DEVELOPMENT OF A PROFESSIONAL LEARNING FRAMEWORK TO IMPROVE TEACHER PRACTICE IN TECHNOLOGY INTEGRATION

by

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DEDICATION

This dissertation is dedicated to my husband, Patrick, for his unwavering support during this doctoral journey. Thank you for always going the extra mile and doing whatever it takes for our family while I was pursuing this degree. This work is also dedicated to my kids, Jacob and Payton, who were patient, kind, and encouraging on those many days of researching and writing. Finally, I dedicate this work to my parents, Lonnie and Mary, for instilling in me the power of hard work and continuing education and for your countless hours of help with the grandkids.

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ABSTRACT

Technology is now considered a critical component and an integral part of a high-quality education (Ertmer & Ottenbreit-Leftwich, 2010). Teachers must be equipped to handle the transactional relationship and dynamics of integrating technology in the classroom (Mishra & Koehler, 2006). Professional development should be designed and implemented to improve instruction and ensure all students are afforded the opportunity to learn effectively using technology. The problem is that current staff development models designed to help teachers integrate technology into their instruction have not resulted in the effective transformation of instructional practices to utilize technology as part of the teaching and learning process (Holland, 2001; Laferriére, Lamon, & Chan, 2006). The purpose of this design based study is to develop and determine a professional development framework that will impact teachers' instructional practices toward technology integration and transformative practices that emphasize active learning, critical thinking, creativity, and communication. In this study, teachers engage in a 15-week professional learning opportunity with multiple components noted in the literature as impacting teacher practice. The goal of the professional learning opportunity was to move teachers toward effective technology integration. This study examined two iterations during the professional learning opportunity that resulted in the following recommended design components for future professional learning frameworks that will move teachers toward effective technology integration: grade level/team collaborative planning time using the Technological Pedagogical Content Knowledge (TPACK)

framework to plan, revise, and evaluate lessons; peer observation time; individual technology coaching time; small, group differentiated learning time based on teachers' needs/goals; and support materials/resources as part of each component. This should be accomplished via the provision of providing teachers with ample, structured, consistent, and focused time for professional learning in order to develop teachers' attitudes, self-efficacy, and knowledge and skills for transformative practice using technology. These components coupled with the provision of ample, structured time for learning have the potential for moving teachers toward more effective technology integration.

Keywords: professional development for technology integration, transformative learning with technology, teacher technology integration, technology integration matrix, SAMR, technological pedagogical content knowledge, TPACK, design based research

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

DA	District Assessments
FTIM	Florida Technology Integration Matrix
PCK	Pedagogical Content Knowledge
PLO	Professional Learning Opportunity
SAMR	Substitution, Augmentation, Modification, Redefinition
TIM	Technology Integration Matrix
TPACK	Technological Pedagogical Content Knowledge

CHAPTER ONE: INTRODUCTION

Technology is now considered a critical component and an integral part of a high-quality education (Ertmer & Ottenbreit-Leftwich, 2010). Lawless and Pellegrino (2007) state that an understanding of technology is now one of the basic skills of teaching. The single most important factor in determining successful and effective technology integration in the classroom is the teacher (Baylor & Ritchie, 2002; Chen, 2008; Inan & Lowther, 2010). Lawless and Pellegrino express concerns about the likelihood that all students will be taught by educators who know how to use technology effectively to support 21st century teaching and learning. While the availability of technology has significantly increased in recent years, how teachers teach has not noticeably changed (Herold, 2015; Judson, 2006; Mishra & Koehler, 2006; Wachira & Keengwe, 2011). Teachers must be equipped to handle the transactional relationship and dynamics of effective technology integration (Mishra & Koehler, 2006). Technology integration is complex and requires teachers to balance multiple factors including content, instruction, technology, and student needs. Professional development should be designed and implemented to improve instruction and ensure all students are afforded the opportunity to learn at high levels using technology. The problem is that current staff development models designed to help teachers integrate technology into their instruction have not resulted in the effective transformation of instructional practices to utilize technology as part of the teaching and learning process (Holland, 2001; Laferriére, Lamon, & Chan, 2006).

Purpose of the Study

The purpose of this study is to develop and determine a professional development framework that will impact teachers' instructional practices toward technology integration and transformative practice that emphasizes active learning, critical thinking, creativity, and communication. Transformative teaching and learning engages students in the work of learning academic standards and skills through the context of solving relevant problems using technology. Transformative instruction provides purposeful learning for students that can be characterized by the elements of active learning, critical thinking, creativity, and communication. Since these are components of transformative instruction, they should be a focus of professional learning that moves teachers to use these skills and practices with students using technology in their classrooms.

Teachers have little understanding of how technology *should* be integrated into the classroom and what student centered learning with technology looks like (Chen, 2008). Student centered learning requires constructivist teaching practices and is an essential element for technology integration (Ertmer, Gopalakrishnan, & Ross, 2001). Constructivist teaching practices can be a challenge for teachers (Judson, 2006). Professional learning that moves teachers toward more constructivist teaching styles is an important strategy to enhance technology integration (Baylor & Ritchie, 2002; Ertmer, 2005; Ertmer, Gopalakrishnan, & Ross, 2001). Inan and Lowther (2010) indicate that insufficient professional learning for technology integration is of increasing concern and that professional development is one of the most influential factors in affecting teachers' techology integration. Therefore, this study aims to develop a professional development framework that will impact teachers' instructional practices and move them toward transformative practice using technology.

Research Questions

This study seeks to answer the following research question: 1) What components of a professional learning framework are most effective in moving teachers toward transformative practice emphasizing active learning, critical thinking, creativity, and communication? Components for purposes of this study refer to the types of professional learning activities that result in changing teachers practice (i.e., peer observations, technology coaching). The research sub questions include: 1) What components of professional learning result in teachers engaging students in using technology to construct knowledge and apply it to authentic situations? 2) What components of professional learning result in changing teachers' beliefs, attitudes, and behaviors toward technology integration in the classroom? and 3) What components of professional learning help teachers effectively plan, implement, and evaluate technology lessons that take into account curricular and student needs?

Significance of the Study

This study is significant due to the fact that many current professional development models seeking to assist teachers in technology integration have been unsuccessful (Laferriére, Lamon, & Chan, 2006; Lawless & Pellegrino, 2007). Herold (2015) notes that even though technology has increased in classrooms, it has been a challenge getting teachers to change their teaching approach to use technology in a more student centered manner that has students engaged in relevant, authentic learning experiences and constructing knowledge. There are many professional learning components that are recommended by the literature for changing teachers' practice. However, this study seeks to determine which components change teachers' practice with regard to using and teaching with technology toward transformative practice by engaging students in learning opportunities that allow for active learning, critical thinking, creativity, and communication. This research will contribute to the literature by providing a framework for effective professional learning that leads to technology integration by studying which components of professional learning are most impacting teachers' use of technology with students at high levels of technology integration.

Context of the Study

The stakeholders involved with this research problem include classroom and support teachers in a K-5 elementary school, school administrators, technology coordinators, lead technology innovators, students, and school district instructional technology personnel. The targeted elementary school encompasses grades K-5 of approximately 1,000 students in a suburb of Atlanta, Georgia. The administration has been providing staff development to the teaching staff in an effort to work toward technology integration for the last five years. Personal interactions in the study's school site indicate that the teachers have been engaged and willing to learn during staff development sessions. However, the results have not translated into instructional practices in the classroom in which students are engaged in relevant, authentic learning experiences and constructing knowledge using technology. This study will focus on teachers across grade levels, support areas, and among various levels of technological proficiency that could benefit from a more effective staff development model to support them in integrating technology into their classrooms.

Summary

This study addresses the problem that current staff development models for technology integration have not resulted in the transformation of teacher practice to utilize technology as an integral part of the teaching and learning process. The development of a professional learning framework using a design based research approach emerges in this study after two iterations of implementing multiple professional learning components with teachers. The goal of the professional learning is to transform teachers' instructional practices to use technology in a more student centered manner that has students engaged in relevant, authentic learning experiences and constructing knowledge. Multiple data sources are used in this study for both design iterations including a survey, lesson plan analysis, classroom observations, reflection log analysis, and interviews in order to determine which professional learning components were most impacting teachers' practice toward technology integration. The data reveal that ample time for professional learning structured around the following components: grade level/team collaborative planning time using the TPACK framework to plan, revise, and evaluate lessons; peer observation time; individual technology coaching time; small, group differentiated learning time based on teachers' needs/goals; and support materials/resources within each component is the framework that moved teachers' practice forward in technology integration. This framework impacted teachers' attitudes, self-efficacy, and knowledge and skills for transformative practice using technology.

CHAPTER TWO: LITERATURE REVIEW

A comprehensive review of the literature on the topic of professional learning for technology integration draws from multiple areas. This literature review is organized around a discussion of technology integration and professional development frameworks. First, the technology integration frameworks are explained, and then a comparison of the frameworks is provided within a discussion of constructivist teaching, factors impacting technology integration, teacher change process, and evaluation of technology integration. Finally, a discussion of professional development in technology integration is provided through the lens of a professional development framework that encompasses the literature and one that will guide this study. A review of the research in all of these areas provides a foundation for the design and implementation of professional development model that will result in sustained technology integration in the classroom.

The following keywords were used in an electronic search in the Education Research Complete and EdITLib databases in Spring 2015 to review research for this literature review: professional development for technology integration, teacher professional development models, staff development in technology, instructional models for transformative teaching practices, transformative learning with technology, teacher change, teacher technology integration, evaluating professional development, technology integration matrix, SAMR, technological pedagogical content knowledge, TPACK. A summary of the keyword search results can be found in Appendix A. The research from the Education Research Complete and EdITLib databases as well as studies that have been collected over time in technology integration and teacher professional development were used in the literature review.

Technology Integration Frameworks

Herold (2015) notes that while technology tools have increased in today's classrooms, there is much evidence indicating that teachers have not transformed the ways they are teaching. Student-centered learning with technology is not consistent and pervasive in our classrooms. When technology is used, it is often not used to support the effective instructional practices demonstrated to impact student learning, and it may include such tasks as completing homework, drill and practice, and completing reports or assignments (Ertmer & Ottenbreit-Leftwich, 2010). Herold reports that teachers frequently use technology to support traditional instructional strategies which has significant implications for professional development designed to increase teachers' integration of technology. Most teachers have little understanding of how technology *should* be integrated into teaching and learning and what student centered learning with technology looks like (Chen, 2008). Several frameworks for moving teachers toward more student centered levels of technology integration in the classroom are evident in the literature. The Technological Pedagogical Content Knowledge (TPACK), the Substitution Augmentation Modification Redefinition (SAMR) model, and the Technology Integration Matrix (TIM) will be defined in this section of the literature review. The TPACK and SAMR frameworks were selected for review because they are the frameworks most frequently found, referenced, and studied in the literature. The TIM was selected for review because this framework is used by the district in which the study took place as an evaluation of schools toward more effective technology integration.

Technological Pedagogical Content Knowledge (TPACK)

The Technological Pedagogical Content Knowledge (TPACK) framework has become a focus of recent research and is based on Shulman's pedagogical content knowledge (PCK) model (1986). Shulman first advanced the concept that teachers' knowledge includes both pedagogical knowledge as well as content knowledge and notes the intersection of the two types of knowledge resulting in pedagogical content knowledge (PCK). The TPACK framework adds the technology knowledge component and extends Shulman's framework to integrate technology into the intersection of pedagogical knowledge and content knowledge of teachers.

The application of the TPACK framework helps teachers address the issues of how one can effectively integrate technology into the curriculum (Chai, Koh, & Tsai, 2013; Kimmons, 2015; Pamuk, Ergun, Cakir, Yilmaz, & Ayas, 2015; Wong, Chai, Zhang, & King, 2015). The TPACK framework indicates that the relationships between technology, pedagogy, and content knowledge must be intertwined in order for technology integration to occur (Chai, Koh, & Tsai, 2013; Graham, Borup, & Smith, 2012; Kimmons, 2015). Teachers have content knowledge and specific content standards that are required to be taught. This knowledge must first be clearly understood by the teacher in order to then transform the knowledge into *how* it will be taught (Shulman, 1986). Pedagogical knowledge is used in conjunction with the understanding of the content as teachers make instructional decisions about instructional strategies, resources, and interventions needed in order for students to learn the content (Starkey, 2010). Technology knowledge includes teachers' skills and abilities about technology as well as knowledge of hardware and software (Kenton, 2009). Technology knowledge intersects with content and pedagogical knowledge as teachers integrate technology tools and resources that will help students move toward mastery of the content. Koehler, Mishra, and Yahya (2007) note the complexity of teaching with technology as all of these types of knowledge intersect and work together. This type of knowledge is different than that of a content expert, instructional strategies expert, or a technology expert. Baran, Chuang, and Thompson (2011) report that when teachers are able to understand and navigate the intersections between all types of knowledge (technology, pedagogy, and content) they become a different type of expert than one solely in a particular knowledge area. Figure 2.1 provides an illustration of the TPACK framework which demonstrates the intersections of all types of knowledge.

