designed with the intent for pedagogical integration by faculty in order to keep faculty actively engaged (Rientes, Brouwer, & Lygo-Baker, 2013).

Conducting technology training in small groups, such as college or departmental specific teams, would give faculty an opportunity for specialized assistance (Wetzel, Foulger, & Williams, 2009). This form of support would increase faculty confidence, which would increase their interest in integrating technology with their pedagogy and content and becoming change facilitators for other faculty who are reluctant to attend technology training (Niess, 2011; Koh & Divaharan, 2011; White & Myers, 2001). Providing social networking events, such as technology symposiums, would allow faculty to share their experiences using instructional technology tools, thus changing beliefs and fostering more technology interest (Messina & Tabone, 2012; Kim, Kim, Lee, Spector, & DeMeester, 2013).

Pedagogy Knowledge (PK) Domain

Participants agreed that they were familiar with pedagogical practices that are conducive for teaching and assessing student learning. This finding is consistent with research (Adler, 2011; Cochran-Smith, & Lytle, 2011; Koh & Divaharan, 2011; Shulman, 1987; Siegel, 2006), which shows that pedagogical strategies for teaching are based on teachers' learning and educational experiences. This finding indicates that faculty believe they are adequately prepared for instructional delivery based on pedagogical training they may have received during their doctoral program or other professional development (Pajares, 1992).

Participants may not have taken into consideration that their content and technology knowledge are separate from pedagogical knowledge. This perspective is consistent with the study conducted by Harris and Hofer (2011) where faculty had an issue with learning how to effectively integrate the technology with the content and their existing pedagogy.

Technology Knowledge (TK) Domain

Participants agreed that they were confident in their ability to use technology as a teaching apparatus. Although this finding indicates technology knowledge (TK) is a perceived strength of faculty, there is always a need for an increase in technology experience to increase confidence (Archambault & Crippen, 2009). Faculty with limited or no technology skills should reflect on previously used instructional techniques in order to enhance their understanding of instructional technology tools (Harris & Hofer, 2011).

With continued use of existing technology knowledge (TK), faculty should become more proficient with identifying new methods of integrating technology to enhance student learning

(Koh & Divaharan, 2011). Research (Pajares, 1992; Abbit, 2011) has also suggested that beliefs may change depending on the faculty member's success at integrating technology knowledge with their content and existing pedagogy. This finding from the literature reiterates the need for institutional support in the form of technology training and other incentives that will increase the use of instructional technology tools (Rientes et al., 2013, p. 123).

Content Knowledge (CK) Domain

The majority of participants were confident in their knowledge pertaining to the curriculum and content they teach. Since it is the norm in doctoral programs and professional development activities for doctoral students and faculty to stay within their curriculum of study (Golde & Dore, 2001), it was expected that the participants would have high confidence in their content knowledge.

Exhibiting high content knowledge should better aid faculty in selecting technology that will enhance student learning of the content, which makes the distinction between technology and content knowledge minimal (Lux, Bangert, &Whittier, 2011). Strong content knowledge can influence the method of instruction and technology used, resulting in good teaching (Lux et al., 2011).

Pedagogical Content Knowledge (PCK) Domain

The majority of the participants agreed that they mix pedagogical strategies with content to create various interpretations of curriculum. This finding is in alignment with Shulman's (1987) PCK theory, where teaching strategies enhance the content for effective learning. A strong pedagogical content knowledge (PCK) offers a foundation for "good teaching" (Archambault & Crippen, 2009).

Faculty PCK is continuously evolving as faculty gain more teaching experience in their respective disciplines. As Harris and Hofer (2011) pointed out in their study the PCK domain, some participants may believe that technology is a limiting aspect for pedagogy. This perspective is to be expected from faculty with limited technology knowledge or limited interest in increase their technology knowledge. This technology limitation will probably be reflected in their teaching behaviors (Pajares, 1992). However, faculty with an interest in enhancing their existing PCK through the use of technology will become change facilitators by collaborating and sharing experiences with other faculty (Niess, 2011; Koh & Divaharan, 2011; White & Myers, 2001).

Technological Pedagogical Knowledge (TPK) Domain

A majority of participants agreed that they have the ability to integrate technology with their pedagogy. This finding indicates that faculty are able to select instructional tools suitable for their instructional styles (Harris & Hofer, 2011) through "pedagogical thoughtfulness" (van Manen, 1995, p. 8). This finding is consistent with van Manen's (1995) "pedagogical thoughtfulness" which suggests that faculty are focused on continuous development of meaningful learning activities (p. 8). Incorporating technology with pedagogy is an example of continuous development of learning activities, as suggested by van Manen (1995).

In addition, faculty should be able to motivate and enhance learning through technologically enhanced pedagogy (Cox & Graham, 2009). Graham (2011) presented the idea that faculty should be able to determine their ability to transition from TPK into TPaCK (p. 1959). This may be feasible with adequate technology training made available to faculty, but it is important to note that this is a gradual learning curve in which faculty should not expect immediate understanding of how technology, pedagogy, and content are merged for all learning activities.

Technological Content Knowledge (TCK) Domain

A majority of the participants agreed that they understand the need for technology to be properly integrated with content. This is consistent with Cox and Graham's (2009) finding that college professors usually have stronger TCK (p. 69). Given the findings of this study, faculty should be able to better select appropriate technology for learning objectives (Lux et al., 2011, p. 423).

Since faculty are discipline experts, it is important for the technology they use to be assessed for its ability to promote active learning (Farra, 1980). Through continued use of the selected instructional technology tools, faculty will become more comfortable with technology, which should increase technology usage (Lux et al., 2011).

Technological Pedagogical and Content Knowledge (TPaCK) Domain

The participants agreed that they have the ability to merge the use of technology with content and their existing pedagogy. This finding suggests that the faculty believe they encompass the full array of good teaching characteristics from a teacher-centered perspective (Harris & Hofer, 2011; Lux et al., 2011; Niess, 2011; Norton et al., 2005). As a result, their beliefs should be evident in their teaching behavior (Pajares, 1992).

Well-blended TPaCK is a gradual process for faculty to develop (Niess, 2011). This requires faculty to be flexible with instructional goals by trying different instructional technology tools in order to expand their overall TPaCK (Messina & Tabone, 2012). Higher education institutions can aid in the growth of faculty members' TPaCK through continuous professional development for all teaching faculty, including doctoral students and existing faculty (Golde & Dore, 2001; Lux, Bangert, &Whittier, 2011, p. 420).

Research Question 2

Is there a difference in faculty self-assessments of technological, pedagogical, and content knowledge (TPaCK) based on educational discipline, gender, and academic, as measured by the HE-TPaCK survey? In this study academic ranking was the only variable that revealed a statistically significant difference. Specifically, there is a significant difference in the pedagogy knowledge (PK), content knowledge (CK), pedagogy content knowledge (PCK), and technological, pedagogical, and content knowledge (TPaCK) across academic rank.

