2015-01-01

Mobile Professional Development: Taxonomic Levels Of Learning On Teachers' Tpack Perceptions And Acquisition Of Technology Competencies

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MOBILE PROFESSIONAL DEVELOPMENT: TAXONOMIC LEVELS OF LEARNING ON TEACHERS' TPACK PERCEPTIONS AND ACQUISITION OF TECHNOLOGY COMPETENCIES

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Dedication

I dedicate this manuscript to my mother, close friends, colleagues, and my doctoral committee. My mother has been my driving force for every endeavor, and my friends and committee have provided mental support throughout my educational journey. The process has not been easy, but the accomplishments I have earned have been made achievable by their contributions. This dissertation will serve as catalyst to my career, and those who have made it possible will forever be remembered as I grow as an individual and as a professional.

MOBILE PROFESSIONAL DEVELOPMENT: TAXONOMIC LEVELS OF LEARNING ON TEACHERS' TPACK PERCEPTIONS AND ACQUISITION OF TECHNOLOGY COMPETENCIES

by

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DISSERTATION

Presented to the Faculty of the Graduate School of

The University of Texas at El Paso

in Partial Fulfillment

of the Requirements

for the Degree of

DOCTOR OF PHILOSOPHY

Department of Teacher Education

THE UNIVERSITY OF TEXAS AT EL PASO

May 2015

Abstract

As it stands, the integration of technology can be advantageous for teachers, students, administrators, and parents, yet teachers are expected to teach and facilitate learning with new technologies in order to prepare students to succeed in a global economy. As the Part D of the Enhancing Education Through Technology Act of 2001 (Part D - Enhancing Education Through Technology, n.d) states, one of its purposes is to "enhance ongoing professional development of teachers, principals, and administrators by providing constant access to training and updated research in teaching and learning through electronic means," one of its goals is to "encourage effective integration of technology resources and systems with teacher training and curriculum development." Additionally, with the number of mobile devices continuing to increase, schools employing initiatives such as Bring Your Own Device (BYOD) that encourage the use of mobile devices in teaching and learning, and the benefits of technology integration on student learning, to provide a 21st century education using technology remains a problem across American schools. At the frontline of preparing and equipping teachers with the training and support needed to increase knowledge and skills, and their impact on attitudes and beliefs (Bandura, 1977, 1994, 1997) is professional development (PD). However, PD often lacks any form of assessment making it difficult to understand what participants really learned. The purpose of this study was to examine and report the impact of mobile professional development (MPD) taxonomic rigor on in-service teachers' attitudes and beliefs towards technology and technology integration and performance on a standardized knowledge and skills assessment on Technology Applications. This study developed a MPD course and designed 3 taxonomic treatment conditions to examine how question-rigor impacts Technological, Pedagogical, and Content Knowledge attitudes and beliefs, and performance on a Technology Applications and Competencies assessment. The rationale for this study is the need to understand how a new mode of PD (i.e., MPD) and taxonomic rigor influences teachers' attitudes and beliefs towards technology and performance on a knowledge and skill performance assessment. This

quantitative study used a modified experimental design to randomly assign 40 in-service teachers to one of three taxonomic treatment conditions. 29 participants yielded complete data. Participants began with a pretest measuring TPACK attitudes and beliefs and knowledge and skills on technology applications, completed the MPD, and completed with taking a posttest. Using an analysis of covariance, this research found increased mild gains in competency and dispositional scores. However, there was no statistical significance in participant gains across the three treatment conditions. Furthermore, the participants contributed to several additional items in their assigned conditions and admitted to the acquired skills in being able to integrate technology into their lessons as a way to express their creativity and heighten their interest in the subject matter. This research contributes to the literature on assessing PD, design issues in MPD, and assessment outcomes of MPD.

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Chapter 1: Introduction

As mobile technologies continue to evolve and monumentally shape the nature of teaching and learning, teachers struggle to incorporate technologies and electronic resources into pedagogically sound activities (Recker, Dorward, Dawson, Mao, Liu, Palmer, Halioris, & Park, 2005; Snyder, Dillow, & Hoffman, 2007; Wells, & Lewis, 2006). Although the U.S. Department of Education's National Educational Technology Plan (2010) noted that "teachers, by and large, are not prepared to use technology in their practices" (p. 39), many schools are implementing Bring Your Own Device (BYOD) initiatives in order to take advantages of how mobile devices can improve instruction (Johnson, 2012). Confronted with the needs of 21st-century learners, educators struggle to effectively integrate technologies as emerging technologies continue to shape the world of business and education. According to the International Society for Technology in Education (ISTE, 2008):

> Effective teachers model and apply ISTE Standards for Students (ISTE-S) as they design, implement, and assess learning experiences to engage students to improve learning, enrich professional practice; and provide positive models for students, colleges, and the community (ISTE, 2008).

With technology standards set in place for both teachers and pupils by the ISTE (2008) (formerly the National Educational Technology Standards) and the Texas Education Agency (TEA), educators, leaders, and policy makers face challenges improving teacher quality and strengthening the teaching profession to meet the needs of all 21st Century learners. With the rise in the number mobile technologies available in schools, the ISTE (2008) has since established standards for students, teachers, and administrators. As many states adopting basic ISTE standards and aligning technology standards, at the forefront facilitating teachers' growth

in content knowledge and instructional practices is “high quality” or “effective” professional development (EPD) (Wei, Darling-Hammond, Andree, Richardson, & Orphanos, 2009, p. 3).

Teacher professional development (PD) typically refers to the ongoing learning opportunities available to educators. Schools, districts, local universities, and other professional third party entities provide PD by means of face-to-face (F2F) workshops, online professional development (OPD), or by a hybrid design consisting of both F2F and online formats. With traditional F2F PD being costly, it also requires in-person attendance while OPD is less expensive and necessitates the use of a desktop or laptop computer along with Internet capability. Advancements in technology and the Internet, desktop computer and laptop applications and performances (e.g., email, word processing, content media, content creation, & communication) are now standard with mobile devices. As mobile devices rise in social and academic popularity across American classrooms, academic institutions face an array of intricate challenges. Challenges span from increasing academic performance of an increasingly diverse population of students to integrating new technologies into classroom teaching and learning. With many school districts looking to modernize teaching practices by integrating technology into the classrooms, mobile devices situates mobile learning (m-learning) as an instructional tool.

Research from Compton (2013) presents M-learning as learning that takes place "across multiple contexts, through social and content interactions, using personal electronic devices" (p. 4). Mobile PD (MPD) is like an OPD. However, it differs in that MPD focuses its accessibility and optimization for mobile devices (e.g., smartphones, tablets, Android, and iPads) to access and submit content whereas desktop computers and laptops access OPD. With mobile devices (i.e., smartphones & tablets) being smaller in size, easier to transport, lower in cost when matched to a laptop or desktop, and offered by all cellular networks, application markets (viz.,

Google Play and iTunes) now exist and are available to mobile devices to download applications. Markets offer task, tool, game, and business applications to which provides immediate access to the user. M-learning involves the use of a mobile device (e.g., smartphone) in the process of learning. M-learning includes distant learning and face-to-face instruction where technology is used during instruction as a learning tool, in a blended fashion.

Although technology can empower teaching and learning, its use in the classroom is rare (Forgasz, 2006). Research has shown that successful technology interrogation requires educators to acquire a new body of knowledge known as Technological Pedagogical Content Knowledge (TPACK) (Angelo & Valanides, 2005, 2009, 2015). However, past research has found that PD in technology integration falls short in providing the environments and opportunities needed to support teachers' acquisition of the knowledge and skills essential to providing technology-based instruction (Darling-Hammond & Snyder, 2000; Lave & Wenger, 1991). In several publications, Koehler and Mishra (2006, 2008, 2009) positioned the concept of TPACK to focus on a comprehensive set of competencies teachers need to integrate technology effectively into their educational repertoire.

Despite the understanding of the need to better prepare teachers to integrate technology and align it to pedagogy and curricular issues (Law, Pelgrum, & Plomp, 2008; McDougall, 2008; Voogt, 2003), research has yet to identify a best approach to prepare teachers to integrate technology. Research also notes the challenge in measuring the impact of high-quality PD (Garet, Porter, Desimone, Birman, & Yoon, 2001; Lawless & Pellegrino, 2007; Penuel, Fishman, Yamaguchi, & Gallaher, 2007). This study contributes to the area of PD design and participant assessment.

Background

As educational systems transition along with today's technologies, institutions that provide educational opportunities must take into account that digital media and connectedness are integral to the everyday processes of today's learners. With today's students referenced as the "New Millennium Learners" or "Digital Natives," there is yet to be a term to reference the teachers of these learners. Assuming teachers have progressed right along technology and its advances, institutions of learning are inclined to think that their facilitators have the capacity to operate and deliver knowledge using new technologies as an instructional tool.

The design and assessment process of PD aimed at providing teachers with training to build the capacity and confidence to use mobile devices changes over time as new technologies and software emerge. Ensuring that teachers, as 21st-century learners, have the ability and confidence to use technologies for teaching and learning requires EPD. Researchers note that one particular obstacle to the integration of technology by educators is the lack of teacher's content, technology, pedagogical knowledge, and lack of professional development (Cuban, 2001, Moursund & Bielefeldt, 1999; Vrasidas & Glass, 2005). The same research agrees that evaluation studies are essential for constructing models for the development, implementation, and support of teacher preparation programs

Problem Statement

Teaching students in a technology-rich society is a central problem for many 21st-century educational institutions. In 2013, US K-12 schools spent upwards of $4 billion on mobile devices (Futuresource Consulting, 2013) with the expectation that educators would integrate technology into teaching and learning. Preparing students in the 21st-century requires teachers to have positive TPACK attitudes and beliefs and Technology Application knowledge and skills. Examining MPD taxonomic rigor in learning, this study sets out to observe any impact on

participant TPACK beliefs and attitudes and performance on a Technology Application Domain 1 (TAD1) assessment.

Statement of Purpose

The purpose of this study was to determine if MPD taxonomic treatment conditions (viz., low-, medium-, and high-level questioning) influenced educators' TPACK self-reporting and performance on a TAD1 assessment. This research designed a MPD course and developed 3 treatment conditions to examine taxonomic rigor and the impact it had on 1) teachers' TPACK attitudes and beliefs, and 2) examine knowledge and skill performances on a TAD1 assessment. The study's first goal was to use TAD1 competencies to design and develop an effective MPD. A second objective was to identify whether MPD taxonomic rigor influences TPACK self-report scores and TAD1 performance scores among educators. This study developed 3 sets of assignments representing each of the 3 treatment conditions (viz. low, medium, and high levels of taxonomic rigor. The final aim of this study was to inform educational policy makers, curriculum and instructional writers, and PD operators on m-learning as an avenue for PD.

Research Questions

This study employed two research questions to guide it. Examined were the following questions:

1) How do taxonomic levels of rigor in learning affect teachers' TPACK attitudes and beliefs towards technology and technology integration in a mobile professional development environment?

2) How do taxonomic levels of rigor in learning affect teachers' technological knowledge and performance on a Technology Applications mock assessment in a mobile professional development environment? (State certification test)

The hypotheses for the two research questions are as follows:

Researcher Hypothesis 1: There is a statistical significant mean difference in participant TPACK scores across the three levels of treatment intervention following the completion of the MPD.

Researcher Hypothesis 2: There is a statistical significant mean difference in participant performance across the three levels of treatment conditions as it relates to a TAD1 mock exam.

Rationale

As it stands, the integration of technology can be advantageous for teachers, students, administrators, and parents. With an educator's role being to equip students with an education to succeed in a global economy, expectations for teachers to teach and facilitate learning with new technologies rise. Part D of the Enhancing Education Through Technology Act of 2001 states that one of its purposes is to “enhance ongoing professional development of teachers, principals, and administrators by providing constant access to training and updated research in teaching and learning through electronic means” and that one of its goals is to “encourage effective integration of technology resources and systems with teacher training and curriculum development” (Part D - Enhancing Education Through Technology, n.d., para. 1). As assessment fails to be part of most PD, the rationale for this study is the need to understand how a new form of PD (i.e., MPD) and its taxonomic rigor- the leveling assignment questions unique to each treatment group, impacts teachers’ TPACK attitudes and beliefs and knowledge and skills of technology applications.

Significance

To provide a 21st-century education to students, teachers need access to effective PD 24/7. By incorporating an experimental dimension for examining PD undergoing taxonomic assignment rigor, the significance of this study is that it examines how MPD taxonomic rigor

affects participants' self-reporting on a TPACK attitudes and beliefs survey and performance score on a knowledge and skills TAD1 assessment. With traditional PD often lacking participant assessment, this study offers insight into PD assessment creation and effectiveness. Moreover, this research provides insight into anytime, anywhere MPD using mobile devices and a mobile interface. This research stands to expand upon the little research on teachers' use of mobile devices to participate in OPD and provides insight into whether PD taxonomic rigor influences PD effectiveness. Additionally, this study contributes to the literature on best practices in designing, delivering, and assessing PD.

Role of the Researcher

The researcher served as the facilitator, designer, and financer of the study. As the facilitator, the researcher offered F2F and online mobile support at times sought out by participants. As the designer, the researcher used his expertise as a district technology trainer, knowledge of instructional design models and of the TPACK framework to develop this study's MPD course. Once the design of the course was developed, the researcher used Anderson and Krathwohl's (2001) revision to Bloom's Taxonomy (1956) to develop 3 levels of taxonomic rigor. The researcher then created a series of questions that targeted MPD module objectives. This study's MPD module objectives matched Domain 1 of the Technology Applications Texas state educator certification exam competencies. Question rigor was specific to the treatment condition.

As an incentive, the researcher offered 10 hours of Continuing Professional Education (CPE)/Gifted and Talented (GT) credit. CPE credit is a requirement and is part of an educator's annual evaluation. As a state requirement, teachers need to complete at least 120 hours of CPE in each three-year period, and a minimum of 20 hours in each one-year period. Teachers must obtain 150 CPE credit hours every 5 years. Any educator with a GT student enrolled in their

class must have their initial 30hr identification and screening training. Then, each year teachers must obtain an annual update of 6hrs. Additionally, the researcher served as financier, and offered a $20 voucher for successful completion of the MPD course and negotiated a classroom assignment waiver for those participants enrolled in higher education courses.

Assumptions

This study operated under several assumptions. The first assumption is that the sample population is representative of a schoolteacher. The second was that participants had never undergone MPD or OPD that used a mobile device interface nor were technology experts. Another assumption is that the sample never received any formal and specific training on Technology Applications. This research also assumed that participants were truthful in their responses, and that participants put effort into completing course modules and assignments.

Limitations

The low sample size of this study is a limitation of this study. Additionally, the small sample in each intervention group was another drawback. Because this study took place in the second semester when student testing is most prevalent in all schools, time factors and issues of stress may have affected participation and effort applied to completing course modules and assignments.

Accessible anytime and anywhere, this study did not require participants to complete modules and assignments during their work schedule. Not having partakers complete study at work increased the likelihood participants would not finish the study at a set time during the instructional workday. Another issue of time is the two-week window given to complete the course. This limited amount of time is not ideal to reflect on the proposed learned objectives, thus not permitting enough time for participants to transform attitudes and beliefs or to fully understand the content presented in the course modules.

Completing modules and assignments at a time and place other than work may be an issue as personal responsibilities (e.g., family issues and personal commitments) compete with professional learning demands. The issue of discipline comes to play as individuals sometimes have difficulty completing a task sitting down. Another limitation of this study is that it is only offered the study at two school sites and to 3 university courses. The amount of possible participant sites increases the chance of a small sample size. Offering the MPD to all campuses within a district and all personal and staff would have increased the overall sample size and generalizability. Finally, the development of the competencies exam was conducted by the researchers and advisor, it is recommended that such type of exam be piloted and potentially faulty items be discarded or improved. Such action was not performed for this study.

Definition of Key Terms

To aid in understanding technical terms throughout this study, the researcher defined the following terms.

Educational technology: using "technology as a tool to enhance the teaching and learning process" (International Technology Education Association, 2000 p. 3).

Professional development (PD): "continuing education of teachers, administrators, and other school employees. The terms in-service education, teacher training, staff development, professional development and human resource development are often used interchangeably" (National Staff Development Council, 2007c, p. 1).

Mobile device: "a handheld tablet or other device that is made for portability, and is therefore both compact and lightweight. New data storage, processing and display technologies have allowed these small devices to do nearly anything that had previously been traditionally done with larger personal computers" (Techopedia, n.d.)

Mobile learning (M-learning): "learning across multiple contexts, through social and content interactions, using personal electronic devices" (Crompton, 2013 p. 4).

Smartphone: "a mobile phone with highly advanced features. A typical smartphone has a high-resolution touch screen display, WiFi connectivity, Web browsing capabilities, and the ability to accept sophisticated applications. The majority of these devices run on any of these popular mobile operating systems: Android, Symbian, iOS, BlackBerry OS and Windows Mobile.

Technology Applications: Texas' "technology standards ensure that students, teachers, and librarians gain and apply critical 21st Century digital knowledge and skills. Technology standards for prekindergarten students, K-12 students, teachers, and librarians are listed below" (Texas Education Agency, n.d.)

Technology Applications Domain 1: Texas' standards for evaluating the skills and knowledge educators need to teach, work, and learn in an increasingly connected global and digital society (Texas Education Agency, n.d.).

ISTE Standards for Students (ISTE Standards•S): The standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world

ISTE Standards for Teachers (ISTE Standards•T): The standards for evaluating the skills and knowledge educators need to teach, work, and learn in an increasingly connected global and digital society

ISTE Standards for Administrators (ISTE Standards•A): The standards for evaluating the skills and knowledge school administrators and leaders need to support digital age learning, implement technology and transform the instruction landscape

Summary

The introduction provided a brief look at mobile devices and technology integration in education. Additionally, it set the need for effective PD on technology integration as the context for this study. This study sets out to identify whether taxonomic rigor in the form of prompted open-ended assignment questions influences participant TPACK and TAD1 scores. By using a mobile platform as the OPD delivery method, this study implements m-learning, the newest phase of education and PD. Optimized for any device with Internet capability, this study held a fixed mobile device interface. This study stands to contribute to the design and assessment process of a student course or teacher PD.

This study uses a traditional five-chapter model in its organization. The first chapter introduces the quantitative study. Within the introduction, the researcher describes the background, problem statement, statement of purpose, research questions and hypotheses, the rationale and significance of the study, including the role of the researcher, assumptions, and the definition of terms. The subsequent chapter reviews literature related to the topic of technology integration reform in the US, professional development, types of learning, mobile devices in education, models of PD design and assessment, and TPACK to support the methodology of this study. The third chapter describes the methodology. The fourth chapter elaborates on the study’s findings, and the fifth chapter provides an in-depth discussion, conclusion and offers recommendations.