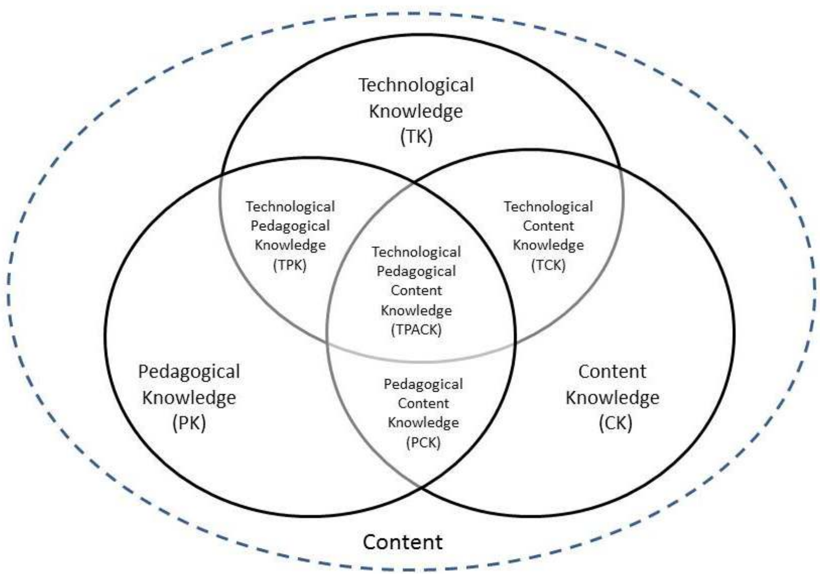

Figure 2.1 TPACK Framework from "What is Technological Pedagogical Content Knowledge,?" by M.J. Koehler and P. Mishra, 2009, Contemporary Issues in Technology and Teacher Education, 9, p. 63. Copyright 2009 by The Association for the Advancement of Computing in Education. Reprinted with permission.

Voogt, Roblin, Tondeur, and van Braak (2013) report that an effective strategy for teachers to develop TPACK is to involve them in active design activities of enhancing lessons with technology. The development of TPACK in teachers should be based on four components: 1) the purposes for technology integration in a given subject; 2) an understanding of how students think, learn, and experience technology in the given subject; 3) an understanding of the curriculum standards/materials that integrates technology into the teaching and learning process for a given subject; and 4) knowledge of instructional strategies for the content (Voogt, Roblin, Tondeur, & van Braak, 2013). Teachers should develop TPACK lessons by beginning with the learning goals based on content standards and then moving to determining the pedagogical approaches to include appropriate assessments. Next, teachers should plan the learning activities in which to engage students and the technology tools and resources needed to achieve the learning goals (Matherson, Wilson, & Wright, 2014).

The TPACK framework is being adopted in the design of teachers' professional development for technology integration as a structure for teachers to scaffold their understanding as they develop lessons integrating technology, pedagogy and content. (Baran, Chuang, & Thompson, 2011; Matherson, Wilson, & Wright, 2014; Wong, Chai, Zhang, & King, 2015). In addition, Kimmons (2015) reports that TPACK is a useful model for evaluating teachers' levels of proficiency as they develop in integrating technology into their classrooms.

Archambault and Barnett (2010) argue against the use and validity of the TPACK framework. They note that while TPACK provides an effective organizational structure, the three content domains of content, pedagogy, and technology knowledge are difficult to separate, and therefore they question their existence in practice. Angeli and Valanides

(2009) note that if these domains cannot clearly be separated and may not be independent, then the TPACK is not valid and should be revised.

Substitution Augmentation Modification Redefinition (SAMR)

The Substitution Augmentation Modification Redefinition (SAMR) model is a technology model that defines various levels of technology use in the classroom. SAMR was developed by Dr. Ruben Puentedura and defines technology usage into four levels: substitution, augmentation, modification, and redefinition (Chou, Block, & Jesness, 2012; Keane, Keane, & Blicblau, 2013; Tangney & Bray, 2013). Substitution is the lowest level of technology usage in which the teacher simply replaces what was already being done with technology. Augmentation is defined as the level in which the technology being used is a direct tool with some improvement. Substitution and augmentation are at the enhancement stage of technology usage indicating that the learning task could have been completed with or without the use of technology. In the modification level the learning task becomes changed or different as a result of technology, and in the redefinition stage the technology allows for the creation of something new. The modification and redefinition stages are considered transformative (Keane, Keane, & Blicblau, 2013).

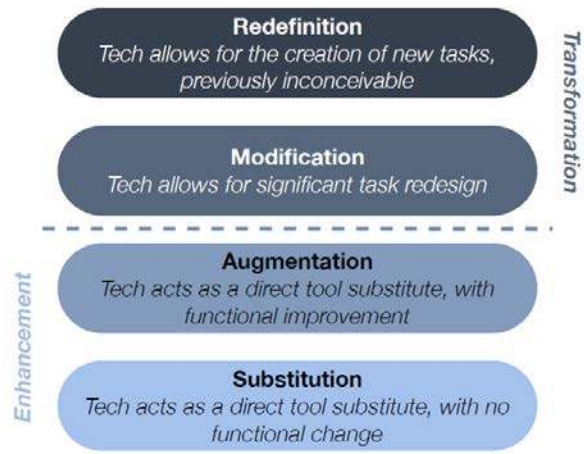

Figure 2.2 The SAMR Model of Technology Adoption from "Transformation, Technology, and Education," by R. R. Puentedura, 2006, Online at: http://hippasus.com/resources/tte/. Copyright 2006 by Hippasus. Reprinted under Creative Commons license.

The use of technology at the enhancement level shows there is minimal impact on student learning (Keane, Keane, & Blicblau, 2013). The higher levels of SAMR aim at transforming the learning experiences of students (Chou, Block, & Jesness, 2012). The Transformative levels allow for technology to play a large role in both the delivery and mastery of skills as well as content (Tangney & Bray, 2013). Keane, Keane, and Blicbau (2013) propose that the SAMR model be used as teachers plan and develop lessons to improve student outcomes and increase technology integration.

One argument against the use of the SAMR framework stems from the validity of the model as not being grounded in research. Green (2014) states that it is irresponsible to use and apply the SAMR framework when its origins can only be traced back to the developer using the model as part of his lectures and educational consultancy as opposed to emerging as a result of research with teachers. She cautions the use of this simplistic model as part of the development of technology integration programs or professional learning.

Another argument about the limitations of SAMR comes from Marcovitz and Janiszewski (2015) in which they state that this framework is too focused on technology. They argue that when planning for technology integration the focus should be on learning.

Technology Integration Matrix

Various states, universities, and other entities have developed Technology Integration Matrices (TIM), which provide a progression of steps teachers may go through as they work toward more effective technology integration. These matrices are descriptive tools that provide for the analysis of instruction and technology. One example is The Florida Technology Integration Matrix (Florida Center for Instructional Technology, 2011), which provides a rubric to assess teachers' and students' levels of technology integration toward transformative teaching which emphasizes active learning, critical thinking, creativity, and communication. The matrix provides a description of the levels of technology integration beginning with entry and moving through adoption, adaption, infusion, and transformation. The Florida Technology Integration Matrix (FTIM) of Table of Teacher Descriptors is located in Appendix D and the Table of Student Descriptors is located in Appendix E.

Summary

The TPACK framework, the SAMR, and the TIM are frameworks found in the literature being used to drive professional development and to measure the levels of technology integration of teachers and in schools. The TPACK framework emphasizes the relationships between technology, pedagogy, and content knowledge, and the literature notes that in order for technology integration to occur at high levels that truly impact student outcomes all three domains must be intertwined (Baran, Chuang, & Thompson, 2011; Chai, Koh, & Tsai, 2013; Graham, Borup, & Smith, 2012; Kimmons, 2015). Teachers can benefit from actively creating lessons using the TPACK framework. The SAMR model is also noted in the literature as a framework for helping teachers develop lessons that move to the higher levels of transformative practice. Finally, Technology Integration Matrices (TIM) are descriptive tools that provide for the analysis of instruction and technology using a rubric which can be used in professional learning to plan and evaluate technology integration in the classroom.

A Comparison of the Technology Integration Frameworks

This section of the literature review further expands the TPACK, SAMR, and TIM frameworks and provides a comparison of the frameworks within the major concepts featured in the literature on factors impacting technology integration. The major concepts discussed include constructivist teaching and modeling constructivism in professional development, factors impacting technology integration including external and internal factors, and evaluation of technology outcomes.

Constructivist Teaching

Ertmer (2005) suggests that low level technology uses in the classroom are associated with teacher-centered practices and higher level uses of technology are student-centered. This aligns with Judson's (2006) study in which he states that teachers who integrate technology in their classrooms most effectively, typically, have constructivist teaching styles or active, student-centered approaches. Baylor and Ritchie (2002) report that one factor impacting technology on students' higher order thinking was correlated to constructivist models, and Ertmer, Gopalakrishnan, and Ross (2001) state that exemplary technology teachers *only* utilize constructivist models during instruction.

In contrast Liu's (2011) study found that teachers with learner-centered beliefs did not consistently use learner-centered teaching strategies. They utilized lecture based teaching strategies more often as opposed to student centered constructivist strategies when integrating technology. So while teachers may acknowledge that student centered learning is best for students, they do not always use these strategies in their instruction when integrating technology. Liu cites reasons for this discrepancy as being tied to student achievement mandates and other external expectations. However, Kim, Kim , Lee, Spector, and DeMeester (2013) found that teacher beliefs about learning and teacher practices in the classroom were aligned. In addition, teachers' levels of technology in their study correlated to their beliefs. Ertmer, Ottenbreit-Leftwich, Sadik, Sendurer, and Sendurer (2012) note that there was an assumption that because teachers held student centered beliefs, that these beliefs would be translated into practice when integrating technology. Their study did find alignment between teachers with student centered beliefs and their use of technology to engage students in constructivist learning.

Constructivism focuses on the learner's active engagement during the process of learning. Learners create their own meaning in constructivism instead of passively learning material decided upon by the teacher (Fineman & Bootz, 1995). Constructivism originated with Piaget's work which stated that knowledge is created by the learner and is not passively provided. Von Glaserfield added to the constructivism theory that learning is constantly changing based on the learner's experiences. Then Vygotsky's studies reported that the role of communication and socialization in the learning process and in the construction of knowledge is an integral part of the active learning process of constructivism (Boudourides & Bourdourides, 2003).

Constructivist teaching and learning are characterized by hands-on activities in which students construct their own understanding (Keengwe, Onchwari, & Agamba, 2014). In constructivist instructional practices, teachers guide students to create their own learning and understanding by posing problems, asking questions, and providing collaborative opportunities for students (Poelmans & Wessa, 2015). In a constructivist environment students exhibit their understanding after interacting with the learning materials, reflecting on the tasks and information, and working with others (Keengwe, Onchwari, & Agamba, 2014). Poelmans and Wessa (2015) indicate that constructivism elicits critical thinking and deep learning through problem solving opportunities. The responsibility of the learning is placed on the student in constructivist environments and the teacher becomes the facilitator (Keengwe, Onchwari, & Agamba, 2014).

Constructivist teaching practices can be a challenge for teachers, yet it is necessary when integrating technology in a more student centered manner as this requires teachers to be more of a facilitator as they help students construct their own knowledge (Judson, 2006). Kong and Song (2013) indicate that teachers have difficulty with constructivist practices with technology integration because of the complexity and differences from more traditional instructional practices. In a technology rich constructivist classroom the teacher provides authentic learning challenges, a variety of learning resources, fosters creativity and critical thinking, and encourages collaboration (Keengwe, Onchwari, & Agamba, 2014).

These constructivist practices should engage students in authentic and open learning opportunities that take into account both the curricular needs and the student needs which can be achieved and evaluated, in part, through the use of the various technology integration models or frameworks discussed. The TPACK, SAMR, and TIM frameworks could all being used with teachers to assist them in designing technology lessons using constructivist practices.

Modeling Constructivism in Professional Development

Professional learning that moves teachers to more constructivist teaching styles is an important strategy to enhance technology integration (Baylor & Ritchie, 2002; Ertmer, 2005; Ertmer, Gopalakrishnan, & Ross, 2001). When using the technology integration frameworks for professional development, it is important to remember that effective professional development must engage teachers in active learning opportunities (Hew & Brush, 2007; Keengwe & Onchwari, 2009; Lawless & Pellegrino, 2007). The professional development itself must be learner-centered to act as a model for teachers to create more learner-centered classrooms while integrating technology (Orrill, 2001). Judson (2006) states that professional development on technology integration should focus on constructivism not merely forcing technology use in the classroom. Using an active, learner-centered, constructivist approach, teachers can construct their own meaning and understanding for new learning which can be more readily applied to the classroom once they experience this approach for themselves (Keengwe & Onchwari, 2009).

The constructivist approach to professional development should plan for and focus on the transactional relationship between content, pedagogy, and technology which aligns with the TPACK model of technology integration (Ertmer & Ottenbreit-Leftwich, 2010; Kopcha, 2010). In Shulman's (1986) work which TPACK originated from, teacher understanding of content standards is emphasized in order for them to effectively transform the knowledge into *how* it will be taught. Richardson, et al. (2008) indicate that combining context, content, and process as part of the professional learning provides a comprehensive and coherent approach for teachers. The use of the TPACK model would provide this opportunity for teachers to integrate context, content, and process as part of technology integration professional development.

The SAMR model can be used with teachers to engage them in the active learning process of developing and refining lessons moving toward higher student outcomes (Keane, Keane, & Blicbau, 2013). Teachers could benefit from embedding the SAMR model into their weekly instructional planning sessions (Chou, Block, & Jesness, 2012). This could be achieved in grade level planning sessions by having teachers plan lessons for their content standards with a discussion around technology that could be used within content delivery via instructional strategies. Then they would use the SAMR model to discuss the level of technology integration that was planned and determine the level of technology use against the framework. Teachers could then discuss and modify their lessons to move to higher levels on the SAMR continuum. Chou, Block, and Jesness (2012) also recommend modeling transformative teaching at the higher levels of the SAMR model as part of professional learning to move teachers to higher levels of impactful technology integration. The modeling of transformative instruction will demonstrate how the role of the teacher at these levels of SAMR is more of a facilitator as a opposed to a deliverer of content thereby resulting in constructivist practices (Tangney & Bray, 2013).