Pedagogy Knowledge (PK) Domain

The results for academic ranking indicated a significant difference in PK between tenured and non-tenured professors, $t(128) = 4.276$, $p = .001$, when controlling for technology training based on gender, educational discipline, and academic ranking. There was no statistical significance based on educational discipline and gender. This finding indicates that tenured and non-tenured faculty differ in their beliefs about their pedagogical knowledge, with tenured faculty having the stronger perception of their PK. This is expected since tenured faculty, which consists of associate professors and professor rankings, have developed years of pedagogical knowledge through years of teaching and conference presentations. Non-tenured faculty, consisting of assistant professors, graduate teaching assistants, and clinical/adjunct instructors, have less number of years of teaching experience and have not fully developed their pedagogical repertoire (Koh & Divaharan, 2011).

The average PK for tenured faculty ($n = 53$) was 1.604 while the average for non-tenured ($n = 75$) is 2.110. These averages also provide support that the difference in experience with instructional methods could be a contributing factor to the difference in the PK averages. Using Bloom's taxonomy as a guide, tenured faculty have transitioned from the remembering level to the creating level throughout their years of teaching experiences (Clark, 1995; Atherton, 2009; Krathwohl, 2002). Lux, Bangert, and Whittier (2011) highlighted that the PK of novice teachers, such as pre-service teachers, is limited due to their lack of experience (p. 423). This same notion applies to non-tenured faculty, especially graduate teaching assistants. This is a plausible reason why there was a statistical difference in this domain.

Technology Knowledge (TK) Domain

The results revealed no statistical significance relationship for the TK and all other independent variables (gender, academic ranking, and educational discipline). With the varying technological skills of faculty, this finding is not deemed unusual. A contributing factor could be that faculty are considering more general forms of instructional technology tools, such as PowerPoint or overhead projectors. These two forms are of common use by many faculty, therefore, probably not considered instructional technology tools. However, this does not convey their ability to truly understand or evaluate common forms of instructional technology tools for more creative uses that would advance to higher order learning levels (Clark, 1995; Atherton, 2009; Krathwohl, 2002).

Content Knowledge (CK) Domain

The results for academic ranking indicated a difference in CK between tenured and non-tenured professors, $t(128) = 7.495$, $p = .004$, when controlling for technology training based on gender, educational discipline, and academic ranking. There was no statistical significance based on educational discipline and gender. This finding indicates that the tenured and non-tenured faculty differ in their beliefs about their content knowledge, with tenured faculty having the stronger perception of their CK. This is expected since the tenured faculty have had years of experience honing their discipline through research and teaching. Non-tenured faculty are either at the beginning stages of their faculty career or do not have interest in depth content expansion. Shulman (1986) stated that “a century ago the defining characteristic of pedagogical accomplishment was knowledge of content” (p. 7). This posits the need for teaching and content development, also known as PCK (Shulman, 1986; 1987).

The average CK for tenured faculty (n = 53) is 1.447 while the average for non-tenured (n = 75) is 1.682. These averages also provide support that the levels of experience within their discipline could be a contributing factor to the difference in the CK averages. Using Bloom’s taxonomy as a guide, tenured faculty are considered experts in their disciplines, thus actively at the creating level of exploring new dimensions of their discipline through continuous research (Clark, 1995; Atherton, 2009; Krathwohl, 2002). Non-tenured faculty could be at any of the Bloom’s levels depending on their years of experience in their discipline (Clark, 1995; Atherton, 2009; Krathwohl, 2002).

Pedagogical Content Knowledge (PCK) Domain

The results for academic ranking indicated a difference in PCK between tenured and non-tenured professors, $t(128) = 6.980$, $p = .025$, when controlling for technology training based on gender, educational discipline, and academic ranking. There was no statistical significance based on educational discipline and gender. This finding indicates that the tenured and non-tenured faculty differ in their beliefs about their pedagogical content knowledge, with tenured faculty having the stronger perception of their PCK. Like with content knowledge, this is expected since the tenured faculty have had years of experience enhancing their instructional methods through research and teaching (Shulman, 1986). The combination of pedagogy and content knowledge may be an area for improvement for non-tenured faculty as they are developing their instructional repertoire.

The average PCK for tenured faculty (*n* = 53) is 1.664 while the average for non-tenured (*n* = 75) is 1.834. These averages also provide support that tenured faculty have crafted their teaching skills through years of experience, where as non-tenured may be still identifying teaching styles that suite their preference. Although there is a statistical difference in PCK between tenured and non-tenured, this is not evident that the PCK used is actually effective for student learning, as pointed out by Harris and Hofer (2011).

Technological Pedagogical Knowledge (TPK) Domain

The results revealed no statistical significant relationship for the TPK and all other independent variables (gender, academic ranking, and educational discipline). This finding could be the result of both tenured and non-tenured faculty reflecting on their ability to use more advanced forms of technology as instructional tools.

Faculty should be able to understand, analyze, and evaluate technology tools that would make learning more effective (Clark, 1995; Krathwohl, 2002; Atherton, 2009; Harris & Hofer, 2011). If faculty members' beliefs are not open to change, then their TPK is likely to suffer, which will reflect in their technology choices or lack thereof (Pajares, 1992).

Technological Content Knowledge (TCK) Domain

The results revealed no statistical significant relationship for the TCK domain and all other independent variables (gender, academic ranking, and educational discipline). As previously mentioned, the TCK domain did not emerge in the Lux et al. (2011) study. The absence of a statistical difference could be an indication that all faculty have experienced an effective masters and/or doctoral program and professional development, where the technology actually enhanced content or was well blended (Cox & Graham, 2009; Lux et al., 2011). Thus changing their beliefs about technology and resulting in an open approach to utilizing technology. On the opposing view, some faculty could perceive technology as a limiting aspect to learning and as a result choose not to enhance their TCK (Harris &Hofer, 2011).

Lux et al. (2011) stated that viewing TCK as a “central component of teacher knowledge” (p. 427) enhances the risk of missing PCK as a valuable paradigm. Non-tenured faculty, such as graduate teaching assistants, may find it challenging to adequately access their TCK without the influence of their PK or PCK. For instance, learning activities are often times matched to the content (Harris & Hofer, 2011). If there is limited evidence that a faculty member’s TCK was incorporated to enhance student learning, then this will decrease their interest in learning new technology for teaching. (Harris & Hofer, 2011). Cox and Graham (2009) indicated that some teacher educators feel that teachers should acquire TCK and as a result TPaCK will develop through instructional usage. With this approach in mind, faculty in higher education settings should focus on developing the TCK of future faculty members in doctoral programs as suggested by Golde and Dore (2001).