Chapter 2: Literature Review

Introduction

The review of the literature related to this study includes ten areas. The first section addresses technology reform in the U.S. educational system as it warrants teachers to teach using technology to teach and facilitate learning. The next section reviews Technology Applications in the context of teaching and learning. Following is a section on teachers' intrinsic factors that affect technology integration. The fourth section covers professional development (PD) in general and in the context of technology integration. The next four sections examine distance learning, electronic learning, mobile learning, and blended learning. The ninth section highlights mobile devices and the final section examines models of PD design, assessment, and TPACK to describe the theoretical and identify the conceptual framework used in this study. This study's literature review includes information from sources obtained through the University of Texas at El Paso Library's databases, specifically ProQuest and Academic Search Complete (EBSCO), and the World Wide Web. Reviewed sources included peer-reviewed professional journals and periodicals, newspapers, Internet resources, conference proceedings, media, and books.

Technology Reform

In a competing global society, the National Commission on Excellence in Education (NCEE) released a report in 1983 titled *A Nation at Risk: The Imperative for Educational Reform.* At the time, the report stated that America was not along side other nations in terms of educating its K-12 students, and that the jobs of the future would require new technological skills from students. With many politicians acknowledging the positive role of technology in education (Task Force on Technology and Teacher Education, 1997), research has shown technology as a catalyst for educational reform to improve student learning (Office of Technology and Assessment, 1995; Apple Education, 1996; Task Force on Technology and Teacher Education, 1997). Research by Apple Education showed that integrating technology into teaching and learning "can

significantly increase the potential for learning, especially when it is used to support collaboration, information access, and the expression and representation of students' thoughts and ideas" (Apple Education, 1996, p. 1).

Under the leadership of President George W. Bush, the No Child Left Behind Act (NCLB) was passed in 2001 an attempt to improve student learning on standardized assessments (U.S. Department of Education, 2002). With NCLB holding educational institutions accountable for increasing student performance, and technology having shown to increase student performance, NCLB decrees the integration of technology in education. In 2004, the U.S. Department of Education released a National Educational Technology Plan (NETP) (U.S. Department of Education, 2004b; 2010). The NEPT presents a technology driven learning model that identifies goals and recommendations in five fundamental areas (viz. Learning, Assessment, Teaching, Infrastructure, & Productivity). With evolving technologies, the NETP recognizes that:

> Technology is at the core of virtually every aspect of our daily lives and work, and we must leverage it to provide engaging and powerful learning experiences and content, as well as resources and assessments that measure student achievement in more complete, authentic, and meaningful ways. Technology-based learning and assessment systems will be pivotal in improving student learning and generating data that can be used to continuously improve the education system at all levels. Technology will help us execute collaborative teaching strategies combined with professional learning that better prepare and enhance educators". (NEPT, 2010, p. ix)

In efforts to determine what it means to be a 21st century learner and teacher, the International Society for Technology in Education (ISTE) has published the National Educational Technology Standards for students (NETS-S) and teachers (NETS-T) (ISTE, 2007). With the NETS-T being "the standards for evaluating the skills and knowledge educators need to teach, work and learn in an increasingly connected global and digital society (ISTE, n.d.), the

NETS-S are "the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world (ISTE, n.d.). Even with identified national technology standards, many states have established and aligned standards to comply with NCLB and the NETP.

Technology Applications

In Texas, the State Board of Education and the Texas Education Agency (TEA) has established their educator, librarian, and student standards known as Technology Applications. "The state's technology standards ensure that students, teachers, and librarians gain and apply critical 21st Century digital knowledge and skills" (TEA, n.d., p. 1). For students, the Texas Essential Knowledge and Skills (TEKS) represent these standards. With the future in mind, Texas established a technology plan called the Long-Range Plan for Technology (TEA, 2006), 2006-2020. This plan acknowledges the need to revise Technology Applications TEKS as necessary to guarantee appropriateness over time and their alignment of 21st Century skills to emerging technologies. The LRPT offers recommendations to Texas educational institutions to assist in achieving the following goals by 2020:

- All learners engage in individualized, real-world learning experiences supported by ubiquitous access to modern digital tools, robust anywhere/anytime connectivity, and dynamic, diverse learning communities.
- All learners access, evaluate, manage, and use information in a variety of media formats from a wide array of sources.
- All learners create knowledge, apply it across subject areas and creative endeavors, and purposefully communicate that knowledge, and the results of its use, to diverse audiences.
- Learning experiences take place in authentic settings and require collaboration and management of complex processes.
- These experiences involve critical thinking, social responsibility, complex decision-making, and sophisticated problem solving.

Ultimately, teachers and educational facilitators are at the forefront of reaching these state and national goals. Employed with the expectation to teach with modern day technologies

regardless of whether or not they have the knowledge or capacity to operate technology as an instructional to tool, teachers face the challenge of being a 21st century educator. To monitor and assist teachers, campuses, and districts in meeting the technology goals of NCLB and of the LRPT, 2006-2020, the Texas Teacher STaR Chart was created to measure the impact of state and local goals. Divided into 4 domains (i.e., Teaching & Learning; Educator Preparation; Administration Support; & Infrastructure), the chart categorizes teachers and campuses into 4 levels of progress (Early Tech; Developing Tech, Advanced Tech; & Target Tech). Each level of progress entails its unique description. The goal in place under the LRPT, 2006-2020 is for students, teachers, and campuses to be on Target Tech. Online data reporting of collected responses using the Texas STaR Chart by individual teachers and campus administrator reveals that there is an inconsistent pattern occurring and that there seems to be a regression. In 2010, less than 1% of Texas campuses reported being Target Tech in both Teaching and Learning and Educator Preparation. Table 2.1 reports that Texas campuses are less than 1% of where they should be in regards to providing 21st century teaching and learning. Table 2.2 reveals that less than 1% of teachers reported having the necessary professional development and training to meet Texas' State Board of Education technology teaching standards. Tables 2.1 and 2.2 show the percentages and description for Target Tech reporting. Table 2.3 shows the campus Target Tech reporting from 2006-2010.

Table 2.1: 2009-2010 Target Tech STaR Chart Campus Reporting for Teaching and Learning

2009-2010	**Teaching & Learning (N=8087)**	
	# of campuses	**Percent**
	n= 73	0.9%
Target Tech Description	The teacher serves as facilitator, mentor, and co-learner. Students have on-demand access to all appropriate technologies to complete activities that have been seamlessly integrated into all core content areas. All Technology Applications TEKS are met K-8; high school campuses offer all Technology Applications courses and teach at least 4 courses.	

Table 2.2: 2009-2010 Target Tech STaR Chart Campus Reporting for Educator Preparation

2009-2010	**Educator Preparation (N=8087)**	
	Number of campuses	**Percent**
	n=57	**0.7%**
Target Tech Description	There are regular technology-supported learner-centered projects. There is vertical alignment of Technology Applications TEKS and anytime, anywhere use of online resources. Administrators ensure integration of appropriate technology. 100% of educators meet SBEC standards. 30% or more of budget allocated for professional development.	

Table 2.3: 2006-2010 Target Tech STaR Chart Campus Reporting for Teaching and Learning and Educator Preparation.

Year	**Teaching & Learning**		**Educator Preparation**	
	# of campuses	**Percent**	**# of campuses**	**Percent**
2006-2007 (N= 7752)	n= 62	0.8%	n= 55	0.7%
2007-2008 (N= 7641)	n= 69	0.9%	n= 44	0.6%
2008-2009 (N=7848)	n= 65	0.8%	n= 48	23.8%
2009-2010 (N=8087)	n= 57	0.7%	n= 57	0.7%

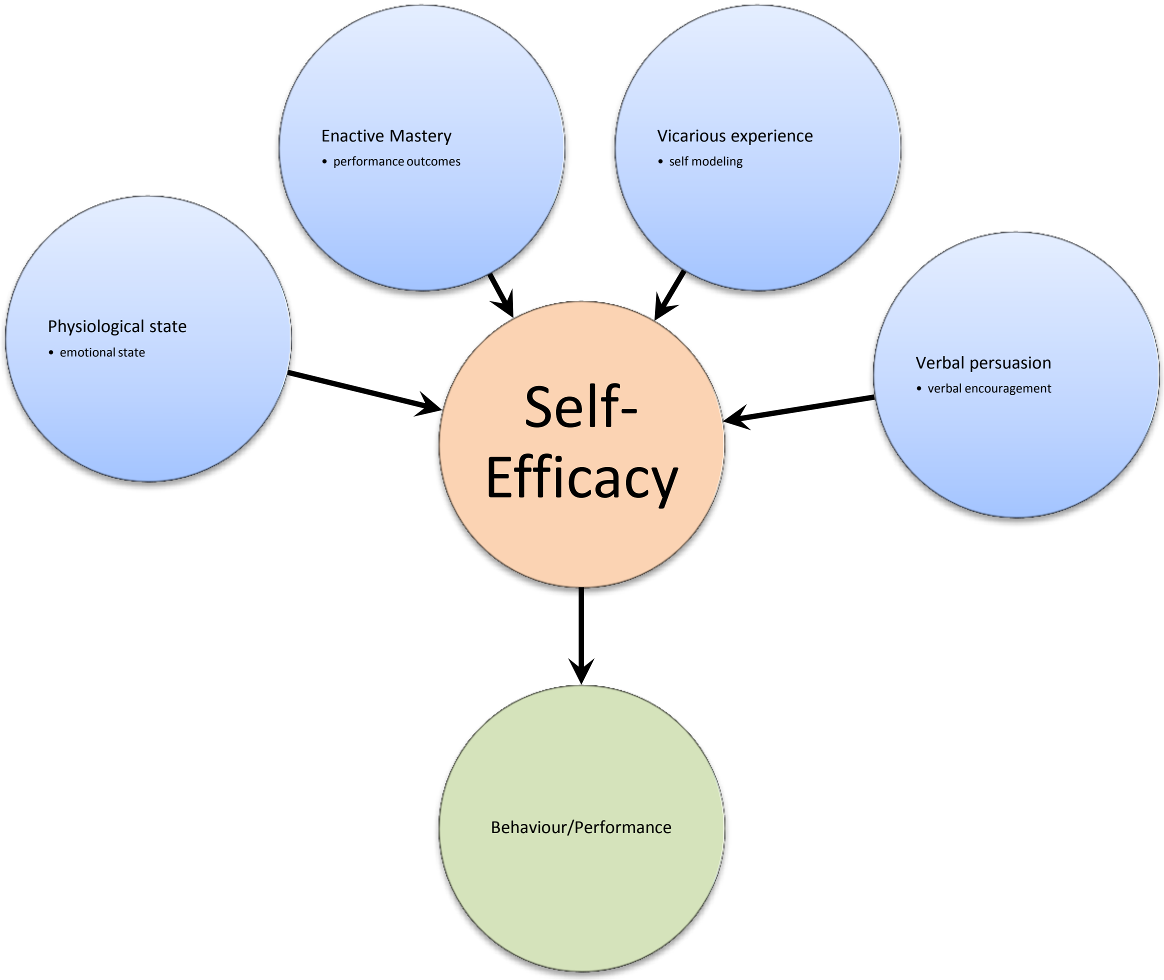
Teachers' Intrinsic Factors Affecting Technology Integration

In efforts to meet federal, state, and local technology goals, and to provide a 21st century education using technologies available, teachers need a high self-efficacy towards technology integration and an understanding of technological, pedagogical, and content knowledge (TPACK) (Cox, 2008; Perkmen, 2008). This study refers to technology integration self-efficacy (TISE) as educator's level of confidence in their ability to effectively integrate technology into the classroom for the purposes of teaching and learning. TPACK is the level of teachers'

knowledge of technology, pedagogy, and content and their ability to integrate them to teach successfully and facilitate learning using effective technological and pedagogical practices.

Self-Efficacy

In 1977, researcher Albert Bandura first conceptualized self-efficacy and later defined self-efficacy as an individual's perceived beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives (Bandura, 1994). In the context of technology integration in teaching and learning, self-efficacy beliefs regulate how people feel, think, motivate them, and thus determine how they behave and perform (Bandura, 1994). This concept recognizes that many factors influence human behavior. With perceived self-efficacy referring to one's belief in their ability to perform a given task, Bandura notes that a high self-efficacy enhances human accomplishment and personal well-being. Oppositely, a low level of self-efficacy will have an adverse outcome. Bandura (1997) identifies several factors affecting individual self-efficacy are: (a) mastery performance, (b) vicarious experience, (c) verbal persuasion, and (d) physiological state. Figure 2.1 illustrates how such factors affect self-efficacy and how self-efficacy affects behavior and performance.



Representation of the factors that influence self-efficacy, and the direct relation to performance/behavior. Image is reproduced by using the work of Albert Bandura (1997).

Figure 2.1: Factors Impacting Self-Efficacy and Impacting Behavior

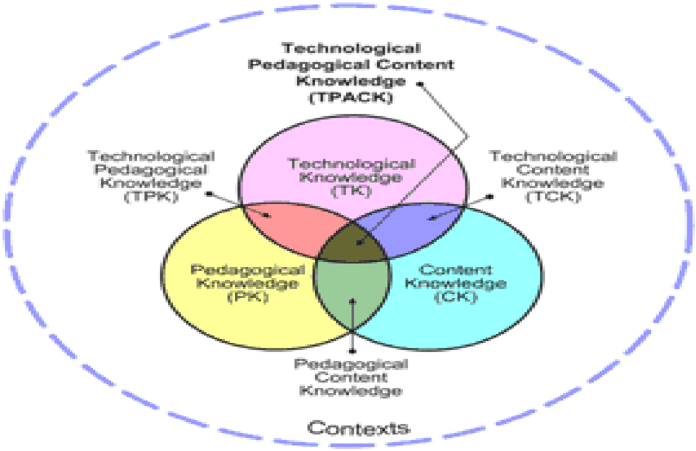
Building on Bandura's theory of self-efficacy, research continues to examine constructs of self-efficacy regarding technology integration (Ball & Levy, 2008, Bansavich, 2005; Browne, 2011). Research has referred to computer self-efficacy as an individual's confidence or belief in their capacity to execute computer related tasks (Smith, 2001). Technology integration holds the same meaning; however, it encompasses general technologies and does not limit itself to just computers. Following is an overview of research that focused on these two constructs and technology use and integration among pre service teachers.

In one study examining female pre-service teachers' use of technology and computer self-efficacy, Novich (2003) found a positive relationship between computer self-efficacy and intent to use technology. A different study focusing on pre-service teachers' ability to teach using technology and computer self-efficacy found that those who experienced a difficult time using technology had a low level of computer self-efficacy (Wall, 2004). Using TISE as a predictor of teachers' technology performances, research by Bansavich (2005) found that TISE is a strong predictor of the level in which a teacher is prepared to utilize technology in the classroom. In a different study exploring the interrelationships between TISE, outcome expectations, and performance goals and their role in predicting technology integration performances, Perkmen's (2008) findings suggested a relation between TISE and outcome expectations. The aforementioned research examined the relationship between self-efficacy and level of technology use. Like past research, this study informs teacher preparation programs and professional development designers tasked with increasing teachers' level of technology use for teaching and learning by building teacher TISE.

Technology Pedagogical Content Knowledge

Another construct affecting teachers' level of technology use for teaching and learning is their TPACK level. Research has revealed that teachers' acquisition of technology skills does not guarantee effective technology integration (Carr, Jonassen, Litzinger, & Marra, 1998; Ertmer, 2003), but rather meaningful teaching and learning with technology requires a systematic understanding of technology, content, pedagogy, and how these components work together (Masterson, Wilson, & Wright, 2014; Mishra & Koehler, 2006; Zhao & Frank, 2003). Harris, Mishra, & Keohler (2009) note that PD that focuses solely on teaching technology skills is insufficient in providing the knowledge needed to effectively integrate technology and does provide the knowledge to facilitate student learning. Figure 2.2 shows the TPACK interplay

between of the different knowledge needed to effectively use technology for teaching and learning.



Representation of the relationships and interplay of knowledge needed by teachers in order to effectively integrate technology: Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK). Image is reproduced by permission of the publisher, © 2012 by tpack.org. Image from http://tpack.org

Figure 2.2: The Components of the TPACK Framework

Building off the works of Shulman (1986), Mishra and Koehler (2006) constructed an instructional model to frame the interplay between content knowledge, pedagogical, and technology knowledge. The TACK framework is broken down into seven parts.

1. Technology Knowledge (TK): Knowledge about standard technologies as well as more advanced technologies.
2. Pedagogical Knowledge (PK): The processes or methods of teaching and learning and how it encompasses overall educational purposes, values and aims, such as classroom management, assessment, learning, and lesson plan development.
3. Content Knowledge (CK): Knowledge about the actual subject matter that is to be learned or taught.
4. Technological Pedagogical Knowledge (TPK): The knowledge of various technologies as they are used in teaching and learning settings and knowing how teaching might change as the result of using particular technologies.
5. Technological Content Knowledge (TCK): Understanding the subject matter they teach and the manner in which the subject matter can be changed by the application of technology.
6. Pedagogical Content Knowledge (PCK): Content knowledge as it relates to the teaching process and the goal of developing better practices within various content areas.

7. Technological Pedagogical Content Knowledge (TPACK): The knowledge teachers must have to integrate technology into the teaching of different content areas. (Schmidt, Baran, Thompson, Mishra, Koehler, & Shin, 2009)

With the integration of technology into teaching and learning standing as a challenge for many teachers, TPACK serves as a useful framework in understanding the knowledge needed to integrate technology into teaching and the processes involved in the development of this knowledge (Schmidt et al., 2009). Schmidt et al. (2009) observed that in order for meaningful technology integration to happen, a sound understanding of all the individual TPACK components is essential. Assisting educators effectively use technology for teaching and learning, the TPACK framework guides educator preparation programs and PD to identify and emphasize what teachers need to understand about technology, pedagogy, content and their interrelationships. With PD being the formal education in which practicing teachers receive training, PD is at the forefront of ensuring teachers are equipped with the knowledge and skills needed to teach and facilitate learning through technology integration in the 21st century.