TIM are descriptive tools that provide for the analysis of instruction and technology using a rubric that indicates a contiuum of levels of teaching and learning with technology. These matrices could be used in professional development like the TPACK and SAMR frameworks to help move teachers toward more constructivist instructional practices. The matrices for teacher and student descriptions such as those found in Appendices D and E from the FTIM could be used to provide a springboard for effective lesson design (Florida Center for Instructional Technology, 2011).

Therefore, all of the technology integration frameworks discussed provide an opportunity for professional developers to model active learning and constructivist practices with teachers as they work to design and implement lessons that integrate technology in a student centered classroom. Moving teachers toward more constructivist teaching and learning practices is an important step toward technology integration.

Factors Impacting Technology Integration

It is critical to understand the realities teachers are facing with regard to technology integration in order help them work through barriers and move toward transformative practice (Meyer, Abrami, Wade, & Scherzer, 2011). An exploration of factors impacting technology integration is provided in this section. It is essential to understand the factors that impact teachers' decisions as to how, when, and why they integrate technology into the teaching and learning process as these decisions are critical to determining successful technology integration in the classroom (Baylor & Ritchie, 2002; Chen, 2008; Inan & Lowther, 2010).

One factor affecting technology integration comes from Rogers (2003) Perceived Attributes of Innovations which explains the different rates of adoption of individuals toward a change or innovation. Rogers' work studies and provides a model for change and describes the characteristics that individuals go through when being asked to adopt something new. The model provides information and guidelines for what attributes could be built into the innovation that would facilitate change for the different levels of individuals or adopters. Watson (2007) notes the importance of the potential adopters perceptions about change as they are the ones who will be making the decision to adopt or reject the innovation. The first level in Rogers' Perceived Attributes of Innovations categorization is relative advantage. The relative advantage or perceived improvement over the previous idea is evaluated by the individual. Greater perceived advantages result in faster adoption rates. Second, compatibility with existing values is considered. Third, the level of complexity is evaluated by the individual and innovations that are simple in nature are adopted more quickly. Next, trialability is how individuals may be able to experiment with the innovation on a small scale and in segments determines adoption rates. Finally, observability is how the innovation is seen by others is considered. For example, Rogers notes that individuals are more likely to adopt when they can see results. With regard to technology integration, teachers may be more inclined to use more technology in their instruction when they can see student ownership in learning and/or student achievement results.

The literature categorizes additional factors impacting technology integration in several ways which can be categorized into two types: 1) External or first-order factors; and 2) internal or second-order factors (Eteokleous, 2008; Wachira & Keengwe, 2011).

Therefore, for the purposes of this literature review external (first-order) and internal (second-order) factors will be used to categorize the major influences that have been identified in the research as having an impact on technology integration in the classroom. A discussion and comparison of the technology integration frameworks as they relate to each category of factors is included in this section of the literature review.

External (First-Order) Factors

External (first-order) factors impacting technology integration are typically school level factors (Wachira & Keengwe, 2011). Appropriate and consistent access to technology has been identified as one of the most common external (first-order) factors (Kopcha, 2010; Wade, Rasmussen, & Fox-Turnbull, 2013). Teacher concerns with access include lack of hardware and appropriate software, as well as the lack of computers with internet access (Wachira & Keengwe, 2011). Hsu and Kuan (2013) noted that access to technology includes more than just computers but encompasses projectors and other equipment as well. The lack of availablity of computer labs and/or computer lab time, unreliability related to slow servers and connectivity concerns were also noted (Wachira & Keengwe, 2011). The quality of a school's infrastructure clearly impacts technology integration in classrooms (Means, 2010).

The second most common external factor identified from the literature is time (Richardson, et al., 2008; Kopcha, 2010). Hew and Brush (2007) note that teachers need time to preview websites and locate information for lessons. Teachers have indicated concerns with not having enough time to prepare lessons that integrate technology (Baylor & Ritchie, 2002). In addition to needing time to plan lessons that integrate technology and time to learn the hardware and software, teachers need time to collaborate with peers on technology integrated lessons (Keengwe, Onchwari, & Wachira, 2008; Kopcha, 2010).

Another external (first-order) factor that impacts technology integration is technology support (Eteokleous, 2008; Hew & Brush, 2007; Hsu & Kuan, 2013; Inan & Lowther, 2010; Keengwe, Onchwari, & Wachira, 2008; Wachira & Keengwe, 2011). For example, technology support that is slow to respond to teachers' needs due to limited human resources is a barrier for teachers integrating technology. In general, the availability and quality of technology support impacts how often teachers use technology in their classrooms (Inan & Lowther, 2010).

Technology leadership has also been found to be an external factor related to school culture impacting technology integration in schools (Baylor & Ritchie, 2002; Eteokleous, 2008; Keengwe, Onchwari, & Wachira, 2008; Wachira & Keengwe, 2011). The principal's use of technology and belief that technology can result in transformative practice is an influential factor in teachers' technology integration (Baylor & Ritchie, 2002). The principal is a facilitator of change and is critically important to moving teachers toward more student centered use of technology. The principal's leadership helps the teaching staff make connections between technology and the school's mission and vision (Chang, Chin, & Hsu, 2008). Anthony and Patravanich (2014) stress uniqueness of the position of the principal in being able to articulate the vision, provide resources as well as encourage, support, and reward teachers as they work toward technology integration. It is up to the principal to develop teachers' skills levels toward all initiatives including technology integration and to create the right conditions for change and development (Petersen, 2014). Chang, Chin, and Hsu (2008) stress that principals should be planning and designing professional development for their schools as they should be viewed as technology leaders in their buildings.

The literature has identified multiple external factors that impact teachers' technology integration. Neither the TPACK framework, the SAMR model, nor TIM include any elements to address the external barriers of appropriate and consistent access to technology, time, and technology support. However, all of the frameworks can be used by technology leaders to address the external barrier of technology leadership and could be utilized by school technology leaders to help define a vision for technology instruction. The TPACK and SAMR models provide leaders with a scaffold to use with teachers to help them plan technology integration lessons. The TPACK model provides more specificity than the SAMR model with regard to leaders assisting teachers with exactly how to plan lessons that integrate content, technology, and effective instructional strategies. TIM can be used by leaders as a tool to help them conduct classroom observations of teachers and students. The technology integration frameworks provide leaders with relevant tools to support technology integration.

Internal (Second-Order) Factors

Internal (second-order) factors are intrinsic in nature and directly influence teachers' decisions regarding technology (Eteokleous, 2008). Hsu and Kuan (2013) note that school level factors have some influence on teachers' decisions to integrate technology. However, teacher factors are the main variance. Internal (second-order) factors require teachers to challenge their belief systems and are more difficult to overcome than external (first-order) factors (Richardson, et al., 2008). Ertmer and

Ottenbreit-Leftwich (2010) report that beliefs are stronger predictors of behavior than knowledge.

Teacher values, attitudes, and beliefs are critically important and, perhaps, the most influential internal factor of teachers integrating technology into their classrooms (Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Fullan & Smith, 1999). Teachers who believe that technology is appropriate and important for student learning will integrate technology at higher levels (Eteokleous, 2008; Inan & Lowther, 2010). Beliefs determine a person's attitude, and attitude is important for technology integration (Hew & Brush, 2007). These factors are examples of the compatability level in Rogers' Perceived Attributes of Innovations in which the change is evaluated against teachers' exisiting values.

Self-efficacy is a specific factor within the context of teacher values, attitudes, and beliefs identified in the literature as an influential internal factor for technology integration (Ertmer & Ottenbreit-Leftwich, 2010; Keengwe, Onchwari, & Wachira, 2008; Wachira & Keengwe, 2011). Self-efficacy is a key component of Bandura's (1986) social cognitive theory. Self-efficacy can be defined as one's belief in his/her capability to accomplish a certain level of performance, and with regard to technology, self-efficacy is teachers' perceptions of how well they use technology in their instruction (Brinkerhoff, 2006). Bandura states that self-efficacy influences the behaviors of people and how much they will persist toward a task. The degree of self-efficacy toward technology that a teacher holds is a predictor for the types of instructional practices and the levels of technology integration that will be implemented (Paraskeva, Bouta, & Pappagianni, 2008).

Teachers' core beliefs are difficult to change, and their type of belief (traditional versus constructivist) will determine the types of technology lessons they will most often implement (Ertmer & Ottenbreit-Leftwich, 2010). Teachers' value beliefs are based on whether or not they believe instructional goals can be achieved using technology (Ertmer & Ottenbreit-Leftwich, 2010). Chen (2008) states that core beliefs are those fundamental beliefs central to one's belief system, and these are more difficult to change. Core beliefs, for example, are those guiding beliefs that determine how one behaves. Ertmer (2005) echoes Chen's discussion on core beliefs adding that staff developers often do not know how to change those beliefs. In addition, Chen reports that teachers also hold pedagogical beliefs which are those educational beliefs about teaching, learning, and students. All of these beliefs should be examined and taken into consideration when working to change teachers' practice.

Another important consideration related to teachers'values, beliefs and attitudes that impact technology integration is teachers' lack of openess to change and innovation (Keengwe, Onchwari, & Wachira, 2008; Wachira & Keengwe, 2011). Baylor and Ritchie (2002) note that teachers' openness to change correlated to their acceptance of technology and willingness to integrate it into teaching and learning. In addition, teachers' perceived value of the technology to include their perception of its effectiveness toward improving student learning is also an internal factor within the teachers' values, beliefs, and attitude realm impacting technology integration (Baek, Jung, & Kim, 2008; Hsu & Kuan, 2013; Inan & Lowther, 2010). This is an example of the first level of Rogers' (2003) Perceived Attributes of Innovations which is relative advantage. In this level teachers evalute the perceived improvement or effectiveness over the previous idea.

Two of the technology integration frameworks can be used to address some of these internal factors of teachers noted in the literature. The TPACK framework provides a structure for teachers to learn how to effectively plan lessons integrating technology, pedagogy, and content knowledge. Engaging teachers in planning lessons using the TPACK framework consistently could potentially impact their beliefs, self-efficacy, and openness to change toward technology integration. However, Chai, Koh, and Tsai (2013) report that while the TPACK framework provides some increase in teachers' development of technology integration skills, additional time and effort should be dedicated to addressing other factors such as contextual barriers and teachers' beliefs.

The SAMR model could be used to address the internal factors of teachers in a manner similar to the TPACK framework as teachers engage in lesson planning for technology integration using the SAMR model. Keane, Keane, and Blicbau (2013) suggest that the SAMR model be used as teachers plan and develop lessons to improve student outcomes and increase technology integration. However, the SAMR model provides less specificity for how to plan lessons which may not provide a high level of impact toward change in internal factors of teachers.

TIM could be used as part of professional development to assist teachers in assessing their own levels of technology integration. The descriptive tools provide teachers an account of what transformative technology integration looks like for both teachers and students. Transformative technology integration is student-centered, technology-based instruction in which students are engaged in authentic and relevant problems and tasks that afford them the opportunity to construct knowledge and take ownership of their learning (Florida Center for Instructional Technology, 2011).

However, this tool does not address the internal factors that impact teachers' technology integration. This tool simply illustrates for teachers where their current levels of technology integration are and where they need to be without addressing teachers' beliefs about teaching with technology or their self-efficacy levels with technology. In order to change beliefs, teachers need to engage in multiple activities that challenge their current beliefs (Ertmer & Ottenbreit-Leftwich, 2010).

The TPACK and SAMR models could potentially address the internal factors of teacher beliefs and self-efficacy through consistent and active engagement in lesson design. While TIM provide teachers with an opportunity to see explanations of what teaching and learning with technology looks like, they do not address the internal factors impacting teachers' technology integration. Therefore, additional professional development components must be provided for teachers that will address these internal factors if sustained, effective technology integration is to be achieved.

Evaluation Of Technology Outcomes

Richardson et al. (2008) report the critical importance of finding valid indicators of effectiveness when evaluating technology integration. They state that two potential measures include changes in teachers' knowledge and skills and changes in classroom teaching practices. Lawless and Pellegrino (2007) express concern with the current evaluation of technology integration outcomes in the literature. They indicate that most studies have teachers conduct self-assessments about how much they enjoy or use technology in their teaching. This method of evaluation does not provide accurate information about technology integration practices in the classroom. Eteokleous (2008) agreed by stating that observing teachers versus relying on surveys and interviews is important in order to truly understand the level of change taking place in the teaching and learning process. Based on the literature, classroom observations and technology usage reports as evaluation components would provide a broader picture of how technology integration is progressing in a school. It is important to note that Hsu and Kuan (2013) state that teacher and student technology usage are different and should be evaluated and considered separately.

While observing teachers and reviewing usage reports will provide a glimpse into the changes in practice taking place in a school, a significant focus on student outcomes and learning should be considered as part of the evaluation process. These outcomes can be measured as part of the specific content based learning target driven professional learning. Baylor and Ritchie (2002) note additional ways that technology integration could be evaluated including the percentage of time that higher other thinking skills were used by students using technology, the percentage of time students were engaged in constructivist uses of technology, and the percentage of time students were engaged in collaborative learning using technology.

Multiple methods should be used to determine the effectiveness of technology integration in classrooms and schools and meaurements other than teacher self-assessments of technology use should be considered.