Technological Pedagogical and Content Knowledge (TPaCK) Domain

The results for academic ranking indicated a significant difference in TPaCK between tenured and non-tenured faculty $t(128) = 4.276$, $p = .012$, when controlling for technology training based on gender, educational discipline, and academic ranking. There was no statistical significance based on educational discipline and gender. This finding indicates that the tenured and non-tenured faculty differ in their beliefs about their technological, pedagogical, and content knowledge, with tenured faculty having the stronger perception of their TPaCK. This finding is to be expected due to the varying knowledge levels indicated in the domains previously presented. The faculty who have an interest in enhancing their instructional styles with technology will probably make the attempt without coercion from higher education administration. These will probably be the faculty who seek the necessary training and guidance needed in order to successfully integrate technology and become more technology savvy trendsetters. The faculty who are technology resistors and demonstrate limited interest in the use of instructional technology tools may only integrate technology when enforced by administrators (Southern Association of Colleges and Schools, 2010a, 2010b). It is important to note that the ranking distinction of faculty does not necessarily adhere to the role of technology savvy trendsetters or technology resistors. It is highly probably that there are technology resistors and technology savvy trendsetters who fall into the categories of both tenured and non-tenured.

The average TPaCK for tenured faculty (n = 53) is 1.950 while the average for non-tenured (n = 75) is 2.234. These averages also provide support that varying levels of interest in technology integration could be a contributing factor of the differences in the TPaCK averages. In order for higher education institutions to meet accreditation guidelines there has to be faculty support geared towards technology integration.

It is hopeful that the tenured and non-tenured faculty are progressing towards a more blended TPaCK. Cox and Graham (2009) stated "as the technologies used in those activities and representations become ubiquitous, TPACK transforms into PCK" (p. 64). This implies that technology, content, and pedagogy are uniquely intertwined in the minds of faculty, which leads to no boundaries. This would be an ideal outcome for faculty at higher education institutions. However, this creates the assumption that faculty have the desire to adjust their pedagogy to include technology while maintaining pedagogical quality.

Conclusions

The results from this study revealed that a majority of the participants either strongly agreed or agreed with each survey items in all domains. These results indicate that the faculty have a positive perception of their knowledge in the pedagogy knowledge (PK), content knowledge (CK), technology knowledge (TK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and the technological, pedagogical, and content knowledge (TPaCK) domains. Since the HE-TPaCK survey is a measurement of data from self-assessments, the high scores could indicate that faculty overestimate their knowledge (Lux et al., 2011). Overall, exposure to new pedagogy styles, technology tools, or content could cause fluctuation in faculty's HE-TPaCK, so it is important to note that HE-TPaCK scores are evolving due to continuous change in contextual settings (Doering et al., 2009).

The results indicated that only academic ranking led to a significant difference and only in the pedagogy knowledge (PK), content knowledge (CK), pedagogical content knowledge (PCK), and the technological, pedagogical and content knowledge (TPaCK) domains. There was no significant difference in the overall TPaCK of faculty based on gender and educational disciplines in any of the domains or the technology training section. This finding could indicate that there is not a need for gender or educational discipline specific training.

In addition, the participants indicated that technology training is important for faculty at higher education institutions. This finding could suggest that the participants utilize technology training provided at the study site. This also indicates that technology training covers useful topics that support technology integration with existing pedagogy and content.

Implications for Future Practice

Findings from of this study revealed the following implications for practice:

1. It should be taken into consideration that the HE-TPaCK scores may be biased. Therefore, additional methods of validation should be conducted through observations and pedagogical evaluations for evidence of sufficient technology integration knowledge and capability. The technology support staff should perform the observations and students should evaluate the effectiveness of technology integration. These validation methods can provide constructive feedback that faculty can use to modify and/or enhance their integration of technology with content and existing pedagogy;
2. Based on the finding that technology training was indicated as important to the participants, regardless of their gender, educational disciplines, and academic ranking, the technology support center should consider providing technology support for the integration of new technology tools as such tools emerge. As indicated by Messina and Tabone (2012), technology training encourages team collaboration and support. This literature finding could be instrumental in designing technology training for faculty and give faculty the opportunity to practice and develop their technology knowledge on a continuous basis; and
3. The HE-TPaCK scores should be collected and periodically reviewed by the technology support center to strengthen their understanding of their faculty technology integration knowledge and capability. Scores can also be compared with those of faculty at other higher education settings, who also use the HE-

TPaCK survey. Review of the scores can be used by administrators to determine areas where technology support and training are needed.

Implications for Future Research

Based on the findings of this study, the following are recommendations for future research:

1. TPaCK has mainly been focused in the science and mathematics curriculum of K-12 settings. Although this study did not find statistical differences based on educational discipline, low consensus (educational) disciplines in higher education should evaluate faculty HE-TPaCK and compare to the findings in K-12 settings. This research will support technology integration in all curriculums/disciplines;
2. Future research involving both qualitative and quantitative research on the development and use of HE-TPaCK will have a significant impact on how faculty and future faculty engage technology as instructional tools. Findings from these research methods would provide a HE-TPaCK scoring and would also allow faculty to reflect on knowledge they have and use. The HE-TPaCK scoring and reflection will allow data to be compared and contrasted, thus mitigating bias of self-assessments;
3. The connection between academic ranking and the HE-TPaCK domains is worth exploring in more detail. Based on the results from this study, a follow up case study would be useful to describe the more in-depth HE-TPaCK differences between tenured and non-tenured faculty at this study site;
4. Due to the relatively low Cronbach alpha (.566) in the Technology Training section of the HE-TPaCK survey, revisions should be considered in order to increase validity of the scale and re-examine the relationship as a covariant; and

5. Future research using the HE-TPaCK survey should consider removing some of the items from select HE-TPaCK domains. A shorter survey could potentially increase the number of completed surveys submitted by participants.

Summary

The purpose of this study was to assess the HE-TPaCK of faculty at a southeastern research university. This study aimed to establish a clear and concise survey instrument that could be used by higher education institutions to compare and analyze data with other research universities. Descriptive statistics revealed that a majority of all participating faculty agreed with the statements in seven domains (technology training, pedagogy knowledge (PK), pedagogy content knowledge (PCK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and the technological, pedagogical, and content knowledge (TPaCK)) and strongly agreed with statements in two domains (technology knowledge (TK) and content knowledge domains (CK)).

A multiple linear regression analysis was conducted to identify differences in HE-TPACK due to educational discipline types, gender and academic rank. Based on academic rank, results revealed significant differences in the pedagogical knowledge (PK), content knowledge (CK), pedagogical content knowledge (PCK), and the technological, pedagogical, content knowledge (TPaCK) domains. There were no differences based on gender and educational discipline types.

REFERENCES

Abbitt, J. T. (2011). An investigation of the relationship between self-efficacy beliefs about technology integration and technological pedagogical content knowledge (TPACK) among preservice teachers. *Journal of Digital Learning in Teacher Education*, *27*(4), 134–143.