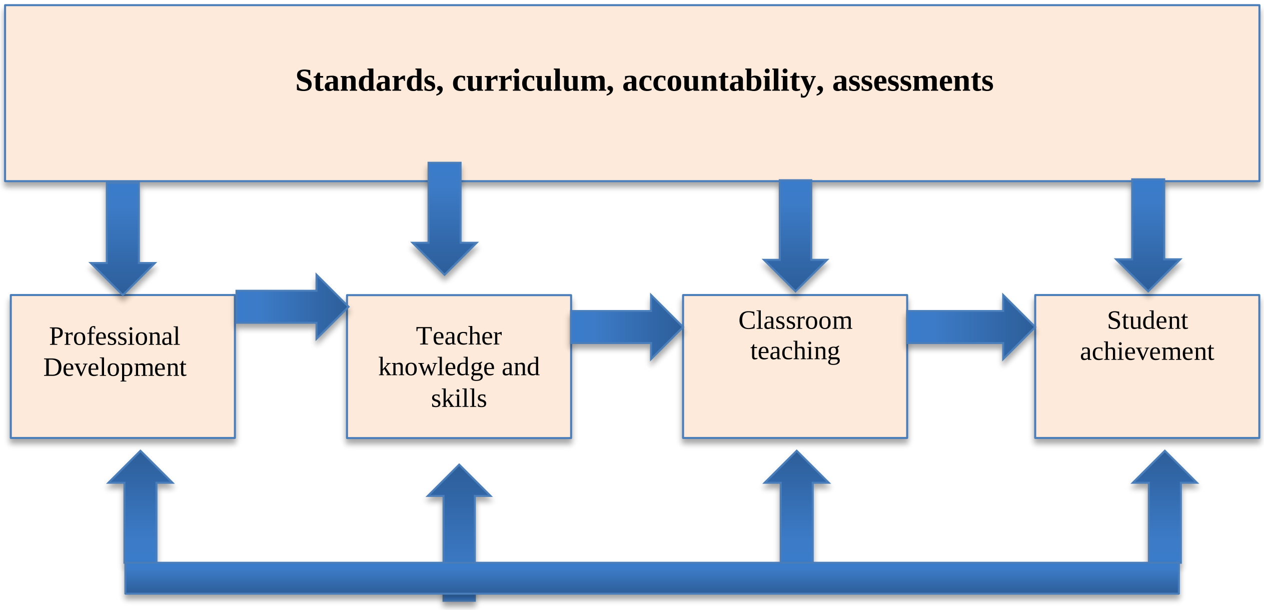
Professional Development

Research has established that highly qualified and highly effective teachers are central to students' academic success (Darling-Hammond & Berry, 2006; Geringer, 2003; Lasley, Siedentop, & Yinger, 2006). The key to empowering teachers is highly qualified and highly effective is professional development (PD) (Ball & Cohen, 1999; Darling-Hammond & McLaughlin, 1995; Elmore & Burney, 1997; Little, 1993; National Commission on Teaching and America's Future, 1996). This study employs the definition of high quality or effective PD to be PD that "results in improvements in teacher's knowledge and instructional practice, as well as student learning" (Wei et al., 2009, p. 3).

PD aims to increase teacher quality to which influences teaching quality (Yoon, Duncan, Lee, Scarloss, & Shapley, 2007). Research by Darling-Hammond (2012) has held the notion that

teacher quality is seen as a “bundle of personal traits, skills, and understandings an individual brings to teaching, including dispositions to behave in certain ways” where as “teaching quality refers to strong instruction that enables a wide range of students to learn” (p. *i*) in the context of instruction. In the context of this study, teacher self-efficacy and TPACK relate to teacher quality and teaching quality as the knowledge, skills, attitudes, and beliefs intertwine. With PD being the common method of improving teacher quality, its goal is to assist teachers master the various components of knowledge that will empower them to make the appropriate instructional decisions that increase student learning (Yoon et al., 2007).

Examining more than 1,300 studies, Yoon et al. (2007) found that teachers who participate in a substantial amount of PD hours (i.e., an average of 49 hours) can improve their student’s achievement by about 21 percentile points. With federal and state accountability, this research assumes that PD directly influences teachers’ knowledge and practice to which directly impacts classroom teaching that then affects student performance. Figure 2.3 illustrates how professional development relates to student achievement.



The above figure shows the relationships leading to increased student achievement. Professional development leads to an increase in knowledge and skills to which influence classrooms teaching. Enhanced classroom teaching leads to student achievement. Adapted from Yoon, Duncan, Lee, Scarloss, & Shapley, 2007.

Figure 2.3: How professional development affects student achievement.

From national to state organizations, curriculum standards now focus on integrating technology tools to support learning (Polly & Hannafin, 2011). Ensuring effective use of technology as an instructional tool calls for effective PD. Although research supports that teacher PD is the strongest school based factor that can improve student learning (Hanushek & Rivkin, 2012; Nye, Konstantopoulos, & Hedges, 2004; Rivkin, Hanushek, & Kain, 2005), there is, however, an identified shortage of high quality PD. The shortage of effective PD led the US government to create a federal mandate under the 2001 NCLB Act to ensure that teachers receive such learning opportunities through funding supported by Tittle II funds. As massive amounts of monies purchase mobile devices for classroom integration, effective PD that increases teacher self-efficacy towards using technology and builds capacity to use technology as an instructional

tool is lacking in teacher preparation and development. Supporting this claim is a reported belief in The U.S. Department of Education's 2010 NETP that stating that teachers "feel they are not well prepared to use technology in their practices" (p. 39, 2010).

Although there has been an observed increase of the use of technology, research reveals a poor integration of computers into teaching and learning processes (Tondeur, Valce, & Van Braak, 2008). Research conducted by Tondeur et al. (2008) indicated that there is a gap between what teachers are introduced to and taught in their educational course work. Researchers found success in implementing educational technologies to be dependent on in-depth high-quality teacher PD and ongoing support (Lemake & Fadel, 2006; O'Dwyer, Russel, & Bebell, 2004; Penuel, 2006). Research supports success in the integration of technology into teaching and learning when PD assists teachers in connecting technology to curriculum standards, and also when PD provides pedagogical approaches (Penuel, 2006). Concerning teacher PD on technology integration, the TPACK framework presents itself as a model for instruction as it enables teachers to consider technology, pedagogy, and content when waking curriculum decisions.

Traditional PD has teachers attend face-to-face (F2F) workshops during the instructional school day, before or after school, or during the weekend. Other types of traditional F2F PD include in-service training, conferences, professional learning communities, the taking of a class at a university or at a local education agency. Unlike university enrollment, many F2F PD span over the course of several hours and conclude at the end of one day. As the most prominent model of PD, F2F workshops are sometimes referred to as "sit and get" PD. These types of trainings offer teachers knowledge about a new pedagogy from an external expert contracted by either a district or school. The expectation is that participants will return to their classroom and

implement what they learned the day before. Research supports that effective PD requires substantial time (Yoon et al., 2007), however, issues of cost and time pose a serious problem for teachers, schools, and districts.

When districts contract external experts to provide F2F PD, costs involve presenter fees, logistical fees, and materials. When attending F2F PD during an instructional day, teachers do not instruct. Instead, substitute teachers provide instruction. F2F PD also poses a cost to schools as monies cover teachers' PD attendance and substitute teacher cost. F2F PD during the instructional day is sometimes during teachers' prep time, and makes for a 45-minute window in which PD is rushed. Additionally, a short PD session during a teacher's prep period takes away time meant for instructional planning. When PD is an afterschool or a weekend event, personal time becomes a critical issue. With the advancement of technologies and the Internet, OPD has presented itself as a delivery mode that addresses some of the aforementioned concerns associated with F2F PD.

Researchers have defined OPD as "teacher learning experiences delivered partially or completely over the Internet" (Fishman, Konstantopoulos, Kubitskey, Vath, Park, Johnson, Edelson, 2013). Time factors associated teaching and personal responsibilities, the cost of PD, and the time needed to participate in substantial PD, the growth and accessibility of the Internet has made OPD a viable choice for teachers, schools, and districts (O'Dwyer, Carey, & Kleiman, 2007). Researchers Dede, Ketelhut, Whitehouse, and McCloskey (2009) have made the case that OPD has many potential advantages for teachers. Dede et al. (2009) noted that OPD accommodates well to the busy schedules of teachers, draws on great resources not locally available, and establishes a "path towards providing real-time, work-embedded support" (p. 9) throughout a teacher's learning. Another benefit to OPD is that it provides

geographically isolated teachers with PD opportunities that would not ordinarily be available.

Examining two comparison groups, teachers who underwent environmental science F2F PD and those who undergone OPD, Fishman et al. (2013) found no difference in learning outcomes. In another study examining coaching as a form of professional development, researchers Powell, Diamond, Burchinal, and Koehler (2010) examined Head Start teachers who received coaching through technology mediation and those received in-person coaching. Their research found improvements in both learning and practice improvements, and concluded that technology mediated PD is a promising alternative to the traditional F2F coaching model. In a different study comparing knowledge and instructional practices between fourth-grade English language arts teachers who received OPD and those who received no PD, researchers Masters, Magidin deKramer, O'Dwyer, Dash, and Russell (2010) found a significant effect of OPD when compared to the control group.

OPD is an alternative to F2F PD because of its accessibility, cost, and convenience. The time constraints of teachers and financial burdens imposed to schools and districts by traditional F2F PD situates OPD as a possible solution to overcome said barriers. Using mobile devices to access and participate in OPD adds to the convenience variable and makes OPD truly accessible anytime, anywhere.

Distance Learning

Unlike traditional face-to-face (F2F) classroom instruction, distance learning (d-learning) is a process of corresponding via means other than F2F. In d-learning, instructors assigned content and lessons and required students to submit assignments for review. Many universities see d-learning as a way to making education accessible to student who were unable to attend traditional campus courses (Nichols, 2003). Researchers have found that d-learning's popularity grows steadily among students in higher education, the business sector, and the military

(Nicholson and McDougall, 2005). However, because d-learning is an asynchronous environment and utilized prepared materials, it offers little teacher-to-student communication (Rosenberg, 2001). With the advancements in technology, specifically the Internet, d-learning has evolved to electronic learning (e-learning) (Welsh, Wanberg, Brown, & Simmering, 2003).

Electronic Learning

Unlike d-learning, e-learning provides content, modules, activities, assessments, and facilitates collaboration between teacher and student in both synchronous and asynchronous environments usually via a desktop or laptop and the Internet. Proving to be an efficient approach to teaching and learning, research by Horton (2000) found 5 key benefits to e-learning. Those strengths are: (a) provides consistent learning for all students, (b) increases convenience and accessibility for students, (c) allows learner to progress at own pace, (d) digitally manages content, progress, and evaluations for both teachers and students and, (e) lowers the cost to operate a course either on an off-site location or on campus. There are many differences when comparing scheduling, interaction, learning style, and technology skills of traditional F2F and e-learning. Table 2.4 provides comparisons of F2F and e-learning options.

Table 2.4: Comparing Face-to-Face and E-learning Options

	Face-to-Face	**E-learning**
Scheduling	Synchronous scheduling- students are expected to attend class.	May be synchronous (attendance expected) or asynchronous (no scheduled meeting time). Deadlines are set.
Interaction	Students can ask questions in class.	Communication is often through email only, which makes previewing material early critical.
	Course content and participation in the course requires class attendance.	Students primarily receive content by reading. Some courses record lectures and video.
	In-class reminders and the physical presence of peers help some students stay on track with their coursework.	Students submit work electronically by set deadlines. Schedules tests with a proctor at their local campus or take an online assessment. Strong self-management skills are required.
Learning Style	Students participate in classroom activities with other students, listen to lectures, and take notes.	Students engage in independent reading and work on assignments or projects on their own schedule.
	Students can study together or work in groups for support.	Group work may or may not be an option.
	Students are less likely to participate in class discussions.	Students actively participate in online discussions and complete online modules.
Technology Skills	Various forms of media may be presented during class. Lectures are usually the primary methods of delivering course content.	Students utilize a wide variety of skills and programs and have the ability to use current technology for course success.
	Communication with instructors and peers occurs in person.	Communication with instructors and peers occurs in via email or in online forums.
	Minimal technology skills required.	Moderate to advanced technology skills needed.

With the advancement of the Internet and the evolution of websites in the early 2000s, e-learning increased in popularity as blogs, social networking sites, and learning management systems advanced in their capacity to facilitate teaching and learning (Downes, 2005). Soon after, many K-12 institutions began implementing e-learning techniques offer both synchronous and asynchronous learning opportunities for students (Staker & Horn, 2012). As technologies (viz., mobile devices) advanced and became more compact, along with the success of e-learning, mobile learning (m-learning) emerged as a new mode of teaching and learning.

Mobile Learning

Offering all the benefits of e-learning, m-learning uses mobile devices and allows

learning teaching and learning to take place anytime, anywhere (Bransford, Brown, & Cocking, 1999; Georgiev, Georgieva, & Smirkarov, 2004). M-learning can also be F2F as students have their mobile devices at their side using it as a tool (e.g., note taking, product creation, and referencing content). Research by DeGani et al. (2010) showed that m-learning allows for a more intimate and personalized means for accessing course content and lessons. Research shows that students using one-to-one (1:1) technologies become more engaged (Dawson, Cavanaugh, & Ritzhaupt, 2008; van t'Hooft & Swan, 2007; Penuel, 2006) and empowered to access, manipulate, and display the knowledge and information they have retrieved and constructed.

The outcry for technology in schools, specifically ubiquitous computing, has led to a focus on handheld mobile devices in schools (Garthwait & Weller, 2005; Swan, van t'Hooft, Kratcoski, & Unger, 2005; Swan, Kratcoski, & van t'Hooft, 2007; van t'Hooft & Swan, 2007). With ubiquitous computing, both teachers and students have access to technologies and Internet services whenever and wherever they need it (van t'Hooft & Swan, 2007), making mobile devices ideal for ubiquitous computing in education. Over the past decade, one-to-one initiatives continue to spread across America. The notion of student increases in learning and academic performance and in the number of teachers who effectively integrating technology comes as research shows an increased access to computer resources (Bebell & Kay, 2010; Cavanaugh, Dawson, & Ritzhaupt, 2011; Gulek & Demirtas, 2005; Lei & Zhao, 2008; Penuel, 2006).

With the use of handheld mobile technologies in teaching and learning comes demonstrated student performance and engagement in content areas such as reading (Bomar, 2006; Patten & Craig, 2007; Shoemaker, 2007), mathematics (Lary, 2004), social studies (Dixon, 2007; Royer & Royer, 2004; Vess, 2006), and science (Roschelle, Penuel, Yarnall, Shechtman, & Tatar, 2005; Tinker, 2007). However, other research found that there was no increase in

student engagement and that technology adversely affected student success when there was an increased access to technology (Donovan, Green & Hartley, 2010; Inal, Kelleci, & Canbulat, 2012). Research by Owusu, Monney, Appiah, and Wilmot (2010) found that academic performance varied among student populations when receiving traditional instruction over computer assisted instruction, and vise versa. Conversely, research utilizing both traditional instruction and online methods, known as blended learning, showed a positive impacted student achievement (Yapici & Akbayin, 2012).

Blended Learning

Blended learning is the systematic and strategic approach to times and modes of teaching and learning that integrate the best aspects online and F2F learning shown to be beneficial to 21st century learners (Bonk & Graham, 2006; Lynch & Dembo, 2004; Yapici & Akbayin, 2012). Yapici & Akbayin (2012) found the 5 following reasons blended learning increased student achievement: (a) allows students to prepare before class, (b) offers unlimited opportunities to revise work, (c) expands on concepts by means of activities, videos, and animations, (d) permits students to self-test in order to determine their competence in content, (e) allows for communication outside of class time, and (f) presents students an opportunity to learn at their own pace. With the influx of technologies in schools and the social popularity of mobile devices, blended learning is a popular initiative for K-12 educational institutions. Table 2.5 provides teaching and learning experiences within blended learning and their equivalent to traditional F2F teaching and learning.

Table 2.5: Face-to-Face and Blended Teaching and Learning Equivalencies

Learning and Teaching Experiences	Face-to-face Learning & Teaching		Equivalent Blended Learning Options	
Assessment	Essays Mid-semester Exams Final Exams Projects	Presentations Product development Posters Peer review	Online quiz/quizzes Online submission of assessment Wiki (individual or group) Blog (individual or group) Learning Journal (individual or group)	Group submissions Online presentations Creating digital items Online peer review Online feedback Discussion Forum contributions
Teacher/student communication	Announcement in lecture/tutorial Office consultations	Notice on door/noticeboard Email	Email or message Announcement Discussion Forum Synchronous chat/virtual classroom Online consultations	Notifications dashboard Early warning notifications Mobile learning Webinars Social Media
Student activities	Hard copy questions and solutions Readings Read textbook Study Preparing for assessment Assessments Presentations	Small group work Discussion Debates Role plays Project work Peer review Study groups	Commenting online on readings Annotations Online reflective journal Practice quizzes Asynchronous discussion Wiki (individual or group) Role plays or debates Blog (individual or group) Mobile learning Simulations	Creating and sharing video/audio Creating and publishing content/product File exchange Online peer review Student led moderation Panel discussions Online study groups E-portfolio sharing open education resources
Teaching activities	Lectures Tutorials Labs Practicum Workshops Seminars Guest lectures	Debates Demonstrations Performances Small group work Q&A sessions Brainstorming Mind-mapping Role plays Surveys	Recorded lectures Live streaming of lectures Desktop recordings Webinars Recorded webinars Video/audio with associated student activities PPT with audio Synchronous chat/virtual classroom	Surveys Social media Online guest presenters Online marking with feedback Digital curation Learning analytics Student response systems Mobile learning Polling
Student resources	Unit Outline/Learning Guide Handouts	Readings Workbook Lecture notes Textbooks	Unit outline/learning guide in Weblinks Online self-directed learning activities	Online guides/instructions Interactive textbook activities Online practice/revision quizzes Open education resources

Mobile Devices

In 2013, the Pew Research Center provided data that showed that 78% of teenagers have a cell phone. Of those phones, 47% were reported as smartphones. The center found that 93% of teens possess a computer or have access to one at home (Madden, Lenhart, Duggan, Cortesi, & Gasser, 2013). Prior to that, a 2009 report from the National Center for Education Statistics showed that roughly 97% of public school teachers had access to at least one centrally located computers every day and had an average of 5.3 ratio of students to computers (NCES, 2010).

To equip schools with technological infrastructure and hardware needed to embrace technologies in schools, President Barack Obama announced in June 2013 the ConnectED Initiative (Education for K-12 Students, n.d.). The ConnectED initiative "empowers teachers with the best technology and the training to make the most of it, and empowers students through individualized learning and rich, digital content" (Education for K-12 Students, n.d., p. 1). In a February 2015 announcement made by President Obama, the ConnectED initiative will be backed by a $2 billion financial commitment made by the Federal Communications Commission (FCC) to expand high speed internet connectivity "connecting twenty million more student studies to next-generation broadband and wireless" (Education for K-12 Students, n.d.). Additionally, several private-sector companies collectively committed over $2 billion to deliver new technologies to classrooms. Posted on the White House ConnectED webpage (Education for K-12 Students, n.d.), those commitments include:

- **Adobe**, which will provide more than $300 million worth of free software to teachers and students, including Photoshop and Premiere Elements for creative projects; Presenter and Captivate to amplify e-Learning; EchoSign for school workflow; and a range of teacher training resources
- **Apple**, which will donate $100 million in iPads, MacBooks, and other products, along with content and professional development tools to enrich learning in disadvantaged U.S. schools
- **AT&T**, which pledged more than $100 million to give 50,000 middle and high school students in Title I districts free Internet connectivity for educational devices

over their wireless network for three years

- **Autodesk**, which pledged to make their 3D design program "Design the Future" available for free in every secondary school in the U.S. — more than $250 million in value
- **Esri**, which will provide $1 billion worth of free access to ArcGIS Online Organization accounts – the same Geographic Information Systems mapping technology used by government and business – to every K-12 school in America to allow students to map and analyze data
- **Microsoft**, which will launch a substantial affordability program open to all U.S. public schools by deeply discounting the price of its Windows operating system, which will decrease the price of Windows-based devices
- **O'Reilly Media**, which is partnering with Safari Books Online to make more than $100 million in educational content and tools available for free to every school in the U.S.
- **Prezi**, which will provide $100 million in Edu Pro licenses for high schools and all educators across America.
- **Sprint**, which will offer free wireless service for up to 50,000 low-income high school students over the next four years, valued at $100 million
- **Verizon**, which announced a multi-year program to support ConnectED through up to $100 million in cash and in-kind commitments.