The TPACK and SAMR models could be used as part of the evaluation of technology integration in classrooms. The TPACK and SAMR frameworks could be used to evaluate lesson plans to determine the level of integration between technology, pedagogy, and content. These frameworks would address the first condition of evaluating technology integration of measuring teachers' knowledge and skills as discussed by Richardson et al. (2008).

TIM can be utilized to address Richardson et al's. (2008) second condition of evaluating technology integration of measuring changes in classroom teaching practices. The FTIM (Florida Center for Instructional Technology, 2011), for example, provides a rubric to assess teachers' and students' levels of technology integration toward transformative teaching and learning. The matrix provides a description of the levels of technology integration beginning with entry and moving through adoption, adaptation, infusion, and transformation. The matrix could be used as an evaluative tool during classroom observations to determine the levels of technology integration for teachers and/or schools.

The technology integration frameworks have potential to be used for the evaluation of technology integration. However, multiple methods of evaluation should be used in order to gain a comprehensive picture of changes in teachers' knowledge and skills as well as changes in classroom teaching practices.

Professional Development in Technology Integration

Current professional development models for technology integration focus on information about the available technology for classrooms that are delivered in a traditional inservice or train the trainer model of delivery (Holland, 2001). In addition, these traditional models are most commonly offered one time ranging in duration from one hour to one day (Lawless & Pellegrino, 2007). In fact, Brinkerhoff (2006) reports that the majority of teachers in America receive less than eight hours of professional development each year. This type of professional development does not meet teachers' needs and is disconnected from instructional practice (Lawless & Pellegrino, 2007).

The type, amount, and quality of training provided to teachers is identified as a factor impacting technology integration in classrooms (Baek, Jung, & Kim, 2008; Baylor & Ritchie, 2002; Eteokleous, 2008; Hsu & Kuan, 2013). Inan and Lowther (2010) indicate that insufficient professional learning for technology integration is of increasing concern and that professional development is one of the most influential factors in affecting teachers' techology integration.

As noted previously the TPACK, SAMR, and TIM frameworks have potential use with teachers as professional learning. These frameworks could be used for lesson planning and observations. The TPACK and SAMR models could be used by teachers to help them integrate technology into their instructional strategies as they plan for required content standards. The TIM framework is a tool that could be used during classroom observations to evaluate the level of technology being used in the classroom. However, the literature notes additional components of professional development that should be an integral part of teacher learning which cannot be addressed solely through the use of technology integration frameworks.

The Standards for Professional Learning developed in 2011 by Learning Forward, formerly the National Staff Development Council, provide a framework that encompasses all of the key components noted in the literature around professional learning. Learning Forward is the primary organization that conducts research and develops policy on professional learning for educators. Most states and organizations that work with professional learning of educators adopt Learning Forward's Standards for

Professional Learning including the school district in which this study takes place. A combination of the Learning Forward framework which includes all key professional development components from the research, the TPACK framework, and the Florida Technology Integration Matrix (Florida Center for Instructional Technology, 2011) form the guiding principles for the professional development design in this study.

Standards For Professional Learning

Learning Forward (2011) contends that all professional development for teachers should be designed around 1) learning communities, 2) leadership, 3) resources, 4) data, 5) learning designs, 6) implementation strategies, and 7) outcomes. This framework provides a structure or organization for all of the components reflected in the literature on professional development and professional development for technology integration. In this section of the literature review each Learning Forward standard is discussed along with how each relates to the professional development research and the technology integration frameworks providing a foundation for the professional development design for this study.

Learning Communities

The first Learning Forward Standard for Professional Learning focuses on the importance of developing professional learning within Learning Communities (Learning Forward, 2011). The Learning Communities standard states that in order for professional development to result in improved teacher practice and student achievement, teacher learning must take place within learning communities that are focused on the continuous improvement cycle, collective responsibility, and aligned with school/district goals (Learning Forward, 2011). There are several professional development components noted in the literature that develop teacher learning communities toward improving technology integration.

The literature supports the use of learning communities and indicates that an essential component of effective professional development includes peer collaboration (Cooley, 2001; King, 2002; Lawless & Pellegrino, 2007; Matzen & Edmunds, 2007; Orrill, 2001). Collaboration should include discussions with other teachers around using technology for specific content to address student learning targets. These discussions should also include the opportunity to share success stories about technology integration lessons (Ertmer & Ottenbreit-Leftwich, 2010). This is an example of the observability level in Rogers' (2003) Perceived Attributes of Innovation level. Individuals are more likely to adopt a new innovation when they can see the results and impact of the change. Ertmer also (2005) reports that teachers' practice is more likely to change if they are involved in collaborative learning and discussions with other teachers as part of professional development.

Several research studies note the importance of teachers working together and collaborating in small peer groups as they learn to effectively integrate technology (Ertmer, 2005; Fullan & Smith, 1999; Hsu & Kuan, 2013; Meyer, Abrami, Wade, & Scherzer, 2011; Richardson, et al., 2008; Wachira & Keengwe, 2011). Inan and Lowther (2010) recommend that teachers work in small collaborative groups based on confidence levels, beliefs, or content areas in order to strengthen teachers' interactions and reflections. Ertmer and Ottenbreit-Leftwich (2010) add that peer pressure can also be a strategy for motivating teachers to try to integrate technology into their classrooms.

Mentoring or coaching for teaching in the area of technology integration aligns with the research on peer support and is identified as a key strategy for impacting teachers' professional learning toward technology integration (Ertmer & Ottenbreit-Leftwich, 2010; Richardson, et al. 2008). This strategy provides teachers with someone they can use to talk through ideas or troubleshoot problems. The mentoring strategy also provides teachers a safe environment for risk taking and experimenting with technology which is also identified in the literature as important (Ertmer & Ottenbreit-Leftwich, 2010; Keengwe, Onchwari, & Wachira, 2008; Richardson, et al., 2008). This strategy of mentoring is an example of the trialability level of change according to Rogers' (2003) Perceived Attributes of Innovation which notes the importance of individuals needing to experiment and practice with the proposed change on a small scale in order to move toward adoption of the innovation or change. The TPACK framework could be used by teachers in learning communities to develop lessons collaboratively through peer collaboration or coaching. TIM could be used to support the Learning Communities standard through peer observations using the tool to assess levels of technology integration.

The Learning Communities standard (Learning Forward, 2011) notes the importance of teacher collaboation as an avenue for sharing, developing, and refining ideas and strategies. Peer collaboration including small peer groups and coaching are components of a learning community that are noted in the literature as specifically impacting technology integration. The technology integration frameworks could be used to support the Learning Communities standard of professional development.

Leadership

Leadership is Learning Forward's (2011) second standard for professional learning. The Leadership standard states that leaders are required who develop capacity for learning and leading, advocate for professional learning, and create support systems including structures if professional learning is to result in improved teacher practice. With regard to technology integration, this standard addresses the external barriers of access, time, support, and leadership as identified by the literature. Leadership can and should address access concerns and support issues in technology. In addition, leadership should provide structures to provide teachers with time for learning to teach and collaborate with others on technology and a shared vision for technology integration as noted in the literature.

Research indicates that administrative support and leadership are key elements in advancing technology integration in classrooms and schools (Hsu & Kuan, 2013; Means, 2010). When the principal provides clear expectations to teachers regarding the use of technology and support of the practice, it creates a condition for sustained change (Richardson et al., 2008). However, technology leadership should be both top down and bottom up (Laferriére, Hamel, & Searson, 2013). Wachira and Keengwe (2011) state that administrators must support technology integration and teachers as they experiment with various technology resources in their instruction. They should also encourage those teachers who are not yet committed to embracing technology into their instructional practices, and Baylor and Ritchie (2002) along with Richardson et al. (2008) suggest that rewarding teachers for striving to integrate technology is an effective strategy.

A strategy that can promote technology integration and one that falls under leadership is that of a shared vision (Hsu & Sharma, 2010; Laferriére, Hamel, & Searson, 2013; Means, 2010). When teachers are not involved in the decision making process of technology planning, this results in a lack of a common vision toward technology integration (Wachira & Keengwe, 2011). A shared vision among teachers and leaders about technology and technology integration can overcome technology leadership factors and barriers (Baylor & Ritchie, 2002; Hew & Brush, 2007). A clear and shared instructional vision for where technology integration is leading is important to teachers and can serve as a roadmap for technology integration (Kopcha, 2010). In addition, a shared vision for technology integration gets teachers involved in the decision making process which is a strategy for teacher and school change (Eteokleous, 2008).

As noted earlier in this literature review in the section on external factors impacting technology integation the TPACK framework, the SAMR model, and TIM could all be utilized by school technology leaders to help define a vision for technology instruction. In addition, the frameworks could be used by leaders to lead technology in their schools and to develop leadership capacity among teachers as they plan technology integration lessons. This study reflects leadership advocating for effective professional development for technology integration which is a key component of the Leadership standard from Learning Forward (2011).

Resources

Learning Forward's (2011) third standard for professional development is Resources. Resources must be appropriate, timely, and requires prioritizing, monitoring, and coordinating by leadership in order for professional learning to result in teacher effectiveness.

Appropriate and consistent access to technology is identified as one of the most common external (first-order) factors that need to be addressed when determining strategies to impact technology integration (Baek, Jung, & Kim, 2008; Hsu & Kuan, 2013; Wachira & Keengwe, 2011; Wade, Rasmussen, & Fox-Turnbull, 2013). Schools must have the appropriate infrastructure and funding plan to provide consistent and appropriate access to teachers in order for technology integration to be successful.

Providing responsive technology support for problems that arise is another key strategy for impacting technology integration in schools (Eteokleous, 2008; Hew & Brush, 2007; Hsu & Kuan, 2013; Inan & Lowther, 2010; Keengwe, Onchwari, & Wachira, 2008; Wachira & Keengwe, 2011). Technology support should be quick to respond to teachers' needs and readily available for immediate assistance (Inan & Lowther, 2010).

The TPACK, SAMR, and TIM frameworks cannot be used to address the Learning Forward (2011) professional learning standard of Resources. This standard is a leadership function but is required for effective professional learning to occur. Since the technology integration frameworks cannot effectively address this professional learning standard, it furthers the argument that professional development for technology integration should encompass additional components such as those found in the Learning Forward framework in order to maximize effectiveness.

Data

Learning Forward's (2011) professional learning standard on Data states that effective professional learning uses a variety of data sources to plan and evaluate professional development. This aligns with the research noted in the Evaluation of Technology Outcomes section of this literature review in which the literature noted that multiple measures of technology integration were critical in the evaluation of teachers' knowledge and skills and classroom practices.

Yoon, Duncan, Lee, Scarloss, and Shapley (2007) state that evaluating the gains of student achievement as a result of teacher professional learning is a challenge. Hirsh and Killion (2007) note that professional development that is not carefully planned and designed is not able to produce the intended results. They further report that if it is intended that professional learning be evaluated, then it is more like to achieve results. If the evaluation of professional learning is determined as part of the design versus being an after-thought, it has greater potential to impact student learning (Earley & Porritt, 2014). Yoon, Duncan, Lee, Scarloss, and Shapley indicate that four elements must be considered when evaluating the impact of professional learning on student learning: 1) a rigorous research design; 2) allow for ample professional learning implementation; 3) multiple measures of teacher practice and student learning; and 4) appropriate statistical methods used in the evaluation process.

Hirsh and Killion (2007) stress that evaluation of professional development could either be oppressive or motivational to teachers and recommend a process for evaluating professional development that will be motivational. The process includes dialogue with teachers about the professional learning process and data analysis. In addition, they argue that professional learning should be measured as to its worth (did it have value?), merit (did it meet desired goals?), and impact (did it change teachers' practice?).

The student achievement impact should be measured as an evaluation of professional learning, thus providing specific student impact information which is identified by Earley and Porritt (2014) as being rare in the evaluaton of professional learning. Yoon, Duncan, Lee, Scarloss, and Shapley's (2007) work indicate that future professional learning studies should address the direct impact of the professional learning on teachers and the indirect impact on students.

The technology integration frameworks can be used as data sources in the planning and evaluation of professional development. For example, the TIM could be used to determine the current reality of technology integration as a result of teacher observations. This would be a data point that could be used in the planning for professional learning. Since the standard indicates that multiple data sources should be used, an additional data point could include an indication of the current levels of teachers' attitudes, beliefs, and values since the internal factors of teachers highly impact their teaching practices (Ertmer & Ottenbreit-Leftwich, 2010). The TPACK framework could also be used as data points for planning and evaluating professional learning. This framework could be used to analyze lesson plans, for example, to guide the planning and evaluation of technology integration professional development.

Learning Designs

Learning Forward's (2011) Learning Designs standard states that effective professional development integrates theories, research, and models of human learning toward the attainment of specified outcomes. Learning Forward indicates that there are multiple designs that are impactful for teacher professional development including active engagement, modeling, reflection, and feedback. The research on professional development for technology integration also cites many of the same learning designs as being effective for improving teachers' practices with technology. The designs should be carefully selected to match the intended outcomes for teachers and students as specified during the development of professional learning.

Active Engagement

Professional development must engage teachers in active learning opportunities (Hew & Brush, 2007; Keengwe & Onchwari, 2009; Lawless & Pellegrino, 2007). The professional development itself must be learner-centered to act as a model for teachers to create more learner-centered classrooms while integrating technology (Orrill, 2001). Judson (2006) states that professional development on technology integration should focus on constructivism not merely forcing technology use in the classroom. Using an active, learner-centered, constructivist approach, teachers can construct their own meaning and understanding for new learning which can be more readily applied to the classroom once they experience this approach for themselves (Keengwe & Onchwari, 2009). This echoes the previous discussion in this literature review on the constructivist teaching factor that impacts technology integration and the importance of modeling constructivist teaching in professional development.