Adler, S. M. (2011). Teacher epistemology and collective narratives: Interrogating teaching and diversity. *Teaching and Teacher Education*, *27*(3), 609-618. doi:10.1016/j.tate.2010.10.015

Archambault, L., & Crippen, K. (2009). Examining TPACK among k-12 online distance educators in the United States. *Contemporary Issues in Technology and Teacher Education, 9*(1), 71-88.

Association of American Universities. (2011). Retrieved from http://www.aau.edu/research/article.aspx?id=4670

Atherton, J. S. (2009). Bloom's taxonomy. Retrieved from http://www.learningandteaching.info/learning/bloomtax.htm

Ausband, L. (2006). Instructional technology specialist and curriculum work. *Journal on Research of Technology in Education*, 39(1), 1-21.

Austin, A. E. (2003). Creating a bridge to the future: Preparing new faculty to face changing expectations in a shifting context. *The Review of Higher Education, 26*(2), 119-144. doi: 10.1353/rhe.2002.0031

Barnes, L., Bull, K., Campbell, N., & Perry, K. (2001). Effects of academic discipline and teaching goals in predicting grading beliefs among undergraduate teaching faculty. *Research in Higher Education, 42*(4), 455-467.

Biglan, A. (1973a). Relationship between subject matter characteristics and the structure and output of university departments. *Journal of Applied Psychology, 57*(3), 204-213.

Biglan, A. (1973b). The characteristics of subject matter in different academic areas. *Journal of Applied Psychology, 57*(3), 195-203.

Browd, S. R. (2000). Online approaches: Introduction to the profession of medicine. In Brown, D. G. (Ed.). *Teaching with technology*. 1st Ed.

Brown, D. (2000). Computing environment at Wake Forest university. In Brown, D. G. (Ed.). *Teaching with technology*. 1st Ed.

Carmines, E. G., & Zeller, R. A. (1979). *Reliability and validity assessment*. Newbury Park, CA: Sage.

Cheesebro, T., O'Connor, L., & Rios, F. (2007). *Communication skills: Preparing for career success.* 3rd Ed. Upper Saddle River, NJ: Prentice Hall.

Chickering, A., & Gamson, Z. (1991). Applying the seven principles for good practice in undergraduate education. San Francisco, CA: Jossey-Bass.

Clark, B. (1987). *The academic life: Small worlds, different worlds.* Princeton, NJ: Carnegie Foundation for the Advancement of Teaching.

Clark, D. (1995). Bloom's taxonomy of learning domains: The three types of learning. Retrieved from http://www.nwlink.com/~Donclark/hrd/bloom.html#affective

Cochran-Smith, A. M., & Lytle, S. L. (1999). Relationships of knowledge and practice: Teacher learning in communities. *Review of Research in Education, 24*, 249-305.

Cox, B. S., & Graham, C. R. (2009). Using an elaborated model of the TPACK framework to analyze and depict teacher knowledge. *TechTrends, 53*(5).

Creswell, J. W. (2007). *Research design: Qualitative, quantitative, and mixed methods approaches.* 3rd Ed. Los Angeles, CA: Sage.

Crocker, L., & Algina, J. (1986). *Introduction to classical and modern test theory.* Philadelphia, Pennsylvania: Harcourt Brace Jovanovich College Publishers,

Curry, L. (1993). *Educating professionals: Responding to new expectations for competence and accountability.* San Francisco, CA: Jossey-Bass Publishers.

D'Andrea, V. M. (1999). Organizing teaching and learning: Outcomes-based planning. In H. Fry, S. Ketteridge, & S. Marsha (Eds.). *A handbook for teaching & learning in higher education: Enhancing academic practice*. London: Kogan Page.

Doering, A., Veletsianos, G., Scharber, C., & Miller, C. (2009). Using the technological, pedagogical, and content knowledge framework to design online learning environments and professional development. *Journal of Educational Computing Research, 41*(3), 319–346. doi:10.2190/EC.41.3.d

Ellington, H., Gordon, M., & Fowlie, J. (1998). *Using games and simulations in the classroom*. London: Kogan Page.

Entwistle, N., & Walker, P. (2000). Strategic alertness and expanded awareness within sophisticated conceptions of teaching. *Instructional Science 28*, 335-361.

Farra, H. (1980). Self-development games and simulations: An evaluation. In R. E. Horn & A. Cleaves (Eds.), *The guide to simulations/games for education and training*. Beverly Hills, CA: Sage Publisher.

Fink, A. (2009). *How to conduct surveys: A step by step guide*. 4th Ed. Los Angeles, CA: Sage.

Freeman, D. (2002). The hidden side of the work: Teacher knowledge and learning to teach. *Language Teaching, 35*, 1-13.

Georgina, D. A., & Olson, M. R. (2008). Integration of technology in higher education: A review of faculty self-perceptions. *The Internet and Higher Education*, *11*, 1-8.

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

Graham, C. R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education, 57*(3), 1953–1960. doi:10.1016/j.compedu.2011.04.010

Golde, C. M. & Dore, T. M. (2001 January). *At cross purposes: What the experiences of today's doctoral students reveal about doctoral education*. Retrieved from http://www.phd-survey.org/report%20final.pdf

Gorsky, P., Caspi, A., Antonovsky, A., Blau, I., & Mansur, A. (2010). The Relationship between academic discipline and dialogic behavior in open university course forums. *The International Review of Research in Open and Distance Learning*, *11*(2), 49–72. Retrieved from http://www.irrodl.org/index.php/irrodl/article/viewArticle/820/1546

Hall, D. W. (2000). Multimedia animation and the insects. In D. G. Brown (Ed.), *Teaching with technology training.* Boston, Anker.

Hammer, J. (2000). Data warehousing and decision support: Tales from a virtual classroom. In D. G. Brown (Ed.), *Teaching with technology*. Boston, Anker.

Harris, J. B., & Hofer, M. J. (2011). Technological pedagogical content knowledge (TPACK) in action: A descriptive study of secondary teachers' curriculum-based, technology-related instructional planning. *Journal of Research on Technology in Education, 43*(3), 211-229.

Hay, K. E., Shaw, J. S., & Hauschildt, P. H. (2000). The virtual solar system project: Students building virtual models for scientific understanding. In D. G. Brown (Ed.), *Teaching with technolog.* Boston, Anker.

Hein, G. E. (1996). *Constructivist learning theory.* Retrieved from http://www.exploratorium.edu/IFI/resources/constructivistlearning.html

Hearn, J., & Anderson, M. (2002). Conflict in academic departments: An analysis of disputes over faculty promotion and tenure. *Research in Higher Education, 43*(5), 503-529.

Hicks, T. (2006). Expanding the conversation: A commentary toward revision of Swenson, Rozema, Young, McGrail, and Whitin. *Contemporary Issues in Technology and Teacher Education, 6*(1), 46-55.

Hilton, N. (2000). Renewing English teaching with computer applications. In D. G. Brown (Ed.), *Teaching with technolog.* Boston, Anker.