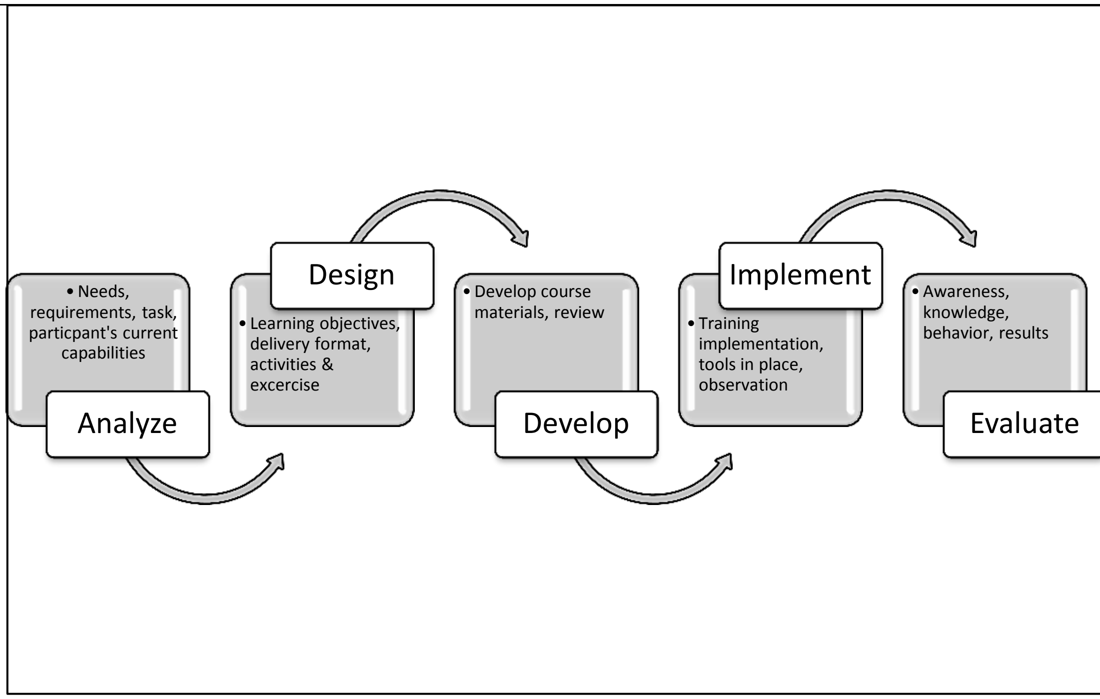
Conceptual Framework

Conceptual Framework is the written product that explains the main idea; the key factors concepts, variables, and their relation to one another (Miles & Huberman, 1994). This study measures change in participant scores before and after engaging in one of three levels of rigor using statistical analyses to determine impact of taxonomic rigor level. Examining the MPD treatment conditions and impact on participant TPACK and TAD1 performance scores, stands to indicate whether design and rigor levels of assessment influence growth.

Instructional Design

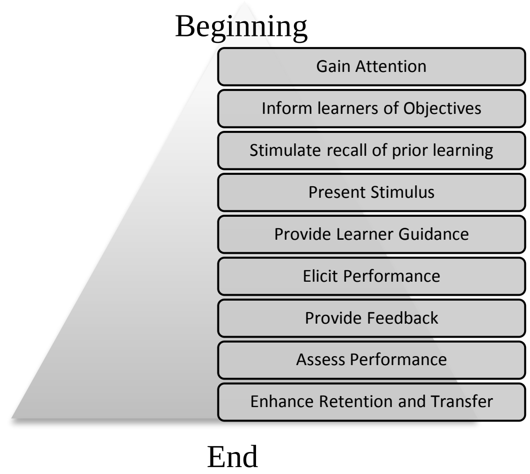
As a theoretical framework, this research utilized principles of Instructional Design (ID)- "a systematic and reflective process of translating principles of learning and instruction into plans for instructional materials, activities, information resources and evaluation" (Smith & Regan, p.4), to develop a MPD that was learner-centered (LC). With one of the key goals of ID being to provide learner-center environments (Morrison, Ross, Kalman, & Kemp, 2011; Rothwell & Kazanas, 2008; Smith & Ragan, 2005), using directed instructional design prescribes

objectives and direct instruction (Kirschner, Sweller, & Clark, 2006; Mager, 1997). Evaluating the ADDIE Model (1975), Gagne's Nine Events of Instruction (1985), and the ARCS Model of Motivational Design (Keller, 1983, 1984, 1987, 2010) allowed this research to pull and adapt its own method for designing a MPD course. Figures 2.4, 2.5, and 2.6 illustrate each ID method blueprint used to generate this study's MPD course design.



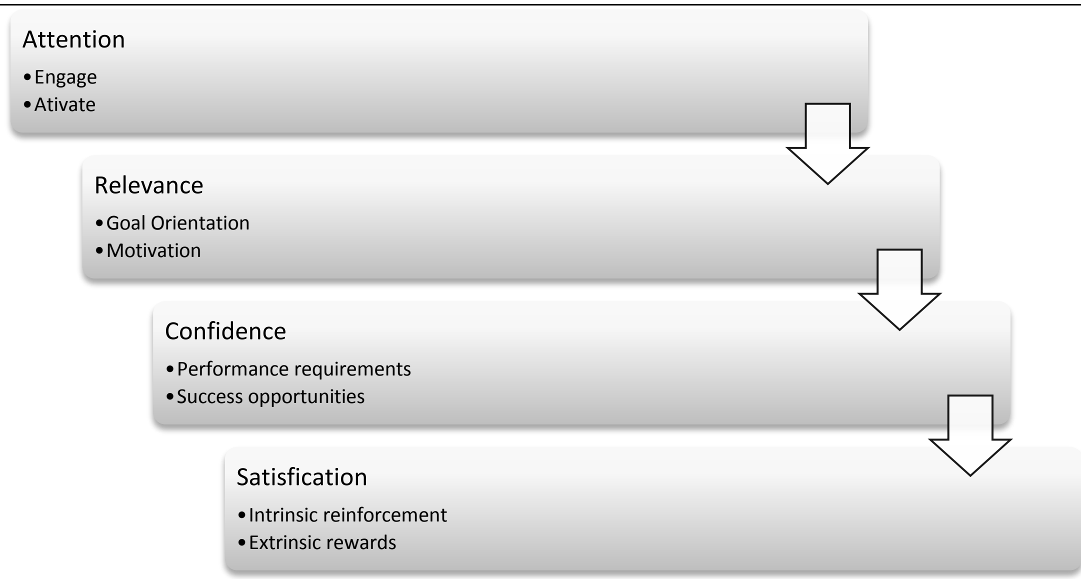
ADDIE Model (adapted from Branson, R.K., Rayner, G.T., Cox, J.L., Furman, J.P., King, F.J., Hannum, W.H. (1975). Inter-service procedures for instructional systems development: Executive summary and model. (Vols. 1-5) TRADOC Pam 350-30, Ft. Monroe, VA: U.S. Army Training and Doctrine Command.)

Figure 2.4: Visual representation of The ADDIE Model used to develop design process.



Gagne's Conditions of Learning (adapted from Gagne, R. (1985). The conditions of learning (4th.). New York: Holt, Rinehart & Winston.)

Figure 2.5: Visual representation of Gagne's Nine Events of Instruction used to develop design process.

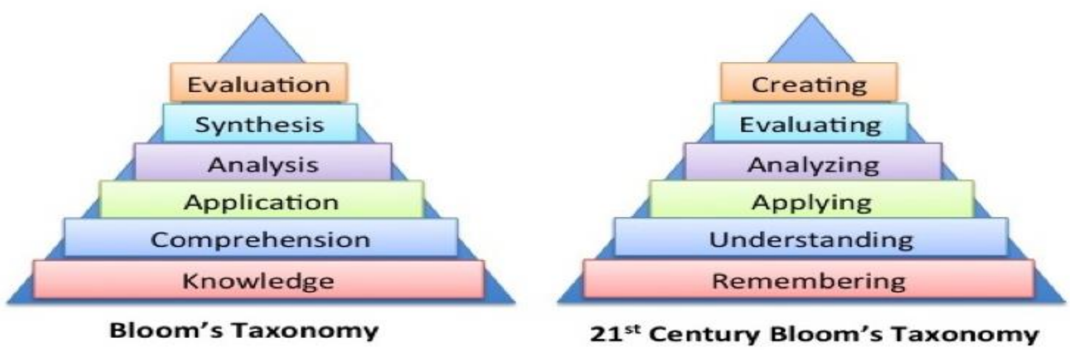


John Keller's ARCS Motivational Model (adapted from ARCS Model of Motivational Design (Keller, J. (2008). Learning-Theories. http://www.learning- theories.com/kellers-arcs-model-of-motivational-design.html)

Figure 2.6: Visual representation of the ARCS Motivational Model used to develop design process.

Bloom’s Taxonomy

Another theoretical framework of this study is Anderson and Krathwohl’s (2001) revision of Bloom’s Taxonomy (Bloom & Krathwohl, 1956), a multi-tiered classification of learning objectives (see Figure 2.7) were all educational learning objectives are classified and leveled, the highest level is to create and the lowest is to remember. A learning objective is a statement of learning that contains both an action (verb) and an object (noun). In the developing learning objectives, the object describes the knowledge learners are expected to understand or construct, and the verb refers to the actions involved in the cognitive process (Anderson & Krathwohl, 2001, pp. 4–5).



Original Bloom’s Taxonomy (1956) and 21st Century Bloom’s Taxonomy, adapted from Anderson, L. W., & Krathwohl, D. R. (Eds.). (2001). A taxonomy for learning, teaching and assessing: A revision of Bloom's Taxonomy of educational objectives: Complete edition, New York : Longman.

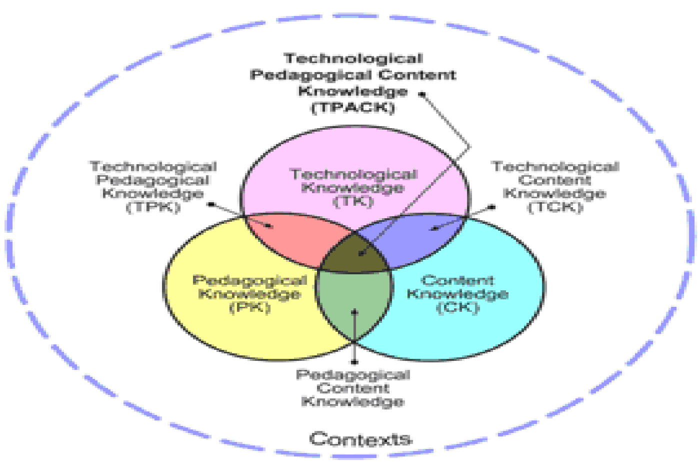
Figure 2.7: Visual representation of Anderson & Krathwohl’s revision to Bloom’s Taxonomy used to develop rigor of assignment questions.

This study measured participant scores from 3 treatment conditions before and after teachers engaged in a MPD course. Separating each treatment condition was assignment questions' taxonomic level of rigor. Each condition had its own unique set of questions. The study developed a low, medium, and high treatment conditions based on Anderson and Krathwohl’s (2001) revision of Bloom’s Taxonomy. Bloom’s Taxonomy served this research by establishing a basis to which assignment questions and rigor were developed. This study's

notions is that with different levels of taxonomic rigor, teachers will be challenged at different levels and score differently on a standardized technology application performance assessment and influence self-reporting on a survey measuring TPACK attitudes and beliefs.

Technology Pedagogical Content Knowledge

Technological Pedagogical Content Knowledge (TPACK) is the third theoretical construct. TPACK serves as a framework for understanding the relationship and overlap between content, pedagogy, and technology (Harris, Mishra, & Koehler, 2009; Koehler & Mishra, 2008, 2009; Mishra & Koehler 2006, 2008, 2009) and emphasizes that effective technology integration into teaching and learning occurs when TPACK overlaps are fully understood and integrated (see Figure 2.8).



Representation of the relationships and interplay of knowledge needed by teachers in order to effectively integrate technology: Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK). Image is reproduced by permission of the publisher, © 2012 by tpack.org. Image from http://tpack.org

Figure 2.8: The Components of the TPACK Framework

Past research has shown that solely possessing technology skills does not ensure effective technology integration into teaching and learning, but rather a systematic understanding of how technology, subject matter, and pedagogy all work together (Mishra & Koehler, 2006; Zhao & Frank, 2003) enables teachers to meaningfully integrate technology into the classroom. The

TPACK framework assisted this study to identify and select course content, activities, and questions.

Conclusion

This chapter provided the foundation to understanding the rationale and significance of this study. Mobile devices are in the classrooms; however, teachers are not prepared to fully integrate them into active learning experiences. Federal, state, and local initiatives are in alignment regarding technology goals. All educational technology initiatives call for substantial teacher training of technology and technology integration. Influencing attitudes and beliefs towards technology and technology integrations are one's own level technology knowledge and skill set. PD is a means to increasing teachers' knowledge and skills, thus positively affecting attitudes and beliefs. As issues of PD time and cost burden budgets and personal schedules, OPD serves as a viable option to relief those concerns. This study's used instructional design theory and models and the TPACK framework develop course models. Anderson and Krathwohl's (2001) revision of Bloom's Taxonomy aided the development of assignment questions for each treatment condition needed to answer research questions.

Chapter 3: Methodology

Introduction

As mobile devices and advancing technologies make their way into schools and households across the world, m-learning becomes the new paradigm of teaching and learning. The development of new technologies and instructional best practices calls for teacher training. With issues of cost and time, MPD offers training on technology integration (e.g., concepts, skills, applications, best practices, etc.) anytime and anywhere by means and modes of which teachers are expected to teach and facilitate learning in the 21st century. Past research has documented that little is known about what teachers actually learned and implemented from engaging in professional development, or how it has impacted student learning and engagement (Fishman et al. 2003; Wayne et al. 2008). The purpose of this quantitative research study was to examine how taxonomic rigor in each condition group's set of assignment questions affects teachers' self-reporting on a TPACK attitudes and belief survey and technology knowledge and skill performance on standardized Technology Applications Domain 1 (TAD1) performance assessment. This study examined two research questions and tested 2 hypotheses:

1) How do taxonomic levels of rigor in learning affect teachers' TPACK attitudes and beliefs towards technology and technology integration in a mobile professional development environment?

2) How do taxonomic levels of rigor in learning affect teachers' technological knowledge and performance on a Technology Applications mock assessment in a mobile professional development environment? (State certification test)

The hypotheses for the two research questions are as follows:

Researcher Hypothesis 1: There is a statistical significant mean difference in participant TPACK scores across the three levels of treatment intervention following the completion of the MPD.

Researcher Hypothesis 2: There is a statistical significant mean difference in participant performance across the three levels of treatment conditions as it relates to a TAD1 mock exam.

This chapter describes the study's research methodology and includes details on: (a) the rationale for a modified experimental research design, (b) the context of the research setting, (c) the research participants, (d) ethical considerations, (e) data collection methods, (f) data analysis methods, (g) issues of trustworthiness, (h) limitations, and (i) delimitations. This chapter concludes with a brief summary highlighting the key points of this study's research methodology. Before conducting the study, this study obtained permission from the university's Internal Review Board (see Appendix A for approval of the study). The partnering school district and site administration received a copy of the study's findings to assist in identifying improvements of mobile learning professional development.

Rationale for the Experimental Design

This study sets out to examine participant pre and posttest self-reporting scores on a TPACK attitudes and beliefs survey and performance knowledge and skills as scored on a standardized assessment across treatment conditions. Each treatment condition was a different set of taxonomic questions according to rigor level (e.g., low, medium, & high). To effectively examine each treatment condition and control for regression and selection factors, this study required a quantitative statistical analysis pretest-posttest control group design to randomly assign participants to 3 treatment conditions (Gall, Borg, & Gall, 2006). Random assignment ensured the absence of any systematic bias in-group composition (Gall et al., 2006). This study

is a quantitative modified experimental design because participants were randomly assigned to a treatment condition, an outcome was being measured, and an analysis was performed to determine whether outcome differences are related to treatment condition, this (Gay, Mills, & Airasian, 2012). Because this study compared posttest means of 3 taxonomic conditions using pretest mean scores as the covariate, the preferred statistical method of analysis is an analysis of covariance (ANCOVA) (Gall et al., 2006). Using qualitative methods would not have served this study in answering identified research questions. As seen below, Figure 3.1 illustrates the research design model used for this study.

Random Assignment *	Pretest	Treatment Condition	Posttest
R	O	X_1	O
R	O	X_2	O
R	O	X_3	O

Figure 3.1: Modified Experimental Pretest-Posttest Control Group Design

Research Setting

With federal and local accountability requiring teachers and students to meet national, state, and district technological goals, this study identified two campuses, one elementary and one middle school, in a west Texas school district well equipped with technology hardware and infrastructure. This district and its two schools were chosen because of their acceptance of a Texas Education Agency grant (i.e., Texas Literacy Initiative). The grant provided for roughly $2.8 million towards the purchase of 7, 237 mobile devices meant to incorporate more 21st century technologies into classrooms. The district's fall 2012 rollout included having 28,000 students use iPads for English language arts and reading (El Paso Times, 2012). Of the 39

campuses within the district receiving the new mobile devices, the two participating schools were among them. Additionally, this district committed to be and signed the *Future Ready District Pledge* (U.S. Department of Education, 2014), bought online textbooks and resources for students and teachers to use, and changed its district policy allowing for students to take and use their personal mobile devices as an instructional tool. Employed by the district, this study's researcher had convenient access to both campus sites and made for convenient sampling. To increase sample size, this research offered the course to students in 3 Master-level teacher education courses at the west Texas borderland university.

Once the two campus sites and university courses were identified, site administrators and professors were contacted via phone and meetings were set to sit down and discuss goals and benefits of the study with each campus administrator. Upon receiving permission from each site administrator, district research request forms were then completed and filed with the district's research department for approval. Forms then received approval from the university's Institutional Review Board (IRB).

Research Participants

The teaching faculty from the identified district campuses were ideal candidates to participate in this study as technology hardware was widespread at both campuses, the use of mobile devices to access content and complete assignments was expected and supported by administration, and there was an essential need for teachers to receive training using mobile devices and mobile learning. Possible participants included all teaching faculty and administration, as they all are instructional leaders and have access technology and students. The participants from the university were also practicing teachers, some in the same district as the other two research sites, and others held employment in surrounding area school districts. All area districts have aligned technology goals and a mutual direction, thus making the university

participants similar to the school based sample. All participants self-selected themselves to participate in the research study, however, once committed they were randomly assigned to the three level of the treatment conditions.