Technology is often taught as a separate entity from content and pedagogy during professional learning. These elements should all be connected (Mishra & Koehler, 2006). Professional development should plan for and focus on the transactional relationship between content, pedagogy, and technology which aligns with the

Technology Pedagogy Content Knowledge (TPACK) model of technology integration. All of these elements must be encompassed versus isolated in professional development for technology integration (Ertmer & Ottenbreit-Leftwich, 2010; Hew & Brush, 2007; Mishra & Koehler, 2006). Professional development should be clearly designed around specific content, pedagogy, and technology in order to achieve a change in teachers' practice. This type of professional development design also yields higher student achievement outcomes (Garet, Porter, Desimone, Birman, & Yoon, 2001; Mishra & Koehler, 2006). Ertmer and Ottenbreit-Leftwich (2010) indicate that professional development should be very specific in how teachers can use strategies to increase student learning. This specificity should also include classroom management strategies as well (Hew & Brush, 2007). However, while specificity is essential, Mishra and Koehler (2006) note that the complex relationships and connections among content knowledge, pedagogy, and technology should also be articulated.

Modeling

Professional development for technology integration should include multiple examples of how technology can improve teaching and learning (Chen, 2008). This should include opportunities for teachers to observe classrooms that integrate technology using a student centered approach(Ertmer & Ottenbreit-Leftwich, 2010; Keengwe & Onchwari, 2009). Observing other teachers serves multiple functions in professional development. First, observations of effective technology integration can be informative for teachers on how to implement specific strategies. Secondly, observations can increase teachers' motivation and confidence toward their own success (Ertmer, 2005). In addition, it is suggested that the observations encompass a variety of strategies and pedagogical beliefs for teachers to see (Ertmer, 2005). The FTIM (Florida Center for Instructional Technology, 2011) framework would be an practical tool for teachers to use during observations to determine levels of technology integration in practice.

Reflection

The research also indicates that reflection on instructional practices is the most important factor in teacher change (Clarke & Hollingsworth, 2002; Matzen & Edmunds, 2007). The best models for professional development ensure that teachers are reflective practitioners as they study their actual classroom practices (Holland, 2001; King, 2002). This includes critical reflection and self-examination of beliefs, attitudes, behaviors, and practices (King). Ertmer (2005) recommends that teacher reflection include questioning their own practice as well as the practice of others and articulating assumptions that may be operating.

Strategies to address internal factors impacting technology integration include providing teachers avenues to examine their values, beliefs, and attitudes and to tie these factors into professional learning design (Ertmer & Ottenbreit-Leftwich, 2010; Inan & Lowther, 2010; Zhao, Pugh, Sheldon, & Byers, 2002). For example, Ertmer (2005) states in order for beliefs to be changed they must be made explicit and then training opportunities that challenge the beliefs should be provided. This can also be achieved by reflecting on one's practice and questioning the practices of others as part of professional learning toward technology integration.

Another professional learning design implication for impacting teachers' values, beliefs, and attitudes is to build teachers' self-efficacy in integrating technology into teaching and learning (Inan & Lowther, 2010; Keengwe, Onchwari, & Wachira, 2008).

Ertmer (2005) and Ertmer and Ottenbreit-Leftwich (2010) both note that changes occur when teachers' confidence is built with successful experiences in small instructional changes prior to moving toward larger changes. This can be achieved by introducing technology to teachers that will meet their immediate needs so they can begin to see successes in their classrooms.

Effective learning designs for professional development in technology integration include active learning opportunities; application of the transactional relationship between content, pedagogy, and technology; modeling technology integration lessons; reflection on instructional practices; and examination of values, beliefs, and attitudes. These learning designs will be implemented using the TPACK and FTIM (Florida Center for Instructional Technology, 2011) as tools for the learning opportunities in this study.

Implementation Strategies

Learning Forward's (2011) Implementation standard states that professional learning that increases educator effectiveness and student achievement employs change research and sustains implementation in order to achieve long-term change. When professional developers understand how teachers respond to change, they are able to differentiate the support for teachers in order to maximize effective performance (Learning Forward, 2011). For example an awareness of Rogers' (2003) Perceived Attributes of Innovation is an example of change research that can be addressed through professional learning by helping teachers see the relative advantage of technology integration and assisting them in integrating the change into their attitudes, values, and beliefs. In addition, allowing teachers the opportunity to try out technology integration and observe technology integration lessons from others will assist with moving teachers through the change process toward technology integration.

Professional development should be more than a one time workshop. It should be embedded into the work and practice of the teachers (Clarke & Hollingsworth, 2002; Hirsh & Killion, 2007). Garet, Porter, Desimone, Birman, and Yoon (2001) add that the professional development should be provided during the school day without requiring teachers to stay additional hours. Situated professional learning that allows teachers to study, reflect, and learn about their own classroom is a recommendation for facilitating teacher change (Ertmer & Ottenbreit-Leftwich, 2010). In addition, a systematic approach to professional development that aligns to classroom practice is an important component (Lawless & Pellegrino, 2007).

Many studies indicate that professional learning with follow-up support that is ongoing and sustained over time is a key component to sustained success in changing teachers' practice (Ertmer & Ottenbreit-Leftwich, 2010; Lawless & Pellegrino, 2007; Matzen & Edmunds, 2007). Ertmer (2005) states that ongoing support helps teachers build self-confidence with technology tools and instructional strategies as they continue to enhance their instruction. In addition, Learning Forward (2011) states that implementation should provide ongoing and follow-up support and feedback to teachers based on expected behaviors and outcomes.

The TPACK and FTIM (Florida Center for Instructional Technology, 2011) will be used to provide professional developers with information about teachers' current levels of technology integration for this study. This information would then allow professional developers the opportunity to give teachers specific levels of support and constructive feedback toward improved performance.

Outcomes

The Learning Forward (2011) Outcomes standard indicates that effective professional learning focuses outcomes on educator performance as well as student learning outcomes. The research on professional development for technology integration aligns with this standard.

Professional development that is results-driven and focused on student outcomes should be clearly articulated to participants (Hirsh & Killion, 2007; Keengwe & Onchwari, 2009; Lawless & Pellegrino, 2007). When professional development is tied to student learning the results are impactful (Holland, 2001). The outcomes should be tied to specific student learning targets and outcomes so teachers can see the impact of their changing practice on student learning (Ertmer & Ottenbreit-Leftwich, 2010; Keengwe, Onchwari, & Wachira, 2008; Means, 2010; Richardson, et al., 2008).

The Learning Forward (2011) Standards for Professional Learning provide a coherent framework for effective professional learning design. There are some elements of professional development specifically for technology integration that can be addressed through the application of the TPACK and FTIM (Florida Center for Instructional Technology, 2011) frameworks as part of the professional development learning design. These frameworks can be applied to several Learning Forward Standards including Learning Communities, Leadership, Data, Learning Designs, and Implementation to move teachers toward more effective practices in teaching with technology.

A Design Based Professional Learning Framework

Orill (2001) conducted a design based research study on professional learning for technology integration which resulted in the development of a framework for professional learning that will move teachers toward technology integration. Figure 2.3 is the framework that resulted from her study. This framework provides a way to organize some of the professional learning components that are noted in the literature as being critical to the development of teachers toward technology integration. The framework notes the inclusion of support materials as well as group and one-on-one activities. Individual goal setting, teacher reflection, and collaboration are the other key components of Orill's framework that resulted in changing teachers' practice toward technology integration.

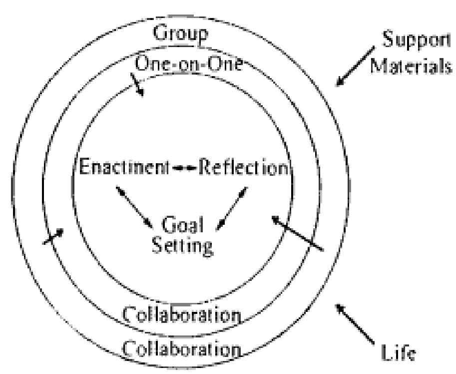

Figure 2.3 Revised Professional Development Framework from "Building Technology-Based Learner-Centered Classrooms: The Evolution of a Professional Development Framework," by C.H. Orrill, 2001, Educational Technology Research & Development, 49, p. 30. Copyright 2001 by Springer Publishing Company. Reprinted with permission.

Conclusion

Professional development needs to be provided to assist teachers in changing their practices in integrating technology into the teaching and learning process so students can experience technology as an integral part of their learning. Inan and Lowther (2010) indicate that professional development is one of the most influential factors in affecting teachers' techology integration. However, they also note insufficient professional learning for technnology integration is of increasing concern.

There are several frameworks found in the literature that are being used with teachers to move them toward technology integration that is student centered and engages students in authentic, relevant learning experiences and the construction of knowledge. The TPACK, SAMR, and TIM such as the Florida Technology Integration Matrix (Florida Center for Instructional Technology, 2011) are examples of these technology integration frameworks. TPACK focuses on the relationships between technology, pedagogy, and content knowledge and states that these must all be intertwined in order for technology integration to occur (Chai, Koh, & Tsai, 2013; Graham, Borup, & Smith, 2012; Kimmons, 2015). The SAMR model is a technology model that defines various levels of technology use in the classroom into four levels with the higher levels of technology integration being the final two stages: substitution, augmentation, modification, and redefinition (Chou, Block, & Jesness, 2012; Keane, Keane, & Blicblau, 2013; Tangney & Bray, 2013). Technology Integration Matrices (TIM) are descriptive tools that provide for the analysis of instruction and technology using a rubric that indicates a continuum of levels of teaching and learning with technology.

These frameworks found in the literature are being used to drive professional development and to measure the levels of technology integration of teachers and in schools. They can be used to address some of the factors noted in the literature as impacting teacher technology integration. The frameworks can all be used to help teachers create lessons that would move them toward more constructivist teaching practices which is an important step toward technology integration. In addition to using the frameworks to create lessons, they can also be used to model constructivist practices during professional development.

The technology integration frameworks cannot be used effectively to address most external factors identified in the literature as impacting technology integration. The external factors of technology access, support, and time are not able to be impacted through the use of a technology integration framework. However, leadership and the role of the principal in advancing teachers technology integration is stressed in the literature as being an important factor toward technology integration. School leaders could use the technology integration frameworks as tools to articulate a vision for technology integration and for the planning and design of professional learning.

The internal factors impacting teacher technology are related to teacher beliefs, values, and attitudes about teaching with technology. These beliefs, values, and attitudes need to be identified, considered, and challenged when working with teachers to impact instructional practices. The technology integration frameworks do not fully address the internal factors of teachers. Therefore, additional professional development components are necessary that will address these internal factors in the development of a professional learning design for technology integration. In order to change beliefs, teachers need multiple activities that challenge their current beliefs (Ertmer & Ottenbreit-Leftwich, 2010).

The evaluation of technology outcomes is an important consideration for technology integration and for the design of professional development in technology in order to determine effectiveness. Richardson et al. (2008) state that two potential measures of evaluation include changes in teachers' knowledge and skills and changes in classroom teaching practices. Multiple methods of evaluation should be used when evaluating technology outcomes. Effective evaluation methods move away from teachers conducting self-assessments on their level of enjoyment about technology professional learning or how much they use technology (Lawless & Pellegrino, 2007).

The technology integration frameworks could be used as evaluation tools for technology outcomes. For example, the TPACK and the SAMR models could be used to evaluate lesson plans to determine the levels of integration between technology, pedagogy, and content. The Florida Technology Integration Matrix (Florida Center for Instructional Technology, 2011) could be used as an evaluative tool during classroom observations to determine the levels of technology integration for teachers and/or schools. While the technology integration frameworks can be utilized as part of a technology evaluation plan, multiple methods of evaluation should be used in order to gain a comprehensive picture of changes in teachers' knowledge and skills as well as changes in classroom teaching practices.

The technology integration frameworks can be used as part of a professional development design toward technology integration in order to address many of the factors noted in the literature as impacting teachers' technology integration. However, there are additional considerations when designing professional learning for teachers as noted by the literature that must be in place and cannot be effectively addressed by the technology integration frameworks. The literature on professional development and on professional development for technology integration can be organized within the framework of Learning Forward's (2011) Professional Standards of Professional Learning.

The Learning Forward (2011) Standards for Professional Learning state at all professional learning should be designed around the following standards in order to result in increased educator effectiveness and student learning: 1) learning communities, 2) leadership, 3) resources, 4) data, 5) learning designs, 6) implementation strategies, and 7) outcomes. Peer collaboration and coaching or mentoring are noted in the literature as being effective strategies toward technology integration which fall under the standard of learning communities. The leadership standard addresses the external barriers for technology integration as well as the development of a shared vision for technology integration and the development of leadership capacity among teacher. The resources standard addresses the external factors noted to impact teacher technology integration including access, support and prioritization of all resources related to the professional learning and technology needs of teachers. The data standard indicates that multiple sources of data should be used to plan and evaluate professional learning. The evaluation of professional learning should be part of the planning process in order to increase the likelihood that the intended outcomes are achieved (Earley & Porritt 2014).

The learning designs standard ensures that appropriate learning activities are matched to desired outcomes as part of the professional learning process. These learning designs recommended in the literature or technology integration include the following: 1) active learning opportunities for teachers; 2) application of lesson design that integrates technology, pedagogy, and content; 3) modeling and observations of technology lessons; 4) reflection on instructional strategies; and 5) examination of values, attitudes, and beliefs on teaching with technology including the building of self-efficacy.