Jackson, W. K, & McRae, W. B. (2000). Computing environment at the university of Georgia. In D. G. Brown (Ed.), *Teaching with technology*. Boston, Anker.

Jarvis, P. (2001). Lifelong learning: Universities and adult education. *Asia Pacific Education Review*, *2*(2), 28-34. doi:10.1007/BF03026288

Jones, K. (1980). *Simulation: A handbook for teachers and trainers*. New York, NY: Nichols Publishing Company.

Jones, W. A. (2011). Variation among academic disciplines: An update on analytical frameworks and research. *Journal of the Professoriate, 6*(1), 9-27.

Khine, M. S., & Fisher, D. (2003). *Technology-rich learning environments: A future perspective*. River Edge, NY: World Scientific.

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. doi:10.1016/j.tate.2012.08.005

King, A. G., & Wong, Y. L. (2000). The use of preclass quizzes in chemistry classes. In D. G. Brown (Ed.), *Teaching with technology*. Boston, Anker.

Koehler, M. J. (2011). *Technological pedagogical and content knowledge model*. Retrieved from www.tpack.org

Koh, J. H. & Divaharan, S. (2011). Developing pre-service teachers' technology integration expertise through the TPaCK-developing instructional model. *Journal of Educational Computing Research*, 44(1), 35-58.

Krathwohl, D. R. (2002). A revision of bloom's taxonomy: An overview. *Theory Into Practice, 41*(4), 212-218.

Lambert, J., & Sanchez, T. (2007). Integration of cultural diversity and technology: Learning by design. *Meridian Middle School Computer Technologies Journal, 10*(1). Retrieved from http://www.ncsu.edu/meridian/win2007/pinballs/index.htm

Lee, J., & Reigeluth, C. M. (2003). Formative research on the heuristic task analysis process. *Educational Technology Research & Development, 51*(4), 5-24.

Legg, S. M. (2000). Computing environment at the university of Florida. In D. G. Brown (Ed.), *Teaching with technolog.* Boston, Anker.

Lieberman, A., & Mace, D. H. P. (2008). Teacher learning: The key to educational reform. *Journal of Teacher Education*, *59*(3), 226-234.

Litwin, M. S. (1995). *How to measure survey reliability and validity*. Thousand Oaks, CA: Sage.

Lomax, R. G., & Hahs-Vaughn, D. L. (2012). *Statistical concepts: A second course*. 4th Edition. New York, NY: Routledge.

Lux, N. J., Bangert, A. W., & Whittier, D. B. (2011). The development of an instrument to assess preservice teacher's technological pedagogical content knowledge. *Journal of Educational Computing Research, 45*(4), 415-431.

Lye, L. T. (2013). Opportunities and Challenges Faced by Private Higher Education Institution Using the TPACK Model in Malaysia. *Procedia - Social and Behavioral Sciences*, *91*, 294–305. doi:10.1016/j.sbspro.2013.08.426

Major, C. H., & Palmer, B. (2006). Reshaping teaching and learning: The transformation of faculty pedagogical content knowledge. *Higher Education*, *51*, 619-647. doi: 10.1007/s10734-004-1391-2

Mangold, K. (2007). Educating a new generation: Teaching baby boomer faculty about millennial students. *Nurse Educator*, *32*(1), 21-23.

Margerum-Leys, J., & Marx, R.W. (2002). Teacher knowledge of educational technology: A case study of student/mentor teacher pairs. *Journal of Educational Computing Research, 26*(4), 427-462.

Merriam, S. B. (2008). Adult learning theory for the twenty-first century. *New Directions for Adult and Continuing Education*, *2008*(119), 93-98. doi:10.1002/ace.309

Messina, L., & Tabone, S. (2012). Integrating technology into instructional practices focusing on teacher knowledge. *Procedia - Social and Behavioral Sciences*, *46*(2011), 1015–1027. doi:10.1016/j.sbspro.2012.05.241

Mezirow, J. (1991). *Transformative dimensions of adult learning*. San Francisco, CA: Jossey-Bass.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A new framework for teacher knowledge. *Teachers College Record, 108*(6), 1017-1054.

Modla, V. B., & Wake, D. G. (2007). Modeling active engagement and technology integration: Learning to teach literacy skills and strategies. *Journal on Excellence in College Teaching, 18*(1), 123-146.

Montagu, A.S. (2001). High-technology instruction: A framework for teaching computer-based technologies. *Journal on Excellence in College Teaching*, 12 (1), 109-128.

Morris, L.V. (2006). Have the devices changed the learner? *Innovative Higher Education*, 31(1), 1-3. doi: 10.1007/s10755-006-9009-5

National Center of Education Statistics (2011). Retrieved from http://nces.ed.gov/

National Education Association of the United States (1999). *Teaching with technology*. United States: National Education Association.

Newby, T. J., Stepich, D. A., Lehman, J. D., & Russell, J. D. (1996). *Instructional technology for teaching and learning*. Englewood Cliffs, NY: Prentice Hall

Nickerson, R. S., Perkins, D. N., & Smith, E. E. (1985). *The teaching of thinking.* Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Niess, M. L., Ronau, R. N., Shafer, K. G., Driskell, S. O., Harper, S. R., Johnston, C., Browning, C., Ozgun-Koca, S. A., & Kersaint, G. (2009). Mathematics teacher TPACK standards and development model. *Mathematics Teacher*, *9*, 4-24.

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

Norton, L. I. N., Richardson, J. T. E., Hartley, J., Newstead, S., & Mayes, J. (2005). Teachers ' beliefs and intentions concerning teaching in higher education. *Higher Education, 50*(4), 537-571. doi: 10.1007/s10734-004-6363-zNunnally, J. C. (1978). *Psychometric theory* (2nd ed.). New York: McGraw-Hill.

Orcher, L. T. (2005). *Conducting research: Social and behavioral science methods.* Glendale, CA: Pyrczak.

Paas, F., Van Gog, T., & Sweller, J. (2010). Cognitive load theory: New conceptualizations, specifications, and integrated research perspectives. *Educational Psychology Review, 22*(2), 115-121.

Pajares, M. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62(3), 307–332.*

Pyrczak, F. (1999). *Evaluating research in academic journals: A practical guide to realistic evaluation.* Los Angeles: Pyrczak.

Reiser, R. (2001a). A history of instructional design and technology: Part I: A history of instructional media. *Educational Technology Research and Development, 49*(1), 53-64.

Reiser, R. (2001b). A history of instructional design and technology: Part II: A history of instructional media. *Educational Technology Research and Development, 49*(2), 57-67.

Renkl, A., Hilbert, T., & Schworm, S. (2009). Example-Based learning in heuristic domains: A cognitive load theory account. *Educational Psychology Review, 21*(1), 67-78.

Rieber, L. P. (2000). The studio experience: Educational reform in instructional technology. In D. G. Brown (Ed.), *Teaching with technolog.* Boston, Anker.