After identifying ideal possible participants, an afterschool faculty meeting was scheduled at each of the school sites and a presentation brief was provided for each university course to present the study, review and collect consent forms, and answer any questions held by participants. A week before the scheduled faculty meeting, study fliers (see Appendix B) were printed and distributed in faculty school mailboxes in efforts to advertise participation benefits and incentives. Additionally, morning announcements advertised the study. A $20 voucher for successful completion of the all course assessments and assignments stood to incentivize participation and increase sample size. For those participants enrolled in higher education courses, a university assignment waiver aimed to gain participation.

A power analysis determined this study's sample size for an ANCOVA of three levels and one covariate. Using an alpha of 0.05, the analysis yielded a power of 0.80 and a large effect size ($f = 0.40$) (Faul, Erdfelder, Buchner, & Lang, 2013). The ideal total sample size to achieve statistical significance was 73 subjects. Incorporating convenient sampling to identify the two campuses, the total possible number of participants was 103. The breakdown of possible participants was 43 at elementary site and 60 at the middle school. Including the 3 university courses added an additional 30 possible participants. All possible participants have a 4-year degree, are all licensed to teach in the state of Texas in their respective content area, and read and write fluent English.

Of the 133 possible participants presented with the study, 40 self-selected themselves, signed, and submitted consent forms. As each acknowledged participant submitted the consent

form, each were randomly assigned to one of the three treatment conditions. Of the 40 participants who singed and submitted consent forms acknowledging intent to participate, 40 began and only completed pretest, however only 29 successfully completed all course requirements making the total sample size N=29. Table 3.1 shows the random assignment and comparison of those who registered to those who actually completed the course.

Table 3.1: Random Assignment Comparison Intended Participants to Actual Participants

Treatment Condition	Number of Acknowledged Participants	Number of Participants N= 29
X1	13	n= 8
X2	13	n= 11
X3	14	n= 10

Of the total sample size of participants who successful completed the course, 4 were male and 25 were female. When asked to identify their teaching experience in years, 4 of the participants reported having 20+ years teaching, 12 participants with 10-19 years, 6 had 5-9 years, and 7 indicated only having between 0-4 years of teaching experience. When asked to identify the highest level of education, 3 participants reported having a both a Master's and Bachelor's Degree while only 10 reported having only a Bachelor's Degree. Those participants with a Masters degree also possessed a Bachelors degree. When asked to identify the mobile devices they have and frequently use, all participants reported having at least 3 mobile devices. All reported having a smart phone and a laptop. Only 1 participant did not have access to an iPad or tablet. One participant reported having a Nook device, and 9 participants reported still using a desktop computer. Table 3.2 provides data related to participants' years of teaching experience, degrees, and mobile device possessions.

Table 3.2: Years of teaching experience, degrees, and mobile device possessions

		Frequency	Percent
Teaching experience	0-4 Years	7	24.1
	5-9 Years	6	20.7
	11-19 Years	12	41.4
	20+ Years	4	13.8
	Total	29	100.0
Degrees	Bachelors	23	79.3
	Masters	6	20.7
	Total	29	100.0
Plan to take certification	No	1	3.4
	Yes	28	96.6
	Total	29	100.0
Smartphone	Yes	29	100.0
	Total	29	100.0
Laptop	Yes	29	100.0
	Total	29	100.0
Desktop	No	7	24.1
	Yes	22	75.9
	Total	29	100.0
iPad or Tablet	No	5	17.2
	Yes	24	82.8
	Total	29	100.00

This study adhered to all district guidelines and IRB guidelines, polices and procedures. No identifiable information of participants, the school or district was released in any form or publication. Upon completion of the research study, all personal identifiable data was destroyed. In no way did this study distribute any data, dataset, or any type of output reports. A copy of the final report was provided to the district.

The procedures ensuring the maintaining of confidentiality of the research included having all data entered into SPSS, a statistical software program, and having only the principal investigator to have access to participant data database. Research was kept on the researcher's hard drive and was not open to anyone. The researcher's hard drive and computer was locked in

a file cabinet in the home cabinet of the researcher. Data from the study was kept on the researcher's hard drive and deleted at the end of the study.

Only the primary research investigator had access to participant information and data (i.e., assignment & assessment submissions, and background information). All registration records and initial assessments were collected during registration and entered and saved alpha numerically onto a statistical dataset to protect participant confidentiality, and then filed in a locked cabinet. Only the primary investigator had access to information. All assignments and assessments were safely submitted online. All assignments and assessments submitted electronically were automatically secured in a private cloud database only accessible to the primary investigator. Collected data was stored during the duration of the study and deleted at the end of the study.

Potential risk for this study included confidentiality in the case of theft or cyber hacking of the principal investigator's hard drive and or personal cloud storage. Participation in this study did not put research participants at physical, psychological, social, legal, or other type of risk. Measures taken by the researcher ensured participant safety, confidentiality, and data secureness.

Data Collection Methods

Because this study examined mobile learning treatment conditions and their impact on participants' perceived TPACK ratings and standardized scores on a TAD1 exam via the use of mobile devices, this study designed its treatment platform to have a mobile device interface and to be fully online. Differences in treatment conditions were the level of rigor of each assignment question. Pretest and posttests were the same across all treatment conditions.

Research Protocol

This study provided a two-week window to complete 4 self-paced course modules and 5 assignments and both pre and post assessments. During the two-week window and before starting modules, participants completed a basic demographic survey and the TPACK and TADA1 pretest. After completing the demographic survey, both pretests, 4 course modules, and all 5 assignments, participants then completed both posttests.

Each module contained its own lesson sequence, learning objectives, access to content, activities, and assignment. Within all modules, materials and assignments were accessible using any mobile device with Internet connection. Participants had to follow a lesson sequence to locate, access, and to review content in order to meet lesson objectives and to successfully complete assignments.

All aspects of this study (i.e., modules, content, assignments, etc.) were accessed, completed, and submitted using technology. Assignments were reviewed to gain better insight as to participant understanding and progress, but will not be scored. All submissions were privately stored and were not published.

Collected Data

Data was coded and entered into a secured statistical database. Consent and registration forms were placed in a locked home filing cabinet. Initial quantifiable data included participant demographics (see Appendix C for demographic survey) and general information. Basic demographic and general information of participants were needed for this study so that an accurate comparison to the performed statistical analyses was made.

This study involved the collection of pre and post quantitative data from two tools, a TPACK survey tool (see Appendix D) and a standardized TAD1 (see Appendix E & F) performance assessment. An analysis of covariance (ANCOVA) examined pre and posttest

scores from both tools to examine the impact of each treatment conditions. Each participant completed a pre and post standardized TAD1 exam and a TPACK self-reporting survey. Also collected were assignment responses from each participant and examined for further discussion at the conclusion of this study. Table 3.3 highlights and describes each quantitative instrument used in this research.

Table 3.3: Description of Instrumentation

Quantitative Data	Description	Number of Items
Demographic Survey	Survey to gain participant background and general information	5 items
TPACK instrument	Pre and posttest to measure effect on participants' perception of teaching and technology	46 items
TAD1 instrument	Pre and posttest to measure effect on participants' knowledge and understanding of Technology Applications Domain 1 competencies	21 items

TPACK Instrument

The TPACK survey tool utilized in this study measures pre service teachers' knowledge of teaching and technology (Schmidt, Baran, Thompson, Koehler, Mishra, & Shin, 2009). The tool has been revised over several studies to provide the most current reliability scores (Schmidt et al., 2009; Schmidt, Baran, Thompson, Koehler, Shin, & Mishra, 2009; Shin, Koehler, Mishra, Schmidt, Baran, & Thompson, 2009. A five-point Likert scale ranging from strongly disagree to strongly agree, this survey contains 46 items across 7 constructs: (a) technology knowledge (TK), (b) content knowledge (CK), (c) pedagogical knowledge (PK), (d) pedagogical content knowledge (PCK), (e) technological pedagogical knowledge (TPK), (f) technological content

knowledge (TCK), (g) technology pedagogy and content knowledge (TPCK). In the TPACK survey, higher scores for each subscale indicate higher perceived acquaintance with the applications of the knowledge base. The survey items are on a Likert-type scale with five response choices: 1=Strongly Disagree, 2= Disagree, 3=Neutral, 4=Agree and 5=Strongly Agree.

Although this survey is meant to access pre service teachers, this instrument is ideal to use with in-service teachers because in-service teachers actually have experienced teaching content to students using technology. Additionally, the TPACK instrument items align better to in-service teachers than non-practicing and non-experienced pre-service teachers. All participants completed this survey as pretest before the beginning the modules and as a posttest after completing all course modules and completing all course assignments. As there is no correct response to the TPACK survey, items were kept in the same order. Results were analyzed to determine impact of treatment conditions and to answer this study's research questions.

Technology Applications Instrument

To develop the TAD1 exam used in this research, TEA released items on Technology Applications Domain 1 were accessed, downloaded, and used as both the pre and posttest. Questions were rearranged in both test and did not appear in the same order. Using released items was ideal as they are the same types of questions that the State Board of Education for Teacher Certification uses. Additionally, items are specific Domain 1 questions. The primary and secondary research investigator reviewed assessment questions in order to ensure reliability of questions. Items on the exam were in a multiple-choice format. Each question provided 4 choices to which there was only 1 correct response. Because there are correct responses associated with this instrument, items were rearranged to increase instrument reliability. All participants completed this survey as pretest before the beginning the modules and completed the

posttest after concluding all course modules and finishing all course assignments. Results were then analyzed to determine impact of treatment conditions in order to answer this study's research questions.

Instructional Design

Before receiving approval from the University Institutional Review Board, this study designed an online professional development course using a mobile platform that focused on learning objectives derived from the TAD1 competencies and that were aligned to the goals of this study. Next, the course was duplicated two more times for its content. Then, a unique level of rigor was used to develop a series of assignment questions. Although each of the courses was the same in the sense of content and course objectives, each had its own level of rigor for its questions. To guide this research in designing the MPD, instructional design models were compared to identify common themes of design. The researcher utilized the common ID themes to design course sequence, learning objectives, content, and assessment. Table 3.4 shows the 3 models of ID used to identify themes of design used for this research.

Table 3.4: Instructional Design Models and Common Themes of Design

ADDIE Model	Gagne's Conditions of Learning	ARCS Motivational Model	Study's Design
• Analysis • Design • Develop • Implement • Evaluate	• Gain attention • Provide a Learning Objective • Stimulate recall of prior knowledge • Present the material • Provide guidance for learning • Elicit performance • Provide feedback • Assess performance • Enhance retention and transfer	• Attention • Relevance • Confidence • Satisfaction	• Needs of learner • Content identification • Content delivery • Learner centered objectives aligned to targeted competencies • Intrinsic & External motivation • Buy-In • Learning opportunities • Assignment rigor

Designing the Mobile Platform

To design the treatment platform to be online and have a mobile interface, this study used a free online website software called Weebly. Weebly is a drag and drop website creator that can be created and modified using a traditional computer or mobile device. This software allows for a created website to have a traditional website view or a mobile device view. Because this study was examined mobile learning using mobile devices, this study controlled for the MPD platform appearance. With Weebly websites being accessible using the district's Internet and that the platform view could be controlled and set to a mobile device view, eWeebly's software to create was ideal for this study. A comparison between a desktop and laptop to mobile device mainly pertain to navigation and view. A visual comparison of the two and it navigation between pages is seen below in Figure 3.2.

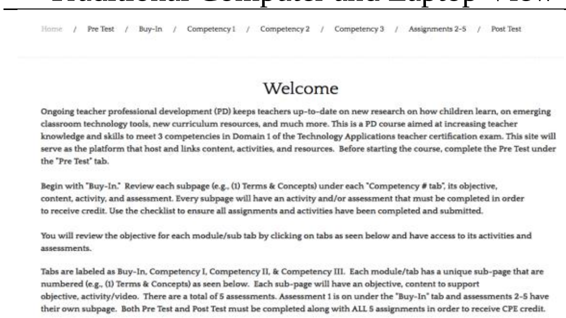
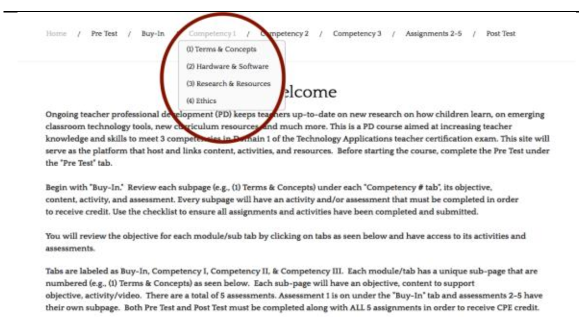
Traditional Computer and Laptop View	Mobile Device View
	
	

Figure 3.2: Comparison View of Traditional vs. Mobile View

Constructing Course Modules

Once creation of the treatment platform was complete, content was then identified that was in alignment to the study's intention of increasing participants' perceived TPACK ratings and standardized scores on a TAD1 exam. To do so, this study accessed the TAD1 competencies from the Texas State Board of Education's educator certification website and examined each competency. Upon examination of each competency and their descriptive statements (see Appendix G), various themes were identified and used to create 3 content learning modules. Competency description and their descriptive statements were also used to construct learning objectives for each for each module. In addition to the identified modules used in the study, an additional module titled "Buy-In" was added to increase participant's awareness of the direction in which technology is being implemented in schools and to build participant acceptance of technology integration as a classroom practice. Because mobile learning entails brief learning modules, this study used free online educational videos, vocabulary activities, links to online readings, and embedded slideshows to deliver and reinforce content throughout the 4 modules. Because this study was examined participant performance on a standardized TAD1 exam, it was essential to use TAD1 competency descriptions and descriptive statements as a basis to identifying treatment modules, learning objectives, content, and assignment topics. Table 3.5 shows the TAD1 competencies and their identified themes used as treatment modules and learning objectives.

Table 3.5: Competency Alignment to Course Modules and Learning Objectives

Competency	Competency Description	Identified Themes Used as Modules	Learning Objectives
1	The Technology Applications teacher knows technology terminology and concepts; the appropriate use of hardware, software, and digital files; and how to acquire, analyze, and evaluate digital information.	1) Terms and Concepts 2) Hardware and Software 3) Research and Resources 4) Ethics	1a) To understand, apply, and convey technological terms and concepts effectively in order facilitate teacher preparation and student learning. 2a) To understand technological hardware, its parts, usage, and processes towards connectivity. 2b) To identify, evaluate, select, and effectively use appropriate software and technology applications to perform basic functions. 3a) To understand how to effectively use search strategies to find and retrieve electronic sources and how to examine critically the accuracy and validity of information 4a) To understand and demonstrate knowledge of the ethical acquisition of intellectual property, intellectual property rights, and acceptable vs. unacceptable use of information
2	The Technology Applications teacher knows how to use technology tools to solve problems, evaluate results, and communicate information in a variety of formats for diverse audiences.	1) Tools 2) Platforms	1a) To understand how to effectively plan. create, edit, and evaluate documents, spreadsheets, databases, presentation and projects. 2a) To understand how to use interactive virtual environments and collaborative software that is accessible to learners with diverse needs and abilities.
3	The Technology Applications teacher knows how to plan, organize, deliver, and evaluate instruction that effectively utilizes current technology for teaching the Technology Applications Texas Essential Knowledge and Skills (TEKS) for all students.	1) Task 2) Plan and Organize 3) Deliver and Evaluate	1a) To understand how to effectively identify task specific tools for student products using technology. 2a) To understand how to effectively design technology integrated lesson plans. 3) This course is designed for grades K-12 classroom teachers and leaders. Instructional Technologists and all other educators are welcome.

Taxonomic Rigor

Examining the effect of assignment rigor, this study used Bloom' Taxonomy to create 3 treatment conditions (i.e., low, medium, and high) to create 5 assignments. The first 4 assignments entailed several questions about the content pertaining to each module, and the last assignment asked students to recap what they learned, and in some treatment conditions, explain how they will integrate new concepts and skills. To identify question rigor, this study examined taxonomic verbs and classified them into three groups (i.e., low, medium, and high). Once treatment levels were associated to each of the ranging levels of Bloom's Taxonomy, verbs and processes were identified to determine rigor and in the development of questions and tasks. Table 3.6 shows each level of Bloom's Taxonomy and this study's associated level of rigor.

Table 3.6: Bloom's Taxonomy Levels and Study's Rigor

Bloom's Taxonomy Levels	**Study's Level of Rigor**
Remembering	Low
Understanding	Low
Applying	Medium
Analyzing	Medium
Evaluating	High
Creating	High

After identifying levels of rigor for this study, verbs and processes were identified for each of the treatment conditions. Assignments across all treatment conditions were designed to assess the same content, however, each condition differentiated in terms of question type and directions, verbs and processes. This study maintained the same question and rigor level for the first assignment (i.e., Buy-In). Tables 3.7, 3.8, and 3.9 shows each treatment condition along with associated verbs and processes, question type and directions, and the questions used in the treatment condition.

Table 3.7: Low Level Treatment Process and Questions

Assignment & Competency	Verbs & Processes	Type of Question/ Directions	Questions/Directions
Buy-In 001-003	recall	write	• Write in some of the basic ideas expressed in EACH video. Write about the terms and concepts that were discussed.
2 001	recall explain identify	what	• What is flipped learning? (Explain) • What are applications? (Explain) • What are some ways to conduct good research online? (IDENTIFY AT LEAST 2) • What are some examples of acceptable uses of information? (Identify at least 2)
3 002	recall explain identify	what	• What is Microsoft Word used for? (Explain) • What is Microsoft Excel used for? (Explain) • What are virtual environments? (Explain)
4 003	recall explain identify	what	• What tools would be best to create a digital presentation? (Identify at least 2) • What are key things to consider when integrating technology into a lesson? (Identify at least 3) • What are some key items to consider when reviewing technology products created by students? (Identify at least 3) • What are virtual learning environments (Explain)
5 001-003	recall explain identify	identify	• Identify some of the new concepts, ideas, and processes you learned. (Identify at least 3)

Table 3.8: Medium Level Treatment Process and Questions

Assignment # & Competency	Verbs & Processes	Type of Question/ Directions	Questions/Directions
Buy-In 001-003	recall	write	• Write in some of the basic ideas expressed in EACH video. Write about the terms and concepts that were discussed.
2 001	examine analyze distinguish contrast identify synthesize	why how what	• Why is flipped learning beneficial to teachers and students? (Identify at least 2 benefits) • How are applications used in teaching and learning? (Name and explain at least 3) • Why is it important to conduct good research online? (Explain at least 3) • What is the difference between acceptable and non-acceptable uses of information? (Provide at least 3 examples)
3 002	contrast compare evaluate explain identify	explain	• Explain the difference between Microsoft Word and Microsoft Excel. (Identify and explain at least 2 differences) • Explain the difference between Microsoft Excel and PowerPoint. (Identify and explain at least 2 differences) • Explain what Microsoft Word, Excel, and PowerPoint have in common. (Identify and explain at least 2 differences) • Explain how you could use virtual learning environments in your current classroom. (Identify at least 3 ways)
4 003	explain identify distinguish demonstrate analyze	why explain	• Why would a student want to create a digital presentation instead of just writing a paper using a word processor? (List and explain at lest 2 reasons) • Explain the difficulty in creating a lesson plan that integrates technology. (List and explain at lest 2 difficulties) • Why is it important to have some sort of evaluation rubric for technology products created by students? (Identify and explain at lest 2 reasons)
5 001-003	explain identify compare	explain	• Explain what concepts, ideas, and processes were learned and how they go with teaching and learning.