Learning Forward's (2011) implementation standard focuses on understanding teacher change in order to differentiate the levels of support as well as the need for job embedded learning with ongoing support. The outcomes standard stresses that professional learning should focus on educator performance as well as student outcomes.

The Learning Forward (2011) Standards for Professional Learning coupled with the TPACK and Florida Technology Integration Matrix (Florida Center for Instructional Technology, 2011) provide a comprehensive and coherent framework for designing professional learning for teachers in technology integration. The technology integration frameworks provide opportunities specific to technology integration that can be used within the Learning Forward framework. The TPACK model is preferred over the SAMR framework as a professional learning tool due to TPACKs specificity in integrating technology, pedagogy, and content. This specificity will help teachers create effective technology lessons more easily by providing a clear structure for lesson design and development.

The TPACK and Florida Technology Integration Matrix (FTIM) (Florida Center for Instructional Technology, 2011) frameworks are excellent tools that can be used to address multiple factors noted in the literature as impacting technology integration. In addition, they can be used in the application of several Learning Forward (2011) Standards for Professional Learning. The design of the professional learning for this study will use the Learning Forward Standards, the TPACK model, and the FTIM as guiding principles. The design will also use Orill's (2001) framework as a foundational piece for the development of the initial professional learning design. The comprehensive design of these principles will provide a coherent professional learning opportunity for teachers toward sustained technology integration that is student centered and engages students in relevant, authentic experiences and in the construction of knowledge.

CHAPTER THREE: METHODOLOGY

Research Implications

It is important to learn about the characteristics of quality professional development in the area of technology integration so this type of professional development can be applied to the larger jurisdictions in schools, districts, and states. All professional development for teachers should be systemically planned and job embedded in order to achieve intended outcomes which is critical for the goal of achieving student-centered teaching with technology (Learning Forward, 2011).

This study has the potential to impact multiple settings. The local school and the school district will benefit from the practical outputs of the study. The local school will have increased technology integration after a design framework for professional learning toward technology integration has proceeded through the iterative and refining process. In addition, the local school district will benefit from implementing the framework for district level staff development at all 137 schools to enhance the districtwide initiative of technology integration using the district learning management platform.

The revised professional learning framework that results from this design based research will impact theory and contribute to the literature on professional development for technology integration. The overall professional learning framework will provide an anchor for future research and it will add to the current literature by identifying professional learning components that are essential to changing teachers' practices toward transformational learning. In addition, the professional learning framework will be able to be applied across settings for those seeking to integrate technology in their schools and classrooms. This study has the potential for high level impact on multiple levels.

Theoretical Framework

Orill's (2001) framework in Figure 2.3 and Learning Forward's Standards for Professional Learning (2011) informed the initial design and development of the professional learning framework in this study. Orrill's framework resulted from a design based research project on teacher technology integration. It includes a specific framework and design for professional learning that articulates key components noted in the literature as being effective in changing teachers' practice. In addition, Ertmer (2005) and Ertmer and Ottenbreit-Leftwich's (2010) studies on changing teachers' beliefs in order to change instructional practices were key resources for this study. The review of the literature demonstrates the impact and importance of changing teachers' beliefs if true impact is desired, and this element is not a component utilized in Orill's framework. While both the Technological Pedagogical Content Knowledge (TPACK) and Substitution Augmentation Modificaton Redefinition (SAMR) frameworks were presented in chapter two because they were the most influential frameworks being used for technology integration throughout the literature, the TPACK framework was selected as a foundational piece for the professional learning design in this study. The reason TPACK was selected as a component of professional learning over the SAMR model is due to the fact that TPACK provides more specificity and clarity in leading teachers toward integrating lessons into their required content and instructional strategies. The TPACK framework was an important component contributing to the professional development design as teachers need to develop lessons that focus on all components of the TPACK framework in order to learn to effectively integrate technology (Chai, Koh, & Tsai, 2013). The TPACK framework guides teachers as they collaboratively plan lessons that are based on standards, learning targets, and integrate technology. In addition, the professional learning design was designed around all of Learning Forward's (2011) Standards for Professional Learning. All of these studies inform the development and design of a professional development model for technology integration in this study.

Figure 3.1 provides a visual for the foundational pieces, supports, and resources that inform the design of the professional learning model for this study. Figure 3.2 provides a model for the professional learning design components for this study which include individual and group processes for learning.

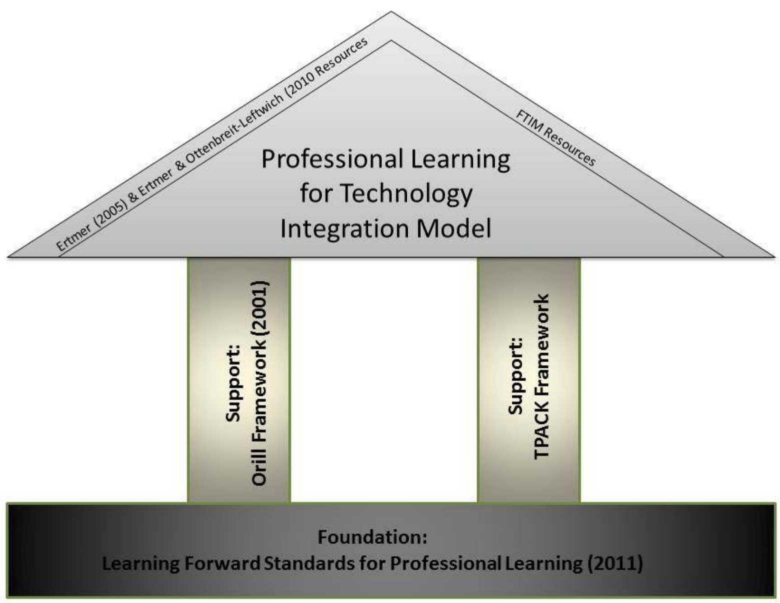

Figure 3.1 Foundation, Support, and Resources for The Professional Learning for Technology Integration Model

Figure 3.2 The Professional Learning for Technology Integration Model

In developing professional learning that will result in sustained, student centered technology integration, a design approach was used that was based on the research findings in the areas of professional development, technology integration, teacher change, strategies for transformative practice, and evaluation of technology integration and professional learning outcomes. An approach that addresses the development of teachers' knowledge, skills and attitudes was essential (Dall'Alba & Sandberg, 2006). A shift from the term "professional development" to "professional learning" needs to take place according to Lindberg and Olofsson (2010) in order to help stay focused on sustaining teacher change in practice. Therefore, from this point forward teacher or professional development will now be referred to as teacher or professional learning as part of a strategic design approach.

Overview of Design Based Research

Design based research is a systematic method of improving educational practice and contributing to theory based on collaboration between researchers and practitioners to design and implement solutions to real world problems using iterations (Wang & Hannafin, 2005). McKenney and Reeves (2012) indicate that what sets design research apart is the concurrent contribution to theory and the development of practical solutions. Design based research helps both researchers and practitioners understand the relationship between theory, the created design, and practice (Design Based Research Collective, 2003). In addition, design based research is concerned with developing usable knowledge in order to foster learning and contribute to theory (Design Based Research Collective, 2003; McKenney & Reeves, 2012). The overall goal of design based research is to create a stronger connection between research and authentic problems in educational practice (Amiel & Reeves, 2008).

Design based research is an effective research genre that can address the complex processes of teaching and learning within the context of educational environments. Learning is complicated, and design experiments result in greater understanding of learning complexities and interactions (Clarke & Dede, 2009; Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003). Many researchers are now pursuing more pragmatic methods of implementing theory that supports educational practice, and design based research meets this criteria (Wang & Hannafin, 2005). In addition, the Design Based Research Collective (2003) notes that educational research that is removed from practice cannot take into account the complexities found in classrooms including the influence of various contextual factors. Design based research has the potential to meet the needs of practitioners and impact educational reform.

A typical design based research process follows a specific process as part of each iteration. First, the problem being studied should be thoroughly analyzed. Next, a solution for the problem should be developed. This solution is then refined during the iteration based on data collection. The iterations repeat as often as necessary. Finally, extensive reflection on the results and refinements during the iterations take place in order to develop design principles and improve future solutions (McKenney & Reeves, 2012).

There are several best practices to be considered when conducting design based research. First, outcomes in design based research are based on the careful consideration of the design procedure, extensive problem analysis, and the design solution that results from the procedure and problem analysis (McKenney & Reeves, 2012). It is also important that formative research be built into the design cycles which requires that not all design decisions be made up front. This provides a clear opportunity for the data results during the study to drive effective and appropriate revisions of the intervention during the iterations. Flexibility is key during design based research so the data can drive changes and improvements during implementation in order to result in a stronger solution.

Edelson (2002) elaborates on reasons why design based research is a viable option for educational research. First, design based research provides a productive approach toward theory development. The practicality of this approach impacts practice immediately while also contributing to theory. Second, design based research uncovers inconsistencies and concerns more so than analytical research approaches. Third, design based research has a specified goal which provides a clear focus and roadmap for theory development. The goal of design based research is to directly impact practice while advancing theory simulanteously contributing to the field of knowledge (Barab & Squire, 2004).

It is important to note that design based research goes beyond designing a product. The intent of design based research is to better understand the complexities of learning and to refine learning theories (Design Based Research Collective, 2003). A main purpose behind designed based research is to increase the relevance of research for educational practice and policy (Akkerman & Bronkhorst, 2013).

Additional Design Based Studies In Professional Learning

In 2013 Ostashewski conducted a design based study in professional learning and wrote a dissertation on the third design iteration of an online professional development in order to evaluate teacher learning and to determine what components of the online professional development design were most effective. The study engaged teachers in authentic learning opportunities and relevant tasks through an online platform. The platform encouraged teacher networking and collaboration as part of their learning as well in order to determine which components of the professional development teachers valued and most impacted their practice. In comparing Ostashewski's study to this design based research study, this study also engaged teachers in constructivist learning opportunities through lesson design and implementation. The tasks were relevant to teacher learning as it is based on student results and learning targets. An online platform is not utilized in this study due to the fact that the culture of the school already requires teachers to meet collaboratively face to face for lesson planning and design weekly. Thus, the technology professional learning could become an integral part of the collaborative planning with the introduction of the TPACK framework.

Forsyth's (2008) doctoral dissertation included a design based study on professional development using online learning communities with a focus on collective learning versus individual learning. Most online learning communities focus on individuals. Forsyth's study concentrated on the collective learning of cohorts of teachers and elements of group learning were studied throughout the professional learning design. Collective learning is powerful and has the potential to improve teachers' collective responsibility toward student achievement. In comparing Forsyth's study to this study, the sample in this design based study is voluntary and teachers from across grade levels were included. Cross grade level learning would be an additional structure that would need to be in place within the context of the school as grade level learning is the norm. The process of change with this shift in culture from grade level to cross grade level learning could be a distraction from the professional learning in this study and add a new dynamic layer of change for the teachers. While this study tapped into teacher collaboration and group learning structures, the data collection and design principles were formed as a result of individual learning results.

This study provides a comprehensive and coherent approach to the development, design, and implementation of a professional learning opportunity toward sustained, student centered technology integration. It addresses a practical need as well as a larger need to determine what professional development components are most effective in the integration of technology. Table 3.1 provides a comparison of the doctoral studies mentioned in this section to the proposed study. Students should be engaged in authentic learning that allow them to construct knowledge and take ownership of their own learning consistently, and teachers need effective professional learning to help them achieve this goal.

Table 3.1

A Comparison of Design Based Dissertations on Professional Learning

Author	**# of participants**	**Length of Study**	**Framework**	**Data Collection**	**Prof Learning Components Used**	**Outcome**
Forsyth (2008)	11	1 year/1 iteration	PD w/i framework of social networking site	Survey Question-airre Document Analysis Interviews	Learning Communities Job Embedded Active Learning	Refined online PD model and design principles
Ostashewski (2013)	13	2 years/4 iterations	DESCANT-Sci-Tech Network Approach to PD	Patterns in online posts Interviews	Learning Communities Job Embedded Face to Face Workshops Reflection	Collective learning found to occur at each stage.
Ledford (2016)	10	1 semester /2 iterations	Learning Forward TPACK Orrill (2001)	Survey Observations Document Analysis Interviews	Learning Communities Job Embedded Coaching Goal Setting Beliefs, Values, Attitudes Analysis Reflections Peer Observations/Feedback	PD framework for technology integration and design principles

Methodology

This study used a design based research approach to developing and refining a professional learning framework that will lead teachers toward sustained, student centered technology integration. A design approach was used that was based on the research findings in the areas of professional development, technology integration, teacher change, strategies for transformative practice, and evaluation of technology integration and professional learning outcomes. In addition, the professional learning design used Orrill's 2001 framework for professional learning toward technology integration, Learning Forward's Standards for Professional Learning (2011) and the TPACK framework as the foundation for design strategies and implementation.

Description of Learning Context

The school and school system in which this study took place already provided the necessary infrastructure to effectively utilize technology with students. The school is a completely wireless setting and all teachers and students have access to log into a teacher/student portal which houses a learning management platform called eClass. All students are trained on how to access eClass, and teachers are encouraged to use the platform for instruction, resources, and homework. In addition, the district is a Bring Your Own Device (BYOD) district. Approximately 50% of the students bring a device to the study's school site for learning each day. Additional devices such as student laptops and tablets are available for student use in each classroom as well. While some classrooms do not have 1:1 capabilities with regard to BYOD and school tablets or laptops, the students often collaborate on devices for technology integrated learning. Three computer labs are also available for teacher sign up as needed. Thus, the external order factors impacting technology integration of appropriate and consistent access are addressed within the study's school setting.