Rienties, B., Brouwer, N., & Lygo-Baker, S. (2013). The effects of online professional development on higher education teachers' beliefs and intentions towards learning facilitation and technology. *Teaching and Teacher Education, 29*, 122–131. doi:10.1016/j.tate.2012.09.002

Robbins, S. P. & Coulter, M. (2005). *Management.* 8th Edition. Upper Saddle River, NJ: Prentice Hall.

Rosiek, J., & Atkinson, B. (2005). Bridging the divides: The need for a pragmatic semiotics of teacher knowledge research. *Educational Theory, 55*(4), 421-442. doi: 10.1111/j.1741-5446.2005.00004

Ruey, S. (2009). A case study of constructivist instructional strategies for adult online learning. *British Journal of Educational Technology, 41*(5), 706-720.

Sahin, I. (2011). Development of survey of technological pedagogical and content knowledge (TPACK). *Educational Technology, 10*(1), 97-105.

Schmidt, D. A., Thompson, A. D., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. *Technology, 42*(2), 123-149.

Shaw, K. M. (2004). Using feminist critical policy analysis in the realm of higher education. *The Journal of Higher Education, 75*(1), 56-79.

Shiue, Y. (2007). Investigating the sources of teachers' instructional technology use through the decomposed theory of planned behavior. *Journal of Educational Computing Research, 36*(4), 425-453.

Shulman, L. (2011). Understand: Knowledge. *Educational Research*, *15*(2), 4–14.

Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, *57*(1), 1-22.

Shysh, A. J. (2000). Adult learning principles: You can teach an old dog new tricks. *Canadian Journal of Anaesthesia*, 837-842.

Siegel, H. (2006). Epistemological diversity and education research: Much ado about nothing much. *Educational Researcher, 35*(2), 3-12.

Smeby, J. (1996). Disciplinary differences in university teaching. *Studies in Higher Education, 21*(1), 69-78.

Southern Association of Colleges and Schools (2010a). Distance and correspondence education policy. Retrieved from http://sacscoc.org/pdf/Distance%20and%20correspondence%20policy%20final.pdf

Southern Association of Colleges and Schools (2010b). Best practices for electronically offered degree and certificate programs. Retrieved from http://sacscoc.org/pdf/commadap.pdf

St. Pierre, E. A. (2000). Poststructural feminism in education: An overview. *Qualitative Studies in Education, 13*(5), 477-515.

Stes, A., Coertjens, L., & Van Petegem, P. (2010). Instructional development for teachers in higher education: Impact on teaching approach. *Higher Education*, *60*(2), 187-204**.**

Stein, R. B., & Short, P. M. (2001). Collaboration in delivering higher education programs: Barriers and challenges. *The Review of Higher Education, 24*(4), 417-435. doi: 10.1353/rhe.2001.0010

Office of Institutional Research & Assessment (2012). *2012 at a glance: Total enrollment*. Retrieved from http://oira.ua.edu/d/content/glance/2013-glance-total-enrollment

Thompson, A. A. & Strickland, A. J. (2003). *Strategic management: Concepts and cases*. New York, NY: McGraw-Hill/Irwin.

Trower, C. A., Austin, A. E., & Sorcinelli, M. D. (2001). Paradise lost: how the academy converts enthusiastic recruits into early-career doubters. *AAHE Bulletin 53*, 3–6.

van Manen, M. (1995). On the epistemology of reflective practice. *Teachers and Teaching: Theory and Practice, 1*(1), 33-50.

Wetzel, K., Foulger, T. S., & Williams, M. (2009). The evolution of the required educational technology course. *Journal of Computing in Teacher Education*, *25*(2), 67-71.

White, J. T. & Myers, S. D., (2001, September). You can teach an old dog new tricks: The faculty's role in technology implementation. *Business Communication Quarterly*, *64*(3), 95-101.

Yang, S.C. & Liu, S.F. (2004). Case study of online workshop for the professional development of teachers. *Computers in Human Behavior*, *20*, 733-761.

Yarbrough, D.N. (2001). A comparative analysis of student satisfaction and learning in a computer-assisted environment versus a lecture environment. *Journal on Excellence in College Teaching*, 12 (1), 129-147.

APPENDIX A

High Consensus (Educational) Disciplines

Colleges and Schools	Low Consensus	High Consensus
College of Arts and Sciences	African American Studies	Applied Mathematics
	American Studies	Biology
	Anthropology	Chemistry
	Art History	Computer Science
	Communicative Disorders	Geology
	Creative Writing	Mathematics
	Criminal Justice	Microbiology
	Dance	Physics
	Economics	
	English	
	English as a Second Language	
	Environmental Science	
	Foreign Languages and Literature	
	Geography	
	German	
	Health Care Management	
	History	
	Interdisciplinary Studies	
	International Studies	
	Latin American Studies	
	Marine Science	
	Music	
	Philosophy	
	Political Science	
	Psychology	
	Public Administration	
	Religious Studies	
	Romance Languages	
	Sociology	
	Spanish	
	Speech-Language Pathology	
	Studio Art	
	Theatre	
	Women's Studies	

College of Commerce and Business Administration	Business Administration Economics Health Care Management* Management Marketing	Accounting Applied Statistics Banking and Finance Management Information Systems Tax Accounting Operations Management
College of Communication and Information Sciences	Advertising Advertising and Public Relations Book Arts Communication and Information Sciences Communication Studies Journalism Library & Information Studies Public Relations	Telecommunication and Film
College of Education	Counselor Education Counselor Education - Community Counseling Counselor Education - Rehabilitation Counseling Early Childhood Education Educational Administration Educational Leadership Educational Psychology Elementary Education Elementary & Middle School Administration/Principalship Higher Education Administration Human Performance Instructional Leadership Music Education School Psychology Secondary Education Secondary School Administration/Principalship Special Education	Educational Research

College of Engineering		Aerospace Engineering Chemical Engineering Civil Engineering Computer Science Construction Engineering Electrical Engineering Engineering Science and Mechanics Environmental Engineering Materials/Metallurgical Engineering Mechanical Engineering Metallurgical Engineering
Graduate School	Interdisciplinary Studies	Materials Science
College of Human Environmental Sciences	Apparel and Textiles Athletic Training Consumer Sciences Early Childhood Education Food and Nutrition General Health Studies Health Education/Promotion Health Studies Human Development and Family Studies Human Environmental Sciences Interior Design Restaurant and Hospitality Management	
School of Law	Law Law (Tax)	
Capstone College of Nursing	Nursing	
School of Social Work	Social Work	