Table 3.9: High Level Treatment Process and Questions

Assignment # & Competency	Verbs & Processes	Type of Question/ Directions	Questions/Directions
Buy-In 001-003	recall	write	• Write in some of the basic ideas expressed in EACH video. Write about the terms and concepts that were discussed.
2 001	explain self-apply demonstrate	explain How	• Explain how you would use Flipped learning in your classroom. (Identify at least 3 ways) • Explain how you would use applications in your classroom for teaching and learning? (Identify at least 3 ways) • How will you ensure that students know how to conduct good research online and how would you have them practice? (Identify at least 3 ways) • How will you ensure your students know the difference between acceptable and non-acceptable uses of information and do not violate copyright laws? (Identify at least 3 ways)
3 002	self-apply demonstrate align	how what explain	• How do you plan on using Microsoft Word for teaching and learning in your classroom? (Identify at least 3 ways) • What specific activities or lessons could you design to use Microsoft Excel in your classroom? (Identify at least 3 ways) • What specific learning activities could you design that has students use Microsoft PowerPoint. • Explain how you could use virtual environments in your current classroom. (Identify at least 3 ways)
4 003	justify self-apply develop produce	explain develop	• Explain how you would decide what tool is best for a specific learning task or objective. (List 4 examples) • Explain your process for developing a lesson that integrates technology into a lesson (Technology to be used by students) • Develop a sample rubric for reviewing technology products by students (Name and explain a minimum if 4 categories and 3 ratings)
5 001-003	demonstrate align self-apply	explain	• Explain what you learned and how you plan to integrate technology into your teaching and student learning (Identify and explain at least 4)

Data Analysis Procedures

To investigate each research question, an Analysis of Covariance (one-way ANCOVA) was performed to assess differences between groups on a single dependent variable after controlling for the effects of one or more covariates. A one-way ANCOVA tests the main effects of the categorical independent variable on a continuous dependent variable while controlling for the effect of other continuous variables that co-vary with the dependent. For each analysis, the posttest scores served as the dependent variable while pretest scores functioned as the covariate. Use of a covariate partials out the effects of those variables on the dependent variable to determine if the effects are strictly due to the covariate or if the differences are independent of the effects of that covariate. There is one independent variable with three levels (group 1 vs. group 2 vs. group 3).

F-tests of significance were used to assess the main and interaction effects. *F* is the between-groups variance (mean square) divided by the within-groups variance (mean square). When the *F* value is greater than 1, more variation occurs between groups than within groups. When this occurs, the computed *p*-value is small and a significant relationship exists. If significance is found, comparison of the original and adjusted group means can provide information about the role of the covariates. Because predictable variances known to be associated with the dependent variable are removed from the error term, ANCOVA increases the power of the *F* test for the main effects and the interaction if actual statistical adjustments are present. Essentially, it removes the undesirable variance in the dependent variable. The assumptions of ANCOVA are similar to those of ANOVA. The dependent variable must be continuous/interval, homogeneity of slopes is present, and normally distributed. This was checked with skewness values. The relationship between the covariate and the dependent variable should be linear, which will be assessed by a scatterplot. There is homogeneity of variance, which will be assessed through the Levene's Test.

According to Creswell (2012), commonly used alpha levels are 0.05 and 0.01. An alpha level of 0.05 was set for this study. Creswell (2012) explained evaluation of results of an experiment begins with an assessment of the null hypothesis in order to calculate the probability of chance events. If the obtained probability is equal to or less than a critical probability or alpha level, then the null hypothesis is rejected and it is determined that the results are significant (Creswell, 2012).

Issues of Trustworthiness

The principal researcher explained internal benefits of the study to participants and offered 10 hours of professional development credit to site based participants, a $20 gift card, and a class assignment waiver to university based participants in order to increase the sample size and to increase participant efficacy of completing modules and assignments. No assessment items were disclosed as being pulled from released items from TEA. However, items used in the pretest were also used in the posttest. These efforts were made to enhance the study.

This study used the same two instruments for its pre and posttest, the TPACK survey and the TAD1 exam. The TPACK survey has been tested over the course of several studies to ensure reliability scores (Schmidt et al., 2009; Shin et al. 2009). The internal consistency, using Cronbach's alpha, for the TPACK constructs are as presented below in table 3.10.

Table 3.10: Reliability of TPACK Scores (from Schmidt et al. 2009)

TPACK Domain	**Internal Consistency (alpha)**
Technology Knowledge (TK)	.86
Content Knowledge (CK)	
Social Studies	.82
Mathematics	.83
Science	.78
Literacy	.83
Pedagogy Knowledge (PK)	.87
Pedagogical Content Knowledge (PCK)	.87
Technological Pedagogical Knowledge (TPK)	.93
Technological Content Knowledge (TCK)	.86
Technological Pedagogical Content Knowledge (TPACK)	.89

Because this study used released items provided by TEA and State Board of Educator Certification, the items used in this study's TAD1 exam were reliable and valid in the sense that items were identified to be aligned to learning objectives and were actual items released by the actual entity to which grants certification. Added questions to the TAD1 were reviewed and cross-referenced by the primary and secondary investigator to ensure reliable and valid question alignment to focused competencies.

Limitations and Delimitations

The small sample size of this study is a limitation of this study

. Additionally, the small sample within each intervention group is another limitation. Because this study took place in the second semester, when student testing is prevalent, time factors and issues of stress influence many in the profession. Although this MPD was designed to be completed anytime and anywhere, it study did not require participants to complete modules and assignments during their work schedule. Not having them complete study at work increased the likelihood participants would not complete study as a set time during the instructional workday was not required. Another issue of time is the two-week window given participants to

complete the course. This limited amount of time is not ideal to reflect on learned objectives. Participants would not have enough time to transform form attitudes and beliefs or fully understand the content presented in the course modules.

Completing modules and assignments at a time and place other than work may be an issue as personal and life responsibilities (e.g., family issues, personal commitments, etc.) compete. The issue of discipline comes to play as individuals sometimes have difficulty completing a task sitting down when such task are not required. Another limitation of this research is that it only extends the study to two school sites and to 3 university courses. The small amount of possible participant requirement sites increases the chance of a small sample size. Offering the MPD to all campuses within a district and all personal and staff would have increased the overall sample size and generalizability.

Summary

Guiding this research are its research questions. This study collected data from 29 participants in the form of a demographic survey that was included in the pretest, open-ended assignment submissions, and from both pre and posttest TPACK and TAD1 instruments. The theoretical frameworks (refer to chapter 3) guided the development of the MPD, its design, and assignment rigor. Statistical software generated descriptive data and performed an analysis of covariance for each research question using the pretest as a covariate. Ethical protocol adhered to Institutional Review Board standards. In the next chapter, I delineate the statistical findings of this quantitative study in response to the research questions.

Chapter 4: Results

This chapter provides a non-evaluative report of this study's findings regarding the research questions. The purpose of this study quantitative research study was to examine how assessment rigor affects teachers' self-reporting on a survey regarding perceived TPACK attitudes and beliefs and performance on standardized Technology Applications Domain 1 (TAD1) performance assessment. Guiding this chapter are the study's two research questions:

1) How do taxonomic levels of rigor in learning affect teachers' TPACK attitudes and beliefs towards technology and technology integration in a mobile professional development environment?

2) How do taxonomic levels of rigor in learning affect teachers' technological knowledge and performance on a Technology Applications mock assessment in a mobile professional development environment? (State certification test)

The hypotheses for the two research questions are as follows:

Researcher Hypothesis 1: There is a statistical significant mean difference in participant TPACK scores across the three levels of treatment intervention following the completion of the MPD.

Researcher Hypothesis 2: There is a statistical significant mean difference in participant performance across the three levels of treatment conditions as it relates to a TAD1 mock exam.

Because this study compares posttest mean scores of 3 treatment conditions using pretest mean scores as the covariate, the preferred statistical method of analysis is an analysis of covariance (ANCOVA) (Gall et al., 2006). Quantitative data was first gathered from the demographic survey and both pre assessments, the TPACK survey and the TAD1 exam.

Additional data was obtained from the post assessments, the TPACK survey and the TAD1 exam. SPSS was used to run a one-way analysis of covariance (ANCOVA) to adjust for initial group differences of TPACK and TAD1 results. Using an ANCOVA for this study's statistical analyses served this study in that it controlled for extraneous variables in order to increase the power of the statistical test by reducing with-in group (i.e., error) variance (Gay et al., 2012). ANCOVA also served this study in that it will adjusted posttest scores for differences between treatment groups on the corresponding pretest.

There are two dependent variables (DV) and three independent variables (IV) in this study. Each posttest, the TPACK survey and the TAD1 exam, served as the DV. Each treatment condition was an IV. Each pretest, the TPACK survey and the TAD1 exam, operated as the covariate in each of the statistical analysis performed.

This research ran two statistical analyses. The fist was a one-way analysis of covariance of posttest TPACK sub scales (DV) scores across the 3 treatment conditions (IV) using the pretest as the covariate. The second was a one-way analysis of covariance of posttest TAD1 (DV) scores across the 3 treatment conditions (IV) using the pretest as the covariate.

This chapter begins with research descriptive statistics, and then leads to the ANCOVA breakdown for the each of the instruments used. Concluding this chapter are comparison findings among assignment responses between treatment groups.

Descriptive Statistics

Using a power analysis determined a desired total sample size of 73 for an ANCOVA of three levels and one covariate. The power analysis was conducted using an alpha of 0.05, a power of 0.80, and a large effect size (f = 0.40) (Faul et al., 2013). Incorporating convenient sampling to identify two school campuses and 3 university courses, this research was only able to recruit 40 participants to register and participate in the study. However, only 29 participants

successfully completed all course requirements making the total sample size for this study N=29. The random assignment of participants to each treatment condition was as follows. Treatment condition 1, low-level assignment rigor, had n= 8 participants. Treatment condition 2, medium-level assignment rigor, had n=11 participants. The third treatment condition group, high-level assignment rigor, had n=10 participants. Out of the N= 29 participants, 13.8% were male and 25% were female. Participant years of teaching experience varied. 24.1% reported having between 0-4 years of teaching experience, 20.7% reported having 5-10 years, 41.4% reported having 11-19 years, and 13.8% indicated that they had 20 or more years teaching experience. Of the N=29 participants, 79.3% reported only having a Bachelors Degree and 20.7 % reported having a Masters Degree. 96.6% indicated on their post assessment that they plan take the SBEC Technology Application Certification exam after participating in this research study. Other descriptive information gathered included the types of technology devices owned. The entire sample reported having a smartphone and of those, 82.2% reported having either a tablet or iPad. Table 4.1 below shows the descriptive statistics.

Table 4.1: Descriptive Statistics

		Frequency	Percent
Treatment Condition	Low	8	27.6
	Medium	11	37.9
	High	10	34.5
	Total	29	100.0
Gender	Male	4	13.8
	Female	25	86.2
	Total	29	100.0
Teaching experience	0-4 Years	7	24.1
	5-9 Years	6	20.7
	11-19 Years	12	41.4
	20+ Years	4	13.8
	Total	29	100.0
Degrees	Bachelors	23	79.3
	Masters	6	20.7
	Total	29	100.0
Plan to take certification	No	1	3.4
	Yes	28	96.6
	Total	29	100.0
Smartphone	Yes	29	100.0
	Total	29	100.0
Laptop	Yes	29	100.0
	Total	29	100.0
Desktop	No	7	24.1
	Yes	22	75.9
	Total	29	100.0
iPad or Tablet	No	5	17.2
	Yes	24	82.8
	Total	29	100.00

Research Question 1

How do taxonomic levels of rigor in learning affect teachers' TPACK attitudes and beliefs towards technology and technology integration in a mobile professional development environment? To answer this question, this study employed a TPACK survey tool in this study to measures pre service teachers' attitudes and beliefs towards technology and technology

integration (Schmidt et al., 2009). Numerous studies contribute this instrument's reliability scores (Schmidt et al., 2009; Shin et al. 2009).

In the TPACK survey, higher scores for each subscale indicate higher perceived acquaintance with the applications of the knowledge base. The TPACK survey includes seven subscales (technology knowledge, pedagogy knowledge, content knowledge, technological pedagogy knowledge, technological content knowledge, pedagogical content knowledge, and technological pedagogical and content knowledge) with 46 survey items. The survey items are on a Likert-type scale with five response choices: 1=Strongly Disagree, 2= Disagree, 3=Neutral, 4=Agree and 5=Strongly Agree. An analysis of covariance determined the statistical significance among the three treatment conditions. In order to examine the meeting of the homogeneity of variances assumption, the Levene's test was used to determine this status for the variables in question. There was no need to report the effect size due to the non-significant outcome. Due to the non-statistical significant results for the treatment conditions, there was no need to perform multiple comparisons such as Tukey's, or Scheffe's tests. This research question's hypothesis was correct. There is no statistical significance difference in mean scores across treatment conditions.

Technology Knowledge

Table 4.2 shows that the participants in the low-level treatment condition had the highest mean score when compared to the other two treatment groups. However, all treatment groups had a positive gain in mean scores. Table 4.2 provides mean scores of for both pre and posttest.

Table 4.2: Technology Knowledge

	Technology Knowledge Pretest Scores			Technology Knowledge Posttest Scores		
Treatment condition	Mean	Std. Deviation	N	Mean	Std. Deviation	N
Low	21.8750	4.94072	8	25.2500	2.86606	8
Medium	21.8182	2.99393	11	24.9091	2.58668	11
High	20.900	6.45411	10	23.2000	3.25918	10
Total	21.5172	4.78555	29	24.4138	2.94615	29

An ANCOVA determined the statistical significance among the three treatment conditions. In order to examine the meeting of the homogeneity of variances assumption, the Levene's test was used to determine this status for the variables in question. The observed Levene's test produced a non-significant result [$F(2, 26) = 2.162$, $p = .135$]. For this particular subscale (TAPCK), the observed $F(2, 25) = 1.387$, $p > .05$., $\eta^2 = .01$. There was no need to report the effect size due to the non-significant outcome. Due to the non-statistical significant results for the treatment conditions, there was no need to perform multiple comparisons such as Tukey's, or Scheffe's tests. Table 4.3 provides the ANCOVA for the Technology construct across treatment conditions.

Table 4.3. Analysis of covariance across the treatment conditions and TK post-test scores covaried with the pretest.

Source	Type III Sum of Squares	df	Mean Square	F^*
TK_Pre_Score	81.287	1	81.287	14.649
Treatment	15.39	2.00	7.69	1.387
Error	138.722	25	5.549	
Total	243.034	28		

$^*p > .05$

Math Content Knowledge

Table 4.4 shows that the participants in the high-level treatment condition had the highest mean score and biggest gain when compared to the other two treatment groups. However, all treatment groups had a positive gain in mean scores.

Table 4.4: Math Content Knowledge

	Content Knowledge Pretest Scores			Content Knowledge Posttest Scores		
Treatment condition	Mean	Std. Deviation	N	Mean	Std. Deviation	N
Low	11.2500	2.71241	8	11.3750	2.55999	8
Medium	11.4545	1.21356	11	11.6364	1.96330	11
High	11.7000	1.41814	10	12.0000	1.24722	10
Total	11.4828	1.74480	29	11.6897	1.89178	29

Social Studies Content Knowledge

Table 4.5 shows that the participants in the high-level treatment condition had the highest mean score compared to the other two treatment groups. However, all treatment groups had a positive gain in mean scores. The medium-level condition group had the biggest gain compared to the other two.

Table 4.5: Social Studies Content Knowledge

	Content Knowledge Pretest Scores			Content Knowledge Posttest Scores		
Treatment condition	Mean	Std. Deviation	N	Mean	Std. Deviation	N
Low	11.8750	2.23207	8	12.3750	1.76777	8
Medium	10.1818	2.08893	11	12.2727	1.48936	11
High	11.8000	2.25093	10	12.4000	.96609	10
Total	11.2069	2.25799	29	12.3448	1.36998	29

Science Content Knowledge

Table 4.6 shows that the participants in the medium-level treatment condition had the highest mean score when compared to the other two treatment groups. However, the medium-level condition group had the biggest gain of the groups. All treatment groups had a positive gain in mean scores.

Table 4.6: Science Content Knowledge

	Content Knowledge Pretest Scores			Content Knowledge Posttest Scores		
Treatment condition	Mean	Std. Deviation	N	Mean	Std. Deviation	N
Low	10.8750	2.74838	8	11.2500	2.12132	8
Medium	11.0000	1.73205	11	11.8182	1.72152	11
High	11.0000	2.62467	10	11.5000	1.08012	10
Total	10.9655	2.27538	29	11.5517	1.61657	29

Literacy Content Knowledge

Table 4.7 shows that the participants in the low-level treatment condition had the highest mean score when compared to the other two treatment groups, however the low-level group decreased somewhat. The high-level condition group had the biggest gain of the groups. Both medium and high-level treatment groups had a positive gain in mean scores.

Table 4.7: Literacy Content Knowledge

	Content Knowledge Pretest Scores			Content Knowledge Posttest Scores		
Treatment condition	Mean	Std. Deviation	N	Mean	Std. Deviation	N
Low	13.2150	1.55265	8	13.1250	1.55265	8
Medium	12.3636	1.50151	11	12.6364	1.36182	11
High	11.5000	2.67706	10	12.0000	1.41421	10
Total	12.2759	2.03359	29	12.5517	1.45372	29

Pedagogical Knowledge

Table 4.8 shows that the participants in the low-level treatment condition had the highest mean score and biggest gain when compared to the other two treatment groups. Both medium and low-level treatment groups had a positive gain in mean scores, however the high-level group decreased.

Table 4.8: Pedagogical Knowledge

	Pedagogical Knowledge Pretest Scores			Pedagogical Knowledge Posttest Scores		
Treatment condition	Mean	Std. Deviation	N	Mean	Std. Deviation	N
Low	31.2500	3.53553	8	32.3750	3.62284	8
Medium	31.0909	3.50584	11	32.0909	3.33030	11
High	31.4000	4.88080	10	30.1000	4.14863	10
Total	31.2414	3.89739	29	31.4828	3.71888	29

Pedagogical Content Knowledge

Table 4.9 shows that the participants in the high-level treatment condition had the highest mean score and biggest gain when compared to the other two treatment groups. Both medium and high-level treatment groups had a positive gain in mean scores, however the low-level group remained the same.