Description of Intervention

The professional learning opportunity for the purposes of this study spanned one semester initially proposing eight face to face meetings in 15 weeks and included essential components from the literature on professional development following Learning Forward's (2011) Standards for Professional Learning. Sixty-five teachers in an elementary school in a suburb of Georgia teachers were eligible to participate in the professional learning opportunity.

A sample of 10 teachers of the 65 participating in the professional learning opportunity was used for in depth data collection on their progress and change toward technology integration. Teachers in the sample for the in depth data collection were from a mixture of grade levels and with varying technology competence levels. Participation in the sample for purposes of this study was voluntary. However, all teachers in the school (65) would participate in the professional learning opportunity as required by the district for their professional development hours toward re-certification. In addition, all teachers were included in the collection of pre/post survey data (discussed in the next paragraph) whereas a sample of 10 voluntary participants was used for additional in depth data collection components. If a teacher decided to opt out of the data collection sample, there were two options. First, if the teacher opted out toward the beginning of the study he/she could be replaced by another volunteer as some data points were gathered on all teachers for school/district evaluation purposes. All teachers in the school as part of the professional learning sessions had some data information that could be entered into the study if needed. The second option would be to continue the study and data collection with fewer than 10 teachers.

The professional learning design was implemented beginning in August 2015 and two iterations took place within the semester to revise and refine the professional development framework based on data collection. The methods of data collection included a pre and post assessment of teacher change in values, attitudes, and beliefs toward technology over the course of the semester. The instrument used for the pre and post assessment was the Computer Technology Integration Survey by L. Wang, P. A. Ertmer, and T. J. Newby (2004). This instrument was chosen because its purpose is to assess how teachers feel about using technology in their instruction. The survey primarily assesses teachers' self-efficacy levels with technology. Since the goal of this study was to determine a professional development framework that would result in changes in teachers' practice, this instrument provided data as to the confidence levels of the teachers using technology at the beginning and at the end of the professional learning intervention. Permission was granted by the publisher, the International Society for Technology in Education, for use of this survey for this study. The instrument was used recently to measure teachers' confidence levels by Skoretz (2011) in her study entitled *A Study of the Impact of a School-Based Job-Embedded Professional Development Program on Elementary and Middle School Teacher Efficacy for Technology Integration*. A copy of this instrument can be found in Appendix F. This instrument is a Likert survey that measures teachers' self-efficacy beliefs and attitudes for technology integration and includes items about teachers' confidence levels for teaching with technology. The instrument uses a 5 point scale ranging from strongly disagree – 1 to strongly agree – 5. The authors of the instrument evaluated the construct and content validity using content expert evaluation and a factor analysis of the survey. The authors concluded the instrument was valid and highly reliable as measured by reliability coefficients. They indicated the resulting form of the survey would be appropriate for application in other research (Wang, Ertmer, & Newby, 2004).

In addition, interviews, classroom observations using the Florida Technology Integration Matrix (Florida Center for Instructional Technology, 2011) found in Appendices D and E, reflection logs, lesson plans, and student achievement data were collected and analyzed during each iteration to determine how the professional learning opportunity should be improved the following iteration in order to result in changes in instructional practice. Guiding questions for the research and framework along with specific data collection methods were drafted for each iteration and can be found in Appendix C. Possible design considerations are also included with the proposed and clearly articulated timeline of each iteration within this design based study. These design considerations are a draft based on the literature review. However, the data collection methods for each iteration determined the actual professional development design components that were enacted during each iterative phase.

Learning Forward's (2011) Standards for Professional Learning indicate the importance of careful learning design selection to match the intended outcomes and educator and student needs. Table 3.2 provides a matrix of learning designs for this study matched to Learning Forward's Standards for Professional Learning and based on intended outcomes and potential educator and student needs. Actual educator and student needs were determined in the first part of iteration 1.

Table 3.2

Matrix of Learning Designs

Learning Forward's (2011) Standards for Professional Learning	Intended Outcome/Educator/Student Need	Learning Design
Learning Communities	• Adult Learning Collaboration • Content Area Weakness Strand • Technology Lesson Plan Creation	• Goal Setting • Identification/examination of values, attitudes, beliefs • Create content specific lessons • Revise existing lesson plans • Peer observations • Peer feedback on desired teacher goal
Leadership	• Time, Resources, Structures for Adult Learning • Implementation of Professional Learning with Fidelity • Expectations for Technology Integration	• Weekly Collaborative Planning sessions with specific dates for technology focused professional learning • Leadership participation in all professional learning sessions • Development of Shared Vision of Technology
Data	• Teacher Pre-test of attitudes, values, and beliefs • Class and Grade Level District Pre-test results	• Class and Grade Level Pre-test analysis for strand of focus and personal goal setting
Resources	• Develop an awareness and understanding of student centered technology integration and how the district learning management platform	• Resources on student-centered technology- based instruction including sample lessons, TPACK structure, FTIM, district learning management platform information, and digital learning guide for instructional teaching strategies. • Identification of and access to teacher technology

	can be used to achieve this. • Begin to develop an understanding of how lessons plan can and should incorporate technology, pedagogy, and content. • Support materials on content specific lessons integrating tech for evaluation	innovators and coach
Learning Designs	• Job embedded • Active Engagement • Modeling • Reflection • Feedback	• Reflection on Current Practice in Technology Integration • Individual Coaching using SRI Coaching Protocols (Appendices) • Reflection toward Goal • Observations of Tech Lessons using SRI Coaching Protocols (Appendices) • Individual reflection on lesson, beliefs, attitudes, values, & student outcomes • Collaborative Planning • Reflection Logs • Revise existing lesson plans • Collaborative planning • Peer feedback on lesson plans • Individual coaching feedback on lesson plans • Reflection of Tech Lessons
Implementation	• Consider Change Research • Sustained Professional Learning	• Monitor Levels of Technology Integration • Differentiated Support with Learning Designs as needed • Continue Professional Learning Opportunity and Coaching Beyond This Study

Outcomes	• Focused on Educator Performance and Student Performance	• Classroom Observations toward Technology Integration and Transformative Teaching • Individual Goal Setting • Student outcome driven lesson plan development • District Assessment Student Results

Implementation of Intervention (Iteration 1)

Iteration 1 spanned eight weeks from August – October 2015 with four face to face meetings for professional learning. The design considerations for Iteration 1 include the following components from Orrill's (2001) framework: Goal setting, reflection, and support materials. In addition, the literature notes the importance of a shared vision of technology integration which is included as a component of the design (Baylor & Ritchie, 2002; Hew & Brush, 2007; Hsu & Sharma, 2010).

The following guiding questions provided informed exploration and enactment principles of the design process. They drove the data collection for the first iteration.

Table 3.3

Iteration 1 Guiding Questions and Data Collection Methods

Theme	Guiding Questions	Data Collection Method
Sample Characteristics	1. What are the characteristics of the sample of teachers including values, attitudes, & beliefs? 2. What are the current student performance levels of the sample classes?	• Pre-assessment of teachers' attitudes, values, and beliefs • Student pre-test on District Assessment (DA) (Grades 1-3)
Technology Integration Levels	3. What are the identified gaps in technology integration? 4. What are the current levels and methods of technology integration?	• Pre-assessment of teachers' attitudes, values, and beliefs • Classroom Observations using the FTIM (Florida Center for Instructional Technology, 2011) • Lesson Plan Analysis
Student Factors	5. How often are students engaged in	• Classroom Observations using the FTIM (Florida

	authentic learning using technology? 6. How often are students using technology to construct knowledge?	Center for Instructional Technology, 2011)
Professional Learning	7. What are the specific learning targets for teachers for this professional learning? 8. What professional development components will address the gaps noted in iteration 1? 9. What professional development components should be included as evidenced in the literature?	• Pre-assessment of teachers' attitudes, values, and beliefs • Classroom Observations using the FTIM (Florida Center for Instructional Technology, 2011) • Lesson Plan Analysis

Data analysis for Iteration 1 included analysis of the pre-assessment of teachers' attitudes, values, and beliefs to determine entry level indices of teacher beliefs and attitudes about technology in the study. The student pre-test data was analyzed to determine strands of content standards that were weak in order to provide a starting point for lesson development as part of the professional learning design using the TPACK framework. Classroom Observations were analyzed using the FTIM to determine the current levels of technology integration. (Florida Center for Instructional Technology, 2011). Lesson plans were analyzed using the FTIM to determine the level of technology integration being planned in classrooms during the first iteration (Florida Center for Instructional Technology, 2011). Finally, reflection logs were examined and coded for the emergence of themes (Creswell, 2013). This coding method began with open coding in search of major themes of information. Then for each theme that emerged additional coding took place focusing on one theme at a time looking for specific categories in the data around each individual theme.

Implementation of Intervention (Iteration 2)

Iteration 2 was originally designed to span seven weeks from October – December 2015 with four face to face meetings for professional learning. The design considerations for Iteration 2 included the following components from Orrill's (2001) framework: Collaboration, reflection, and support materials. In addition, the literature discussed the importance of helping teachers understand the relationships between technology, pedagogy, and content knowledge (TPACK) as they plan for instruction that integrates technology around content standards (Baran, Chuang, & Thompson, 2011; Chai, Koh, & Tsai, 2013). Components from Learning Forward's Standards of Professional Learning (2011) included in the design of Iteration 2 include Learning Communities, Leadership, Resources, Data, Learning Designs, Implementation, and Outcomes.

The following guiding questions provided informed exploration and enactment principles of the design process. They drove the data collection for the second iteration.

Table 3.4

Iteration 2 Guiding Questions and Data Collection Methods

Theme	Guiding Questions	Data Collection Method
Sample Characteristics	1. What do student outcomes reflect in the sample classes? 2. What changes are noted in teacher	• Student Quarter 1 District Assessment (DA) (Grades 1-5) • Post-assessment of teachers' attitudes,

	attitudes, values, and beliefs?	values, and beliefs
Technology Integration Levels	3. What are the current levels and methods of technology integration? 4. How are teachers planning, evaluating, and implementing technology integration levels? 5. What is the progress toward the shared vision of technology integration and transformative practice?	• Classroom Observations using the FTIM (Florida Center for Instructional Technology, 2011) • Lesson Plan Analysis • Reflection Log Analysis
Student Factors	6. How often are students engaged in authentic learning using technology? 7. How often are students using technology to construct knowledge?	• Classroom Observations using the FTIM (Florida Center for Instructional Technology, 2011)
Professional Learning	8. What components of professional learning are impacting teacher practice? 9. How effective is this professional learning at meeting the desired learning targets and goals? 10. How will this professional learning impact theory?	• Classroom Observations using the FTIM (Florida Center for Instructional Technology, 2011) • Lesson Plan Analysis • Interviews

Data collection methods were determined by the guiding questions and included the following in Iteration 2: Student 9 week District Assessment (DA results), Classroom Observations using the FTIM (Florida Center for Instructional Technology, 2011), Lesson Plan Analysis, Interviews, Reflection Logs, Post-assessment of teachers' values, attitudes, and beliefs

Data analysis for Iteration 2 included a paired samples *t*-test of the pre and post-assessment of teachers' attitudes, values, and beliefs to determine the level of change in teacher beliefs and attitudes about technology in the study. This was conducted to compare the pre and post means of the teachers' responses on the Computer Technology Integration Survey (Wang, Ertmer, & Newby, 2004). The student pre-test data on the District Assessment (DA) and Quarter 1 DA results of the sample classes were analyzed in comparison to the grade level mean on these assessments to determine a variance in achievement levels, if any, among sample classes and the grade level.

Classroom observations were analyzed using the FTIM to determine the amount of change in technology integration from iteration 1 to iteration 2. Lesson plans were analyzed using the FTIM to determine the level of technology integration being planned in classrooms and the level of change from iteration 1 to iteration 2 (Florida Center for Instructional Technology, 2011).

Reflection logs were be examined and coded for the emergence of themes as related to the guiding questions for Iteration 2 following the same process used in Iteration 1. Next, selective coding was completed and a conditional matrix created in order to visually make connections about the influences on the professional learning results thus far in the design cycle (Creswell, 2013). Finally, interviews were conducted to determine teachers' perceptions of the professional learning and the components of the learning they found most/least impactful to their practice. Interviews used an interview protocol and were recorded and transcribed. The interview protocol is located in the

Appendix G. The interview transcripts were analyzed for the emergence of themes and a conditional matrix was created in order to visually make connections about the influences on the professional learning results.

Development of Professional Development Framework

The findings of this study with regard to the professional development strategies that impact technology integration will help to revise existing professional development frameworks and contribute to the literature on this topic. A framework for designing and implementing professional learning for technology integration will be developed as a result of this study based on data collection and analysis from the two iterations. From a practical perspective, this study is relevant in that the results can be applied to other settings in which schools are working to provide professional learning for technology integration. In addition, this study is relevant for practitioners as many schools and districts are actively seeking ways to effectively train teachers in how to integrate technology to result in transformational learning.

CHAPTER FOUR: DATA COLLECTION

This chapter provides an overview of the data collected in the study to answer the research question: What components of a professional learning framework are most effective in moving teachers toward transformative practice which emphasizes active learning, critical thinking, creativity, and communication? The research sub questions are: 1) What components of professional learning result in teachers engaging students in using technology to construct knowledge and apply it to authentic situations? 2) What components of professional learning result in changing teachers' beliefs, attitudes, and behaviors toward technology integration in the classroom? and, 3) What components of professional learning help teachers effectively plan, implement, and evaluate technology lessons that take into account the curricular needs as well as the student needs? The data collection presented in this chapter is organized by design iteration, category and questions for each category that informed the study. A description of the instrument used for data collection along with a summary of the data and the date collected for each method is provided for each guiding question and iteration.