APPENDIX B

HE-TPaCK Survey

DEMOGRAPHIC INFORMATION

1. Gender
    a. Female
    b. Male
2. Academic Ranking
    a. Assistant Professor
    b. Associate Professor
    c. Professor
    d. Adjunct
    e. Clinical Instructor
    f. Instructor
    g. Graduate Teaching Assistant
3. Tenure Status
    a. Tenured
    b. Tenure-track
    c. Neither
4. Total number of years of full time faculty (i.e. teaching experience)
    a. 0
    b. 1-4
    c. 5-9
    d. 10-14
    e. 15-19
    f. 20+
5. Select the primary college of which you are a member:
    a. College of Arts and Sciences
    b. College of Commerce and Business Administration
    c. College of Communication and Information Sciences
    d. College of Education
    e. College of Engineering
    f. Graduate School
    g. College of Human Environmental Sciences
    h. School of Law
    i. Capstone College of Nursing
    j. School of Social Work
6. Select the **primary** discipline program which you are a member:

    Applied Mathematics, Biology, Chemistry, Computer Science, Microbiology, Physics, Accounting, Applied Statistics, Banking and Finance, Management Information Systems, Tax Accounting, Telecommunication and Film, Aerospace Engineering, Chemical Engineering, Civil Engineering, Computer Science, Construction Engineering, Electrical Engineering, Engineering Science and

Mechanics, Environmental Engineering, Materials/Metallurgical Engineering, Mechanical Engineering, Metallurgical Engineering, and Materials Science African American Studies, American Studies, Anthropology, Art History, Communicative Disorders, Creative Writing, Criminal Justice, Dance, Economics, English, English as a Second Language (ESL), Environmental Science, Foreign Language and Literature, Geography, Geology, Health Care Management, History, Interdisciplinary Studies, International Studies, Latin American Studies, Marine Science, Mathematics, Music, Philosophy, Political Science, Psychology, Public Administration, Religious Studies, Romance Languages, Sociology, Spanish, Speech Language, Pathology, Studio Art, Theatre, Women's Studies, Business Administration, Economics, Management, Marketing, Operations Management, Advertising, Advertising and Public Relations, Book Arts, Communication and Information Sciences, Journalism, Library & Information Studies, Public Relations, Counselor Education, Community Counseling, Rehabilitation Counseling, Early Childhood Education, Educational Administration, Educational Leadership, Educational Psychology, Educational Research, Elementary Education, Elementary & Middle School Administration/Principalship, Higher Education, Administration, Human Performance, Instructional Leadership, Music Education, School Psychology, Secondary Education, Secondary School Administration/Principalship, Special Education, Interdisciplinary Studies, Apparel and Textiles, Athletic Training, Consumer Sciences, Early Childhood Education, Food and Nutrition, General Health Studies, Health Education/Promotion, Health Studies, Human Development and Family Studies, Human Environmental Sciences, Interior Design, Restaurant and Hospitality Management, Law, Tax Law, Nursing, and Social Work

7. How many technology training sessions have you attended in the last year?
    a. 0
    b. 1-3
    c. 4-6
    d. 7-9
    e. 10+

Please read each item carefully and then rate to what extent you agree with the statement using the scale below. Each statement will be about your perception of your teaching knowledge and experience.

Using the following scale, to what extent do you agree with the statement below?

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
1	**2**	**3**	**4**	**5**

HE-TPaCK items
Technology Training
8. Technology training would enhance my teaching.
9. It is the University's responsibility to train me to use technologies that will enhance my teaching.
10. The University should not make technology training a requirement for faculty.
11. Technology training should be offered in each academic department at my University.
PK domain
12. I have a clear understanding of pedagogy (e.g., designing instruction, assessing students' learning).
13. I am familiar with a wide range of practices, strategies, and methods that I can use in my teaching.
14. I know how to assess student learning.
15. I know how to motivate students to learn.
TK domain
16. I am familiar with a variety of hardware, software and technology tools that I can use for teaching.
17. I know how to troubleshoot technology problems when they arise.
18. I do not know how to use technology in my everyday life.
19. I recognize that technology use can have positive and negative effects.
20. I cannot decide when technology can be beneficial to achieving a learning objective.
21. I can decide when technology may be detrimental to achieving a learning objective.
CK domain
22. I have a comprehensive understanding of the curriculum I teach.
23. I understand how knowledge in my discipline is organized.
24. I am familiar with the common preconceptions and misconceptions in my discipline.
25. I can explain to students the value of knowing concepts in my discipline.
26. I can make connections between the different topics in my discipline.
27. I stay abreast of new research related to my discipline in order to keep my own understanding of my discipline updated.
PCK domain
28. I understand that there is a relationship between content and the teaching methods used to teach that content.
29. I can anticipate students’ preconceptions and misconceptions.
30. I can address students’ preconceptions and misconceptions.

31. I understand what topics or concepts are easy or difficult to learn.
32. I can provide multiple representations of content in the form of analogies, examples, demonstrations, and classroom activities.
33. I can adapt material to students’ abilities, prior knowledge, preconceptions, and misconceptions.
TPK domain
34. I understand how teaching and learning change when certain technologies are used.
35. I do not understand how technology can be integrated into teaching and learning to help students achieve specific pedagogical goals and objectives.
36. I do not know how to adapt technologies to support teaching and learning.
37. I know how to be flexible with my use of technology to support teaching and learning.
38. I cannot reconfigure technology and apply it to meet instructional needs.
39. I understand that in certain situations technology can be used to improve student learning.
TCK domain
40. I cannot select and integrate technological tools appropriate for use in specific disciplines (or content).
41. I understand how the choice of technologies allows and limits the types of content ideas that can be taught.
42. I do not understand how some content decisions can limit the types of technology that can be integrated into teaching and learning.
43. I am aware of how different technologies can be used to provide multiple and varied representations of the same content.
44. I cannot select specific technologies that are best suited for addressing learning objectives in my discipline.
45. I understand that I need to be flexible when using technology for instructional purposes.
TPaCK domain
46. I can effectively integrate educational technologies to increase student opportunities for interaction with ideas.
47. I have different opportunities to teach specific curriculum content topics with technology.
48. I can use appropriate instructional strategies to teach specific curriculum content topics with technology.
49. I cannot determine when a technology resource may fit with one learning situation in my discipline, and not with another.
50. I can flexibly incorporate new tools and resources into content and my teaching methods to enhance learning.
51. I understand how digital technologies can be used to represent content in a variety of formats.
52. I can use teaching methods that are technology-based to teach content and provide opportunities for learners to interact with ideas.
53. I understand what makes certain concepts difficult to learn for students and how technology can be used to leverage that knowledge to improve student learning.
54. I do not understand how to integrate technology to build upon students’ prior

	knowledge of curriculum content.
55.	I know how to operate classroom technologies and can incorporate them into my particular discipline to enhance student learning.
56.	I know how to integrate the use of educational technologies effectively into curriculum-based learning.
57.	Please enter your email address if you would like to receive a comparison report of your individual score with the participant population. (Optional)

APPENDIX C

IRB Approval

Office for Research

Institutional Review Board for the Protection of Human Subjects

THE UNIVERSITY OF ALABAMA RESEARCH

April 24, 2013

Kristi Garrett
Instructional Technology Program
Department of ELPTS
Box 870302

Re: IRB # EX-13-CM-048: "Higher Education Technology, Pedagogy, Content Knowledge (HE-TPaCK) and Technology Training"

Dear Ms. Garrett,

The University of Alabama Institutional Review Board has granted approval for your proposed research.