Table 4.9: Pedagogical Content Knowledge

	Pedagogical Content Knowledge Pretest Scores			Pedagogical Content Knowledge Posttest Scores		
Treatment condition	Mean	Std. Deviation	N	Mean	Std. Deviation	N
Low	16.3750	2.44584	8	16.3750	1.76777	8
Medium	15.9091	1.81409	11	16.8182	2.31595	11
High	15.7000	2.35938	10	16.8000	2.09762	10
Total	15.9655	2.12943	29	16.6897	2.03722	29

Technological Content Knowledge

Table 4.10 shows that the participants in the low-level treatment condition had the highest mean score when compared to the other two treatment groups. Although all treatment groups had a positive gain in mean scores, the medium-level group had the biggest gain.

Table 4.10: Technological Content Knowledge

	Technological Content Knowledge Pretest Scores			Technological Content Knowledge Posttest Scores		
Treatment condition	Mean	Std. Deviation	N	Mean	Std. Deviation	N
Low	14.7500	2.76457	8	17.0000	2.13809	8
Medium	13.4545	2.42337	11	16.3636	1.68954	11
High	14.9000	3.69534	10	16.1000	2.13177	10
Total	14.3103	2.97734	29	16.4483	1.93808	29

Technological Pedagogical Knowledge

Table 4.11 shows that the participants in the low-level treatment condition had the highest mean score when compared to the other two treatment groups. However, the medium level group had the biggest gain. All treatment groups had a positive gain in mean scores.

Table 4.11: Technological Pedagogical Knowledge

	Technological Pedagogical Knowledge Pretest Scores			Technological Pedagogical Knowledge Posttest Scores		
Treatment condition	Mean	Std. Deviation	N	Mean	Std. Deviation	N
Low	34.6250	5.75543	8	39.2500	4.49603	8
Medium	32.7273	6.38891	11	38.2727	4.07654	11
High	34.3000	7.13442	10	39.9000	4.22821	10
Total	33.7931	6.32105	29	39.1034	4.15198	29

Technological Pedagogical Content Knowledge

Table 4.12 shows that the participants in both the low and medium-level treatment conditions had the highest mean score of the three. However, the medium level group had the biggest gain. All treatment groups had a positive gain in mean scores.

Table 4.12: Technological Pedagogical Content Knowledge

	Technological Pedagogical Content Knowledge Pretest Scores			Technological Pedagogical Content Knowledge Posttest Scores		
Treatment condition	Mean	Std. Deviation	N	Mean	Std. Deviation	N
Low	14.7500	2.76457	8	17.0000	1.92725	8
Medium	13.5455	3.04512	11	17.0000	1.34164	11
High	14.3000	3.40098	10	16.8000	2.09762	10
Total	14.1379	3.03226	29	16.9310	1.73063	29

An ANCOVA determined the statistical significance among the three treatment conditions. In order to examine the meeting of the homogeneity of variances assumption, the Levene's test was used to determine this status for the variables in question. The observed Levene's test produced a non-significant result [$F(2, 26) = 908$, $p = .416$. For this particular subscale (TAPCK), the observed $F(2, 25) = 0.141$, $p > .05$., $\eta^2 = .01$. There was no need to report the effect size due to the non-significant outcome. Due to the non-statistical significant results for the treatment conditions, there was no need to perform multiple comparisons such as Tukey's, or Scheffe's tests.

Table 4.13. Analysis of covariance across the treatment conditions and TPACK post-test scores covaried with the pretest.

Source	Type III Sum of Squares	df	Mean Square	F^*
TPACK_Pre_Score	13.718	1	13.718	4.908
Treatment	.789	2	.394	.141
Error	69.882	25	2.795	
Total	83.862	28		

$^*p > .05$

Research Question 2

How do taxonomic levels of rigor in learning affect teachers' technological knowledge and performance on a Technology Applications mock assessment in a mobile professional development environment? The hypotheses for the two research questions are as follows. To

answer this question, this study developed a Technology Application Domain 1 performance assessment using TEA released items. Additional questions were developed and added by the primary and secondary investigator after assessment questions were reviewed and cross-referenced to ensure reliability of questions. Items on the exam were in a multiple-choice format and provided 4 choices in which there was only 1 correct response. Because there are correct responses associated with this instrument, items were rearranged to increase instrument reliability. All participants completed this survey as a pretest before beginning the modules and as a posttest after completing all course modules and completing all course assignments. Results were analyzed to determine impact of treatment conditions and to answer this study's research question. This study's research hypothesis was incorrect. This study revealed no statistical significant means difference in participant TAD1 knowledge and skills.

Table 4.14: Technology Application Domain 1

	Technology Application Domain 1 Pretest Scores			Technology Application Domain 1 Knowledge Posttest Scores		
Treatment condition	Mean	Std. Deviation	N	Mean	Std. Deviation	N
Low	12.1250	1.95941	8	12.5000	1.19523	8
Medium	12.0000	2.09762	11	13.2727	2.00454	11
High	12.1000	2.13177	10	13.2000	1.87380	10
Total	12.0690	1.99877	29	13.0345	1.74198	29

$^{*}p > .05$

An analysis of covariance determined the statistical significance among the three treatment conditions. In order to examine the meeting of the homogeneity of variance assumption, the Levene's test determined the status for the variables in question. The observed Levene's test produced a non-significant result [F(2, 26) = 143, p = .868. For this particular subscale (TAPCK), the observed F(2, 25) = 0.445, $p > .05$., $\eta^2 = .01$. There was no need to report the effect size due to the non-significant outcome. Due to the non-statistical significant

results for the treatment conditions, there was no need to perform multiple comparisons such as Tukey's, or Scheffe's tests.

Table 4.15. Analysis of covariance across the treatment conditions and Technology Domain 1 post-test scores covaried with the pretest.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
TAD1_PRE_SCORE	28.358	1	28.358	13.270	.001
Treatment	3.576	2	1.788	.837	.445
Error	53.424	25	2.137		
Corrected Total	84.966	28			

Ancillary Findings

Reviewing responses to assignment questions across the 3 treatment conditions provided insight into what participants gained undergoing the study's MPD. Across the 3 levels of rigor, all participants reported learning from the experience. Although responses varied in length across treatment conditions, all were positive. One common patter was the length of question responses among the conditions. The low-level rigor group wrote considerably fewer sentences than the medium and high group. The high-level treatment group wrote more than the medium-leveled group. Table 4.16 highlights a few of the most reflective responses from assignment five across the 3 levels of rigor. Although the 3 conditions had a different prompt, the 3 prompts sought to elicit what knowledge was gained completing the MPD. The higher level asked its subjects to also identify how they plan to use what they know and apply theory to practice.

Table 4.16: Assignment 5 Question 1 Response Comparison Across Treatment Conditions

Level	Question	Quotes from responses
Low	Identify some of the new concepts, ideas, and processes you learned. (Identify at least 3	Using library technology to teach Boolean searches which is applicable to all databases. Rubric design for student created technology. I understood the concept of flipping your classroom. I will include it in my future lesson thru the entire curriculum. I learned how to work with graphs and tables. I will show the students' performance, or students need to graph their data from surveys, Throughout this course I have been able to understand how to better incorporate technology into the classroom. I learned the concept of why it is important. I have learned that by doing this I am allowing the students to become active learners and they are learning how to take charge of their learning.
Medium	Explain what concepts, ideas, and processes were learned and how they go with teaching and learning.	Some of the new concepts, processes, and ideas that I have learned will be valuable to begin incorporating in my classroom. I really liked the awesome tools and apps for student projects because there were a lot more different types of programs to create presentations as opposed to the overused PowerPoint. I feel that these programs/apps see a lot more "kid friendly" and will really engage students in their work. I also learned about the flipped classroom which hopefully will be implemented in more classes in the future. The most important thing I learned is that students today have abilities to learn by doing and are familiar with technology to use as a tool. Technology is not new to them and should be integrated into the instruction. In order to do this, I as a teacher must become literate in the technology world so as to engage students. This will enhance their learning environment and stimulate them to learn.
High	Explain what you learned and how you plan to integrate technology into your teaching and student learning (Identify and explain at least 4)	I will definitely be using Skype Education in the near future. I would love to get a "pen pal" type classroom somewhere around the world to be able to exchange ideas with. My AP Human Geography class is all about learning to be Culturally Literate Global Citizens and i know that adding this component would aid in that endeavor. I found out a great deal about the new Microsoft office applications that I did not know before. I use these almost everyday; however, some of the tricks I struggle with can now be easily done to save time. I also found in especially useful to find out some of the online tools available for students to create projects that before might have been simple essays or Power point presentations. Also, Edmodo is going to be my new best friends. I cannot get into twitter despite my neighboring teacher's efforts, but this seems more relevant a doable to me. One of the processes that I learned was about integrating technology into my lesson plans. I have to admit before I took this professional development, I thought I did a good job at incorporating technology into my lessons. However, I realized that incorporating technology entails way more and I wish I had more technology resources to do so. I also thought that the concept of implementing a program like Reminder or Edmodo would help me keep in closer contact with my students' parents. I personally loved the idea of incorporating digital presentation with my students because I feel it would be something they enjoy, and a way to express their creativity.

Responses across the 3 levels revealed participant knowledge of skills and concepts. However, the rigor of the medium and high-level condition group, being deeper in complexity, asked participants to explain what they learned and to state their intended application of the newfound knowledge. Responses from the medium and high-level group revealed participants' intentions to integrate technology into teaching and learning in the future.

As part of the final assignment, the study asked participants to note what they liked and disliked about the MPD. Reponses indicated that participants enjoyed the selected content media. According to participants, the content media provided useful ideas on technology integration. Responses also indicated that the media was interesting and easy to comprehend. However, some participants reported that the media was broad and redundant. Many reported that the MPD provided many great and free resources and provided strategies on how to access additional resources. Table 4.17 provides several responses from participants when asked to note what they liked and disliked from the MPD.

Table 4.17: MPD Participant Likes and Dislikes

Question	Responses
What did you dislike about the professional development you completed during the study?	There wasn't really anything I disliked. Honestly that every time I would finish a quiz if I don't select submit all my work was deleted and i had to start all over again. I would have really liked to have learned a few more way to implement technology for each content area or ideas in how to do so and see an actual lesson in a real classroom with access to only four devices. Provided a broad area of technology topics useful in the instructional classroom.
What did you like about the professional development you completed during the study?	I liked how it introduced me to new technologies and the videos were great. I feel that the information I learned will be beneficial to my teaching and my students' learning. I like the videos he provide since there are very interesting and well explain to achieve anyone questions about technology. I really found the ideas for implementation to be very useful. As one of the videos stated, it is not that we do not want to implement technology, it's just that we don't know how or where to begin. The actual lesson plan steps to implement technology and the presentation of actual FREE resources that we can already implement are wonderful! Learning how technology has advanced and effected students learning and the need for change in our "traditional" instructional model.

Conclusion

The purpose of this quantitative study was to examine how taxonomic levels of rigor in learning affect teachers' TPACK perceptions and performance on a Technology Applications Domain 1 mock assessment in a mobile professional development environment. This study had a total sample size of N=29 and randomly assigned all participants to treatment groups. The majority of the sample was women with only a few men in the total sample. The entire sample reported having a smartphone. While all groups showed growth, there was no statistical significant mean difference across the treatment groups in any of the scales or subscales. Each research hypothesis resulted in rejection. Chapter 5 provides a further analysis of the study's findings within the context of the research questions, ties findings to literature review, discusses the implications of the findings, and offers recommendations to educators, universities, and school districts for future research.

Chapter 5: Discussion

This chapter integrates the results of the study with existing theory and research. Past research reveals that little is known about what teachers actually learn and implement from undergoing professional development or how it impacts student learning and engagement (Fishman et al. 2003; Wayne et al. 2008). This research designed a MPD course with three taxonomic treatment groups. Random assignment placed self-selected teaching participants into one treatment level. Treatment conditions were unique in that each condition group was a different level of rigor. Anderson and Krathwohl's (2001) revision to Bloom's Taxonomy was utilized to develop 3 rigor levels (viz., low, medium, high). Each taxonomic level challenged participants differently as was ultimately the primary focus of this study.

Participants first completed both TPACK and TAD1 pretest, then underwent the MPD and completed taxonomic assignment questions, and concluded with the completion of both posttests. An analysis of covariance was the statistical analysis used to measure mean differences across each treatment condition for both TPACK and TAD1. All scales and sub scales revealed no statistically significant mean differences across taxonomic treatment conditions. The following section provides a discussion of the study's results.

Despite being no statistical significant mean differences, there was growth in all treatment conditions across all scales and subscales. This finding relates to the literature review surrounding professional development. PD is a means to increase teacher attitudes, beliefs, knowledge, and skills (Ball & Cohen, 1999; Darling-Hammond & McLaughlin, 1995; Elmore & Burney, 1997; Little, 1993; National Commission on Teaching and America's Future, 1996). This research shows that PD of technology integration does serve to increase teachers TPACK scores. This is consistent with other research supporting the use of TPACK as a foundation to

designing PD. The increase in attitudes and beliefs indicates a likeliness that teacher behavior will change and that there will be an increase in technology integration as knowledge, skills, attitudes, and beliefs towards technology and technology integration are up. Teacher efficacy and teacher quality are connected.

With increases in scores across all treatment conditions, it is safe to presume that the MPD design and assessment was effective. This adds and supports to research on instructional design. Using learning objectives, relevant content, participatory activities, and gaining teacher buy-in are key facets to instructional design of PD. This study's organization of responses and hosting of content using an online platform served as an excellent organizational and teaching tool. The electronic systems permitted quick scoring of assessment and safe keeping of records. Using components of instructional design and the TPACK theory to develop the MPD design and to identify course content served ideal as all treatment groups benefited from participating in this study.

Of the 3 taxonomic treatment groups, the medium level scored higher across the scales and subscales. This may be because the level of rigor was not too easy or too hard. The middle level seemed to be just the right level of rigor needed to increase knowledge, skill, attitudes, and beliefs. The interrelation ship within Bloom's Taxonomy levels maybe the cause of this finding. In Bloom's Taxonomy, many of the verbs and processes build off one another and often overlap. The middle group contained verbs and processes from both the low and high taxonomic rigor levels. This finding indicates that PD should be neither too easy nor too difficult. This increase in scores across all condition groups indicates that any form of assessment is beneficial in raising scores.

Using a mobile device interface, participants underwent the MPD course with a fixed mobile view. When using a smartphone or laptop, the Internet and certain sites look different. The mobile interface is more compressed. The mobile device interface did not seem to be an issue in this study. Every participant reported having a smartphone. With such a high percentage, it is likely that many participants completed their course using their smartphone. Nonetheless, the influx of technology hardware in schools indicates that the direction of technology in schools is moving from stationary technology to mobile devices (e.g., smartphone and tablet). With the expectation of teachers to incorporate blended learning and the use of mobile devices in teaching and learning, exposure to a mobile interface and platform was beneficial as mobile devices stand to facilitate teaching and learning. Exposure to MPD interface provided an experience to those unfamiliar to the viewpoint and navigation processes.

The research questions guiding this study yielded results that proved the study's two-research hypothesis were incorrect. Each ANCOVA yielded no statistically significant mean differences across the taxonomic treatment conditions in either scale. However, the data showed increases in mean scores for all scales and subscales. Many factors can attribute to results not being significant. As reported in previous chapters, the sample size obtained was small in relation to the ideal sample yielded from a power analysis. Another factor influencing significance is the period in which the MPD took place. Although learning may have taken place, the short duration of the study may have not permitted enough time for participant attitudes and beliefs towards technology and technology integration to change.

The fact that this MPD was not required or in any form considered high stakes, effort put into completing course may not be as high as it would have been if it were high stakes. This factor also contributed to participants registering to participate and then dropout of the study only

after solely completing the pretest. Being accessible anytime and anywhere, the MPD requires a disciplined person to complete the study with minimal guidance or direction to sit down and put effort into the course. With the MPD being accessible 27/4, there was no set time to work on the course. Not having the MPD scheduled to work on completing the course during the instructional workday decreases the amount of time teachers will have to work on it as personal responsibilities after school hours supersedes PD.

Although mean scores did increase from pretest to posttest, scores do on indicate total TPACK confidence and proficiency among participants. Scores reveal that participants have a fair level of TPACK attitudes and beliefs. This finding supports the reports by the National Educational Technology Plan (2010) and other research that indicates that teachers are not fully prepared or have the perceived belief that they can effectively use and integrate technology into teaching and learning. This study's data also supports data reported in chapter 2 regarding the Texas Star Chart. With n=28 participants indicating they plan to take the Technology Application state certification exam sometime in the future, data reveled that passing the actual certification exam would not be likely.

Although this study did not yield any statistically significant mean differences, this research was able to obtain some good information regarding the design and assessment aspects of creating a MPD. This research design had several flaws. The first flaw was in the sampling. This research should have gained access to multiple schools in order to increase the chances for a higher sample. Another flaw is that this research should have insisted that site administrators encourage campus teachers to participate as part of school participation, thus making it mandatory and possible to access during the instructional school day. The third flaw deals with the length of time between pre and posttest. The brief amount of time did not provide substantial

time for attitudes and beliefs to change. This study could extend and examine other modes of PD by incorporating other treatment categories by utilizing other modes of PD. Examining F2F, hybrid, and OPD would examine delivery modes of PD and taxonomic rigor on learning of each PD mode, thus providing a deeper insight into the modality of PD.

Implications

This research offers several implications for social significance. The first implication is that MPD is effective in the sense that means scores did increase from pre to posttests. The next implication is that the cost and time to complete a traditional F2F reduces when substituting it with MPD. A third implication is that a medium taxonomic rigor level may be more beneficial when embedded into PD rather than low or high level rigor. The fourth implication is that a MPD designed from learning objectives, one that uses several key facets from popular instructional design models, is an ideal design process for PD. The final implication is that by using TPACK theory to assist in the design process of an MPD and its selection of content media positively influenced the effectiveness of the MPD. These implications serve educational institutions and preparations programs as PD remains at the forefront of training teachers after they have graduated college and are no longer gaining a formal education on their profession. These findings stand to assist PD designers and school districts interested in developing their own model and delivery mode of PD.

Recommendations

For further study, a recommendation is to send follow up letters or emails to participants seeking qualitative responses in the form of open-ended questions pertaining to participant views on online learning, mobile learning, blended learning, and mobile devices in the classroom. Such insights serve to highlight teachers’ dispositions on technology initiatives across schools to which they have no control over. Another recommendation is for campus participation instead of

individual participation. This recommendation will ensure that all possible participants within a school are required to participate because it would be a campus activity. The final recommendation deals with time. When observing attitudes and beliefs, ensure that there is ample time for transformation. Although this study showed mean gains, higher scores are possible if participants had more time to develop their attitudes and beliefs. More time permits for an increase with more time to implement what they had learned in the MPD.