Your application has been given exempt approval according to 45 CFR part 46.101(b)(2) as outlined below:

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:

i. information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and

ii. any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

This approval expires on April 23, 2014. If the study continues beyond that date, you must complete the IRB Renewal Application. If you modify the application, please complete the Modification of an Approved Protocol form. Changes in this study cannot be initiated without IRB approval, except when necessary to eliminate apparent immediate hazards to participants. When the study closes, please complete the Request for Study Closure form.

Please use the IRB-approved consent language.

Should you need to submit any further correspondence regarding this application, please include the assigned IRB application number.

Good luck with your research.

Sincerely,

Director & Research Compliance Officer
Office for Research Compliance
The University of Alabama

358 Rose Administration Building
Box 870127
Tuscaloosa, Alabama 35487-0127
(205) 348-8461
FAX (205) 348-7189
TOLL FREE (877) 820-3066

APPENDIX D

IRB Revision

Office for Research

Institutional Review Board for the Protection of Human Subjects

THE UNIVERSITY OF ALABAMA RESEARCH

August 16, 2013

Kristi Garrett
Instructional Technology Program
Department of ELPTS
College of Education
Box 870302

Re: IRB Approval # EX-10-CM-048 (Revision): "Higher Education Technology, Pedagogy, Content Knowledge (HE-TPaCK) and Technology Training"

Dear Ms. Garrett,

The University of Alabama Institutional Review Board has reviewed the revision to your previously approved exempt protocol. The Board has determined that the change does not affect the exempt status of your protocol.

Please remember that your approval period expires one year from the date of your original approval, 4/24/13, not the date of this revision approval.

Should you need to submit any further correspondence regarding this proposal, please include the assigned IRB approval number. Changes in this study cannot be initiated without IRB approval, except when necessary to eliminate apparent immediate hazards to participants.

Good luck with your research.

Sincerely,

Director & Research Compliance Officer
Office for Research Compliance
The University of Alabama

358 Rose Administration Building
Box 870127
Tuscaloosa, Alabama 35487-0127
(205) 348-8461
fax (205) 348-7189
toll free (877) 820-3066

APPENDIX E

IRB Renewal

Office for Research

Institutional Review Board for the Protection of Human Subjects

THE UNIVERSITY OF ALABAMA

RESEARCH

January 27, 2014

Kristi Garrett
ELPTS
College of Education
The University of Alabama

Re: IRB # EX-13-CM-048-R1 "Higher Education Technology, Pedagogy, Content Knowledge (HE-TPaCK) and Technology Training"

Dear Ms. Garrett:

The University of Alabama Institutional Review Board has granted approval for your renewal application. Please be advised that your protocol will expire one year from the date of approval, January 27, 2014.

Your protocol has been given exempt approval according to 45 CFR part 46.101(b) (2) as outlined below:

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:
(i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and
(ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Should you need to submit any further correspondence regarding this proposal, please include the assigned IRB application number. Changes in this study cannot be initiated without IRB approval, except when necessary to eliminate apparent immediate hazards to participants. Please use reproductions of the IRB approved consent form to obtain consent from your participants.

Good luck with your research.

Sincerely,

Director of Research Compliance & Research Compliance Officer
Office of Research Compliance
The University of Alabama

358 Rose Administration Building
Box 870127
Tuscaloosa, Alabama 35487-0127
(205) 348-8461
FAX (205) 348-7189
TOLL FREE (877) 820-3066

APPENDIX F

Invitation to Participate

Subject: Research Invitation to Participate for Faculty and Graduate Teaching Assistant (GTAs)

Body of Email:

Kristi Garrett, Principal Investigator (PI) from the University of Alabama, is conducting a research study called Higher Education Technology, Pedagogy, Content Knowledge (HE-TPaCK) and Technology Training. This study seeks to learn your perceived knowledge, skill level, and beliefs as they pertain to the fields of technology based teaching and the technology training. This study is part of Ms. Garrett's dissertation work and she is being supervised by Dr. Angela Benson, Associate Professor in the Department of Educational Leadership, Policy, and Technology Studies (ELPTS).

Taking part in this study involves completing a web survey that will take about 10-20 minutes. This survey contains questions about demographics, technology based teaching, and technology training. You must be at least 19 years old to participate.

We will protect your confidentiality by using the Qualtrics Software, which is password protected which is only accessible by the PI. Only Kristi Garrett (self) will have access to review to the data during the data analysis phase of this study. Dissertation committee members will have access to summarized data. Only summarized data will be presented at meetings or in publications.

There are no known risks or discomforts associated with your participation in this study. Higher education institutions may benefit from this survey by gaining a better understanding of the technology based teaching knowledge of faculty and graduate teaching assistants (GTAs) in higher education. This is an anonymous survey, you will not be asked to supply your name or any other personal information. However, if you would like to receive a comparison analysis of your data and the study population, you can provide your email address at the end of the survey. Otherwise, subject identities will be kept confidential within the Qualtrics Survey Software. The data collected for this survey will not be furnished to any personal agency.

If you have questions about this study, please contact Kristi Garrett (investigator) by email at kgarrett@ua.edu or Dr. Angela Benson (Advisor & Committee Chair) at 205-348-7824 or via email at abenson@bamaed.ua.edu. If you have questions, concerns, or complaints about your rights as a research participant in this research study, you may contact Ms. Tanta Myles, the Research Compliance Officer at UA, at (205) 348-8461 or toll-free at 1-877-820-3066. If you have complaints about your rights as a participant in this research study, file them through the UA IRB outreach website at http://osp.ua.edu/site/PRCO_Welcome.html. Also, if you participate, you are encouraged to complete the short Survey for Research Participants online at this website. This helps UA improve its protection of human research participants.

YOUR PARTICIPATION IS COMPLETELY VOLUNTARY. You are free not to participate or stop participating any time before you submit your answers.

If you understand the statements above, are at least 19 years old, and freely consent to be in this study, click the URL below and then click on the checkbox in the acknowledgement statement to begin the survey.

SURVEY LINK: http://bamaesprmc.us2.qualtrics.com/SE/?SID=SV_2uEg9GgP5Dmahwx

Thanks,
Kristi Garrett
Doctoral Candidate and Graduate Teaching Assistant
Instructional Technology Program
Department of Educational Leadership, Policy, and Technology Studies (ELPTS)
The University of Alabama

UNIVERSITY OF ALABAMA IRB
CONSENT FORM APPROVED: 4/24/2013
EXPIRATION DATE: 4/23/2014