Conclusion

This research set out to examine how taxonomic levels of rigor in learning affect teachers' TPACK attitudes and beliefs towards technology and technology integration in a mobile professional development environment. Although the study showed no statistically significant mean differences across treatment conditions, mean scores did increase moderately. This research also set out to examine how taxonomic levels of rigor in learning affect teachers' performance on a Technology Applications mock assessment. Similarly, examining this question revealed no statistically significant mean differences across treatment groups. Yet, mean scores did increase mildly.

This research agrees with past research by Darling-Hammond (2012) regarding teacher quality and teaching quality being interrelated and influenced by professional development. PD on technology integration, specifically built around a TPACK framework (Mishra & Koehler, 2006; Zhao & Frank, 2003), does increase attitudes and beliefs. Increases in teacher TPACK attitudes and beliefs leads to a higher technology self-efficacy. Research by Bandura suggests that teacher attitudes and beliefs influence behavior. The resulting behavior of participants undergoing this MPD is an increase integrating technology.

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Appendix A: IRB Approval Letter

THE UNIVERSITY OF TEXAS AT EL PASO
Office of the Vice President for Research and Sponsored Projects
Institutional Review Board

El Paso, Texas 79968-0587
phone: 915 747-8841 fax: 915 747-5931

FWA No: 00001224

DATE:	February 17, 2015
TO:	Raul Saldana, PhD
FROM:	University of Texas at El Paso IRB
STUDY TITLE:	[435470-2] Impact of a professional development intervention to assess teachers' acquisition of technology competencies and dispositions
IRB REFERENCE #:	435470-2
SUBMISSION TYPE:	Amendment/Modification
ACTION:	APPROVED
APPROVAL DATE:	February 17, 2015
EXPIRATION DATE:	October 2, 2015
REVIEW TYPE:	Expedited Review

Thank you for your submission of Amendment/Modification materials for this research study. University of Texas at El Paso IRB has APPROVED your submission. This approval is based on an appropriate risk/ benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This study has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

Please report all NON-COMPLIANCE issues or COMPLAINTS regarding this study to this office.

- 1 -

Generated on IRBNet

Appendix B: Research Advertising Flyer

Appendix C: Demographic Survey

Your participation to complete lessons, assignments, and assessments is voluntary. You may withdraw at any time during the study.

Name*

Degrees Earned*

- ☐ Bachelor's Degree
- ☐ Master's Degree
- ☐ Doctorate's Degree
- ☐ Other

Sex*

- ◯ Male
- ◯ Female

Years Teaching*

- ◯ 0-4
- ◯ 5-10
- ◯ 10-19
- ◯ 20+

Check all personal mobile devices you use.*

- ☐ smart phone (iPhone, Android, etc.)
- ☐ laptop
- ☐ desktop computer
- ☐ iPad or tablet
- ☐ Other

Check all teaching and leadership certifications*

- ☐ Secondary English Language Arts
- ☐ Secondary Social Studies
- ☐ Secondary Math
- ☐ Secondary Science
- ☐ EC-4th
- ☐ EC-6th
- ☐ Gifted and Talented
- ☐ Bilingual Education
- ☐ ESL
- ☐ Principal
- ☐ Technology Applications
- ☐ Physical Education
- ☐ Special Education
- ☐ Counseling
- ☐ Other

Appendix D: Technological Pedagogical Content Knowledge TPACK Pretest and Posttest

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
TK (Technology Knowledge)					
1. I know how to solve my own technical problems.					
2. I can learn technology easily.					
3. I keep up with important new technologies.					
4. I frequently play around the technology.					
5. I know about a lot of different technologies.					
6. I have the technical skills I need to use technology.					
CK (Content Knowledge)					
Mathematics					
7. I have sufficient knowledge about mathematics.					
8. I can use a mathematical way of thinking.					
9. I have various ways and strategies of developing my understanding of mathematics.					
Social Studies					
10. I have sufficient knowledge about social studies.					
11. I can use a historical way of thinking.					
12. I have various ways and strategies of developing my understanding of social studies.					
Science					
13. I have sufficient knowledge about science.					
14. I can use a scientific way of thinking.					
15. I have various ways and strategies of developing my understanding of science.					
Literacy					
16. I have sufficient knowledge about literacy.					
17. I can use a literary way of thinking.					
18. I have various ways and strategies of developing my understanding of literacy.					

PK (Pedagogical Knowledge)					
19. I know how to assess student performance in a classroom.					
20. I can adapt my teaching based-upon what students currently understand or do not understand.					
21. I can adapt my teaching style to different learners.					
22. I can assess student learning in multiple ways.					
23. I can use a wide range of teaching approaches in a classroom setting.					
24. I am familiar with common student understandings and misconceptions.					
25. I know how to organize and maintain classroom management.					

PCK (Pedagogical Content Knowledge)					
26. I can select effective teaching approaches to guide student thinking and learning in mathematics.					
27. I can select effective teaching approaches to guide student thinking and learning in literacy.					
28. I can select effective teaching approaches to guide student thinking and learning in science.					
29. I can select effective teaching approaches to guide student thinking and learning in social studies.					
TCK (Technological Content Knowledge)					
30. I know about technologies that I can use for understanding and doing mathematics.					
31. I know about technologies that I can use for understanding and doing literacy.					
32. I know about technologies that I can use for understanding and doing science.					
33. I know about technologies that I can use for understanding and doing social studies.					

TPK (Technological Pedagogical					

Knowledge)					
34. I can choose technologies that enhance the teaching approaches for a lesson.					
35. I can choose technologies that enhance students' learning for a lesson.					
36. My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.					
37. I am thinking critically about how to use technology in my classroom.					
38. I can adapt the use of the technologies that I am learning about to different teaching activities.					
39. I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.					
40. I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.					
41. I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.					
42. I can choose technologies that enhance the content for a lesson.					

TPACK (Technology Pedagogy and Content Knowledge)					
43. I can teach lessons that appropriately combine mathematics, technologies and teaching approaches.					
44. I can teach lessons that appropriately combine literacy, technologies and teaching approaches.					
45. I can teach lessons that appropriately combine science, technologies and teaching approaches.					
46. I can teach lessons that appropriately combine social studies, technologies and teaching approaches.					

Appendix E: Technology Applications Domain 1 Pretest

A student would like to perform a search for all of the books published in 1961 that were written by authors whose last name is Smith. Which of the following statements would most efficiently provide this information?

- ◯ Smith AND 1961
- ◯ Smith OR 1961
- ◯ "Smith AND 1961"
- ◯ "Smith" OR "1961"

Which of the following computer applications would best help a teacher keep records of students' academic information in a format that would allow complex searches using logical operators such as AND, OR, and NOT?

- ◯ utility
- ◯ database
- ◯ spreadsheet
- ◯ word processing

Amy tells Daniel about her summer vacation, and he says he'd love to see her pictures. Amy uses a peer-to-peer (P2P) file-sharing program to upload the photographs she took at camp so he can download them. That's copyright infringement.

- ◯ True
- ◯ False

Adam recorded a video for his YouTube channel about the upcoming Senate elections and includes an official photo taken by a government employee and four bills authored by the incumbent that Adam found on the Senate's website. That's copyright infringement.

- ◯ True
- ◯ False

Diana is presenting to her 5th grade class her project on the solar system. Which would be the best application to use in order to create a vivid presentation?

- ◯ Microsoft Word
- ◯ word processor
- ◯ spreadsheet
- ◯ Microsoft PowerPoint

The "dot.com" really refers to the domain of a Web site. Sites on the Web are grouped by their URLs according to the type of organization providing the information on the site. Which of the following is incorrect?

- ◯ ".com" typically means it's a communication site
- ◯ ".edu" typically means that it is part of an educational institution
- ◯ ".org" typically means it is part of a non profit organization
- ◯ ".gov" typically means that it's a federal government site

The use of instructional simulation software would be most appropriate in which of the following situations?

- ◯ Students are presenting the results of a student survey at a school assembly.
- ◯ Students are investigating systems that have cause-and-effect relationships.
- ◯ Students are planning the layout design for a poster on the history of their community.
- ◯ Students are compiling and analyzing weather data they have collected.

Video conferencing hardware and software would be most appropriate in which of the following situations?

- ◯ Students are updating their blog with their daily writing entry.
- ◯ Students conducting online library research for their weekly essay.
- ◯ Students are planning the layout design for a poster on the history of their community.
- ◯ Students are compiling and analyzing weather data they have collected.

You can change the font size with the ___________.

- ◯ Font Size box
- ◯ Shrink Font command
- ◯ Grow Font command
- ◯ All of the above

If you're emailing a document, you should compress the images in order to ___________.

- ◯ Reduce the file size
- ◯ Improve the image quality
- ◯ Reduce the contrast
- ◯ Increase the file size

To add text to the top of every page, you should use a ________.

- ◯ Slider
- ◯ Footer
- ◯ Header
- ◯ Spacer

Which Excel formula below will add the value of B2 to the value of C3?

- ◯ =SUM(B2+C3)
- ◯ =B2+C3
- ◯ =C3+B2
- ◯ All of the above

You want to create a chart to provide a picture image of the data in your spreadsheet. Which menu do you select?

- ◯ Data Menu
- ◯ Edit Menu
- ◯ Insert Menu
- ◯ Tools menu

In which of the following situations is instant messaging software most appropriate for classroom use?

- ◯ A scientist who has been in the news recently is participating in an online interview with a middle school science class.
- ◯ A well-known artist has recently joined an online discussion group on a topic currently being studied by a middle school art class
- ◯ Two middle school classes are exchanging data from similar science conducted by the two classes.
- ◯ A group of middle school mathematics teachers are responding to invitations to a statewide mathematics fair.

When developing a performance assessment to measure student;s technology skills, which of the following questions should be answered first?

- ◯ What are the alternatives to performance assessment?
- ◯ Does the task involve multiple components?
- ◯ How complex is the task being assessed?
- ◯ What specific skills are to be assessed?

Before beginning a computer based slide show presentation it is necessary to appropriately configure the computer. Which of the following computer attributes must be true in order to assure that the presentation be projected?

- ◯ The computer's power management system is enabled
- ◯ The computer is sending the video signal to the port connecting the computer and the projector
- ◯ The computer has a networking card
- ◯ The computer's video controls are set to their maximum brightness and contrast levels

A third grade class wants to document a recent field trip to the museum. Using photographs taken by some students, they intend to use the class computer and software to produce an album that will include the photographs and caption as well as a summary written by one of the students. An important advantage of using desktop publishing software instead of word processing software in this situation is that desktop publishing software is more efficient for _______________.

- ◯ importing graphics
- ◯ reproducing colors
- ◯ specifying text attributes
- ◯ arranging page elements

A teacher would like to assess students' skills in using a graphics program to create products. In this situation, one advantage in using an informal assessment process rather than a formal assessment process is that the informal process would allow the teacher to:

- ◯ evaluate the students' products against a set of objective criteria.
- ◯ involve the students in the learning and evaluation process.
- ◯ compare the students' performances with those of their grade-level peers.
- ◯ measure what the students have learned when their products are finished.

A teacher wants to place students in cooperative groups for an upcoming computer project. Which of the following steps would be most effective in facilitating the success of this learning strategy?

- ◯ forming groups of students with similar levels of ability
- ◯ instituting whole-group accountability for the project
- ◯ closely directing each step of the group project
- ◯ discussing group process skills with students before starting the project

A computer science teacher has agreed to work with students in the school district who are engaged in a research project on the impact of computer science on society. The teacher will be communicating with the students via e-mail and chat room to help them refine their choice of topics and guide their research. For the collaboration to be effective, it is most important for the computer science teacher to:

- ◯ develop a list of topics the students should research.
- ◯ know the format in which the students' projects will be presented.
- ◯ understand the goals and logistics of the collaboration.
- ◯ make sure that the students know appropriate online etiquette.
- ◯ Choice 1

A sixth-grade teacher would like to provide students with a graphical representation of the properties of Boolean operators. Which of the following representations would be appropriate for this task?

- ◯ a tree diagram with two branches extending from each node
- ◯ a flowchart with the control statements in a search algorithm
- ◯ an x-y coordinate graph showing the relationship between two variables
- ◯ a Venn diagram showing the union and intersection of sets

Submit

Appendix F: Technology Applications Domain 1 Pretest

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- ◯ "Smith AND 1961"
- ◯ "Smith" OR "1961"

What did you like about the professional development you completed during the study?

What did you dislike about the professional development you completed during the study?

Submit

ou may take the Technology Applications
n the future as a result of this course?

- ☐ Yes
- ☐ No

Appendix G: Technology Applications Domain 1 Competency and Standards

DOMAIN I—TECHNOLOGY APPLICATIONS CORE
Competency 001
The Technology Applications teacher knows technology terminology and concepts; the appropriate use of hardware, software, and digital files; and how to acquire, analyze, and evaluate digital information.

The beginning teacher:

- Knows technology terminology and concepts.
- Knows the appropriate use of hardware components (e.g., input, processing, output, and primary/secondary storage devices), operating systems, software applications, and networking components.
- Knows how to select, connect, and use a variety of input, output, and storage devices and peripherals (e.g., scanner, voice/sound recorders, touch screen, digital camera, and printer).
- Knows how to evaluate software (e.g., graphics, animation, multimedia, video, Web authoring) for quality, appropriateness, effectiveness, and efficiency and how to make decisions regarding its proper acquisition and use.
- Knows how to perform basic application functions (e.g., opening an application program; creating, modifying, saving, and printing documents) and how to access, manage, and manipulate information from secondary storage devices.
- Knows strategies for acquiring information from electronic resources (e.g., encyclopedias, databases, libraries of images, reference software, Internet).
- Knows search strategies (e.g., keyword, Boolean, natural language) for locating and retrieving information in electronic formats (e.g., text, audio, video, graphics).
- Knows how to assess the accuracy and validity of acquired information.
- Knows how to resolve information conflicts through research and comparison of data from multiple sources.
- Demonstrates knowledge of the ethical acquisition (e.g., citing sources using established methods) and acceptable vs. unacceptable use of information (e.g., privacy, hacking, piracy, vandalism, viruses, current laws and regulations).
- Demonstrates knowledge of intellectual property rights and related issues (e.g., copyright laws, fair use, patents, trademarks) when using, manipulating, and editing electronic data.
- Knows how to use online help and other support documentation.
- Knows how to use technical-writing strategies to develop documentation for a variety of communication products.
- Demonstrates knowledge of the impact of Technology Applications on society and the importance of technology to future careers, lifelong learning, and daily living for individuals of all ages.

Competency 002

The Technology Applications teacher knows how to use technology tools to solve problems, evaluate results, and communicate information in a variety of formats for diverse audiences.

The beginning teacher:

- Knows how to plan, create, and edit documents using word-processing features (e.g., readable fonts, alignment, page setup, tabs, ruler settings) to solve problems and communicate results.
- Knows how to plan, create, and edit spreadsheets using spreadsheet features (e.g., data types, formulas, functions, charts) to solve problems and communicate results.
- Knows how to plan, create, and edit databases using database features (e.g., defining fields, entering data, horizontal and vertical layouts) to solve problems and communicate results.
- Knows how to integrate two or more objects (e.g., tables, charts, graphs, and graphics) into a product.
- Knows how to use productivity tools to create products (e.g., slide shows, posters, multimedia presentations, spreadsheets) for defined audiences.
- Knows how to publish information in a variety of ways (e.g., printed copy, monitor displays, Internet documents and video).
- Knows how to use telecommunications tools (e.g., Internet browsers, video conferencing, distance learning) for a variety of purposes.
- Knows how to use interactive virtual environments (e.g., virtual field trips, instructional simulations).
- Knows how to use collaborative software.
- Knows how to share information through online communication.
- Demonstrates knowledge of issues concerning proper etiquette when communicating using electronic tools.
- Demonstrates knowledge of how to design and implement procedures to track trends, set timelines, and review and evaluate products using technology tools (e.g., database managers, daily/monthly planners, project management tools).
- Knows how to evaluate projects for design, purpose, audience, and content delivery using various criteria (e.g., technology specifications, established criteria, rubrics).
- Knows how to select representative products to be collected and stored in an electronic evaluation tool and how to evaluate products for relevance to the assignment or task.
- Knows how to plan and design communication products that are accessible to learners with diverse needs and abilities.

Competency 003

The Technology Applications teacher knows how to plan, organize, deliver, and evaluate instruction that effectively utilizes current technology for teaching the Technology Applications Texas Essential Knowledge and Skills (TEKS) for all students.

The beginning teacher:

- Knows how to plan applications-based technology lessons using a range of instructional strategies for individuals and small/whole groups.
- Demonstrates knowledge of issues related to the equitable use of technology (e.g., gender, ethnicity, language, disabilities, access to technology).
- Knows how to plan and implement instruction that allows students to use technology applications in problem-solving and decision-making situations.
- Knows how to develop and facilitate collaborative tasks and teamwork among group members.
- Knows how to use technology tools to perform administrative tasks (e.g., attendance, grades, communication).
- Knows how to use a variety of instructional strategies to ensure students' reading comprehension.
- Knows strategies to help students learn how to locate, retrieve, analyze, evaluate, communicate, and retain content-related information.
- Knows how to evaluate student projects and portfolios using formal and informal assessment methods.
- Knows the relationship between instruction and assessment and uses assessment results for gauging student progress and adjusting instruction.
- Identifies resources to keep current with the use of technology in education and issues related to legal and ethical use of technology resources.
- Knows how to use technology to participate in self-directed activities in society and how to participate within electronic communities in a variety of roles (e.g., as collaborator, learner, contributor, teacher/mentor

Vita

Raul Saldana Jr. earned her Bachelor of Interdisciplinary Studies degree with a minor in Elementary Education from the University of Texas at El Paso in 2008. In 2009, he received his Master of Education Instructional Specialist degree from UTEP. He joined the Teaching, Learning, and Culture doctoral program in 2010.

Raul Saldana has five years of experience as a professional educator. He has taught multiple grades in Texas, and worked as Technology Integration Consultant for the Advanced Academics and Region 19. During that time, he actively participated in leadership committees for his school site and served on the district's educational improvement committee (DEIC). While pursuing his doctoral degree, Raul held full-time positions as a teacher, instructional science specialist, staff developer and trainer.

Raul has presented her research at local and international conferences including the 2012 Society for Information Technology and Teacher Education (SITE), the El Paso ISD GT Teacher Institute (2013), the Texas Association for the Gifted & Talented Regional Conference (2013, 2014), and at the MiniCast Science Teachers Association of Texas (2014). He has published research in the proceedings for the Society for Information Technology and Teacher Education (2012, pp. 4869-4871).

Following graduation, Raul intends to maintain his joy working with students and teachers in servicing public education. In efforts in improving teacher development and enhancing student achievement, Raul will continue research in areas of teacher professional development and technology integration.

Raul's dissertation, Mobile Professional Development: Taxonomic Levels of Learning on Teachers' TPACK Perceptions and Acquisition of Technology Competencies was supervised by Dr. Arturo Olivárez Jr.

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