Iteration 1

Iteration 1 spanned from August 4-October 2, 2015 and included four face-to-face meetings for professional learning toward technology integration. The professional learning components for iteration 1 were comprised of multiple components including the creation of a shared vision for technology integration, individual goal setting, reflection on current practice, use of technology support materials, grade level collaboration using the Technological Pedagogical Content Knowledge (TPACK) framework, individual coaching, and differentiated small group learning sessions.

The shared vision for technology integration was created by teachers using a text protocol which helped them to categorize their thinking about the most important elements of technology integration and what it should look like. Additional protocols were used to further combine and categorize the ideas, and a draft of the shared vision was created. The teacher leadership team finalized the draft of the shared vision for the school.

Teachers set individual goals at the beginning of the professional learning for themselves in the area of technology integration around the shared vision and in the use and application of the district learning management platform. The teacher, the technology coach, and the researcher kept copies of each teacher's individual goals.

Support materials were provided on a variety of topics that aligned with the teachers' goals. The technology coach, teacher leaders, and the researcher all provided support materials frequently throughout the study.

Grade levels used the TPACK framework to collaborate and plan lessons that integrate technology. These grade level sessions were led by the content area instructional coach for the content and pedagogy discussions. Then the technology coach would begin the discussion around technology by sharing models and examples of technology tools that could be integrated into the instruction based on the instructional strategies that were selected. A template was used for grade level planning with TPACK. The template is one that was already in place for teacher planning within the school for teachers to deconstruct standards, create assessments, and discuss instructional strategies.

The researcher added the technology component to the template and the technology coach to the grade level discussions as part of the TPACK process. Some of the grade level planning sessions utilized this process while other grade level planning sessions during the professional learning had teachers revising current lesson plans to integrate technology. The power of this process was in the conversation and modeling by the instructional coach. An example of grade level planning using TPACK on the template can be found in Appendix I. There is also an example of a grade level lesson plan that was revised by teachers to integrate technology. However, the rich discussions and understanding among teachers of how the content, pedagogy, and technology intertwine are not effectively captured on a template or in a written lesson plan.

Individual coaching was provided by the technology coach. The coach was available for teacher request, administrator request, grade level request, or as she saw needs arise. Her duties and responsibilities allow her to be a full-time technology coach in the school. She would provide support in a variety of ways to individuals and teams. She analyzed goals and data alongside the researcher to ensure she was providing teachers effective support that would move them to higher levels on the FTIM. This support included modeling, planning using TPACK, revising lessons, observing, planning and leading professional learning, and providing support materials on topics that meet teachers' needs and goals.

Differentiated, small group learning sessions were planned by the technology coach, teacher leaders, and the researcher. These groups were created based on the teachers' goals and reflections. The goals and reflections were categorized to create small learning groups and teachers were assigned to attend a learning group based on their articulated needs/goals. Teacher leaders along with the technology coach led these small group sessions providing teachers with support in the areas they most desired. Table 4.1 lists the professional learning components by date during Iteration 1.

Table 4.1

Professional Learning Components Iteration 1

Professional Learning Component	Intro	Mtg 1	Mtg 2	Mtg 3	Mtg 4
	8/4/15	8/18/15	9/3/15	9/10/15	9/29/15
Creation of Shared Vision for Technology Integration	X				
Individual Technology Coaching			X	X	X
Technology Integration Support Materials Provided		X	X	X	X
Grade Level Collaborative Planning with Instructional and Technology Coaches Using TPACK			X	X	
Goal Setting		X			
Reflection Entry		X			X
Differentiated Small Group Sessions Led by Teacher Leaders and Technology Coach Based on Goals					X
Technology Integration Support Materials Provided and Time to Work with the Materials with Colleagues	X				X

Sample Characteristics.

What Are The Characteristics Of The Sample Of Teachers Including Values, Attitudes, And Beliefs?

The professional learning opportunity for this study spanned one semester totaling 15 weeks. The study originally planned for 65 teachers to participate in the professional learning opportunity. However, 51 teachers actually participated in the professional learning experience. This is a difference of 14 teachers from the original plan of study. The discrepancy is due in part to a personnel reduction that took place in the school in week four of the study. Due to student enrollment being lower than projected, the school lost four staff members. Ten certified staff members are not functioning in positions that lend themselves to technology integration and did not participate in the study. The non-participating staff included two assistant principals, two counselors, one speech language pathologist, two content area specialists, one reading recovery teacher, the media specialist and technology coach.

While 51 staff members participated in the professional learning opportunity created for the study (‘PLO participants’), ten volunteered to participate in the in-depth data collection activities hereafter referred to as ‘study participants.’ The study participants included two first grade teachers, two second grade teachers, two third grade teachers, one fourth grade teacher, one special education teacher, and two fifth grade teachers. The average years of teaching experience in the school for all certified teachers is eleven. Teaching experience of the study participants ranged from three years to ten years of experience.

Technology integration factors were measured using a pre-assessment of teachers' values, attitudes, and beliefs toward technology. The Computer Integration Technology Survey by Wang, Ertmer, and Newby (2004) was given to the PLO participants at the beginning of the semester (August 18, 2015) for Iteration 1. It is a five point Likert survey with twenty-one questions that measures teachers' self-efficacy, beliefs, and attitudes for technology integration. It also includes information about teachers' confidence levels for teaching with technology. The mean on the pre-assessment of the survey for the sample of 48 teachers was 4.04. A score closer to one on the five point scale indicates very low confidence levels of using and teaching with technology while a score closer to five indicates high confidence levels. The overall mean score of 4.04 indicates that teachers in this school are confident using and teaching with technology. Table 4.2 provides a description of the sample characteristics including years of teaching experience and individual results on the Computer Technology Integration Survey.

Table 4.2

Characteristics of Study Participants

Participant	Grade Level	Years of Teaching Experience	Computer Technology Integration Survey Mean (Pre-Assessment)
1	Special Education	3	4.00
2	4th	9	4.04
3	3rd	6	3.76
4	2nd	10	4.62
5	2nd	7	4.04
6	5th	10	4.57

7	5th	9	3.90
8	1st	10	4.28
9	1st	7	4.00
10	3rd	10	4.14

Pre-assessment Survey

While the study participants' data were used for the focused analysis, pre- and post-survey scores on The Computer Technology Integration Survey were used from all PLO participants with consent in the professional learning. Forty-eight teachers had matched pre and post samples on the survey out of the 51 teachers participating in the study. The three teachers who do not have matched samples went out on maternity or extended leave and were not able to complete the professional learning experience. The mean on the pre-assessment of the survey for the sample of 48 teachers was 4.04 on the five point scale indicating that teachers in this school are confident using and teaching with technology.

What Are The Current Student Performance Levels Of The Sample Classes?

Student Pre-test On District Assessment

All students in grades 1-3 were administered a math pre-test on state and district standards in August 2015. This is a required assessment for grades 1-3, and the goal of the assessment is to provide teachers with formative information on grade level content standards to guide their instruction. Grade 5 teachers opted to take the assessment this year as well in order to guide their instruction even though it was not required. The grade 4 teacher in the sample and the Special Education teacher in the sample who supports grade 4 do not have pre-test data on student achievement levels. The data gathered for purposes of this study included the class average in the math content area on the district pre-test assessment. The assessment score reports the percent correct out of 100. An overall class average for the study participants is reported as well as an average for the study participants' grade level. The pre-test was administered on August 10, 2015. Table 4.3 provides current student performance levels of the sample classes.

Table 4.3

Participant District Pre-Test and Grade Level District Pre-Test Scores

Participant	Class Pre-Test Mean (out of 100)	Grade Level Pre-Test Mean (out of 100)
1	N/A	N/A
2	N/A	N/A
3	46	43
4	56	62
5	53	62
6	49	42
7	49	42
8	53	53
9	60	53
10	48	43

Technology Integration Levels.

What are the current levels and methods of technology integration?

Classroom Observations

Classroom observations were conducted every other week by the researcher and two Assistant Principals beginning the week of August 24, 2015. Observations lasted for ten minutes which is the expectation for observing teachers in our school district. Administrators have a weekly grade level schedule of classroom observations to visit.

Observations were documented using the Florida Technology Integration Matrix (FTIM) (Florida Center for Instructional Technology, 2011). Observers noted what level of technology was being used on the rubric for both teacher indicators and student indicators. The observations for this study were included as part of the administrators' weekly walkthroughs. The researcher conducted a training using the FTIM to ensure we were all using the matrix in the same manner to observe both teachers and students. This training included watching two videos of teachers integrating technology together as a team and scoring the videos using the FTIM. One face to face observation of a teacher was also conducted together as a team using the FTIM in order to better focus on both teacher and student descriptors. Scores of both the videos and the face to face observations were discussed by all administrators to collaborate and come to consensus on using the FTIM rubric in an effort to ensure reliability in scoring. A weekly agenda item at administrative meetings is to discuss and reflect on the prior week's observations. Only one administrator observed a class at a time. However, as part of weekly meetings administrators discussed and reflected on the scoring of the teacher and student descriptors for the recent observations as a way to collaborate on the scoring.

The Entry level of the FTIM is characterized by the teacher being the only one using the technology. In this level the teacher uses technology for low level learning activities such as for drill and practice or to show a Power Point presentation. Teachers at the Adoption level of the FTIM control the type of technology being used in the classroom and provide students step by step instructions for how to use technology tools. In the Adaptation level the teacher still chooses the technology, but students are permitted to collaborate and begin exploring the technology tools beyond the teacher's specific instructions. At the Infusion level the teacher guides the student in the use of technology choices and lessons allow students to be self-directed. In addition, the Infusion level is characterized by student collaboration using technology, and students are able to choose the technology that will help them best accomplish the task. Technology is readily integrated into the instruction at the Infusion level. The highest level and the goal for technology integration is Transformation. At the Transformation level students choose technology tools that will help them accomplish the learning goal which is characterized by higher level thinking and the construction of knowledge. Students collaborate with peers as well as others outside the classroom and school as part of the learning process. Innovation is encouraged by the teacher and student ownership of learning is evident at the Transformation level. In addition, students engage in activities and learning that may not have been possible without the technology at the highest level on the FTIM.

Table 4.4 indicates the primary level of technology integration as measured by FTIM of Teacher Descriptors and Student Descriptors for each observation. A hyphen indicates no technology use was observed during walkthroughs and observations.

Table 4.4

Iteration 1 Classroom Observation Results by Week

Participant	8/24/15 Teacher	8/24/15 Student	9/7/15 Teacher	9/7/15 Student	9/21/15 Teacher	9/21/15 Student	10/5/15 Teacher	10/5/15 Student
1	-	-	-	-	-	-	-	-
2	Entry	Entry	-	-	-	-	Entry	Entry
3	Entry	Entry	-	-	Entry	Entry	Infusion	Adapt
4	-	-	Entry	Entry	Adopt	Adopt	-	-
5	-	-	-	-	-	-	-	-
6	-	-	-	-	Infusion Infusion	Infusion Adapt	-	-
7	-	-	-	-	-	-	-	-
8	-	-	-	-	Adopt	Adopt	-	-
9	Infusion	Infusion	-	-	-	-	Adopt	Adopt
10	-	-	-	-	Entry	Entry	-	-

Lesson Plan Analysis

Lesson plans were analyzed at the beginning of the study using lesson plans from the participants from the week of August 24-28, 2015. Lesson plans were analyzed using the FTIM. The current levels and methods of technology integration were noted by coding any technology activity noted in the lesson plans. Then the activity was scored using the FTIM for a level using the teacher and student descriptors and an overall FTIM score for the teacher's lesson plans was assigned. Table 4.5 indicates the results of Iteration 1 Lesson Plan Analysis.

Table 4.5

Iteration 1 Lesson Plan Analysis Results

Participant	Lesson Plan Analysis 8/24-28/15 Teacher	Lesson Plan Analysis 8/24-28/2015 Student	Lesson Plan Analysis 9/21-10/2/15 Teacher	Lesson Plan Analysis 9/21-10/2/2015 Student
1	Entry	Entry	Adoption	Adoption
2	Entry	Entry	Entry	Entry
3	Entry	Entry	Adoption	Adoption
4	Entry	Entry	Infusion	Infusion
5	Adoption	Adoption	Adoption	Adoption
6	Entry	Entry	Infusion	Infusion
7	Entry	Entry	Entry	Entry
8	Adoption	Adoption	Entry	Entry
9	Adoption	Adoption	Entry	Entry
10	Entry	Entry	Entry	Entry

What Are The Identified Gaps In Technology Integration?

Pre-Assessment Survey

The mean score of the 48 PLO participants on the pre-assessment Computer Technology Integration Survey was 4.04 on a five point scale indicating that teachers overall in this school are confident using and teaching with technology. A gap exists between teachers’ perceptions of their technology integration levels and actual use of technology as evidenced by classroom observations in Table 4.4 and lesson plans in Table 4.5.

Classroom Observations

Classroom observations noted in Table 4.4 indicate that no technology was used at all in 68% (56/82) of the observations of the participants in the first Iteration. Descriptors scoring at the Adaptation, Infusion, or Transformation levels on the continuum were considered as students using technology for authentic purposes. Scores at the Infusion or Transformation levels indicate students using technology to construct knowledge as evidenced by the descriptors on the continuum. Seven percent (6/82) of the observations indicated levels of technology at the highest two levels of the FTIM. Figure 4.1 reflects the percentage of classroom observations at each level of FTIM for Iteration 1.

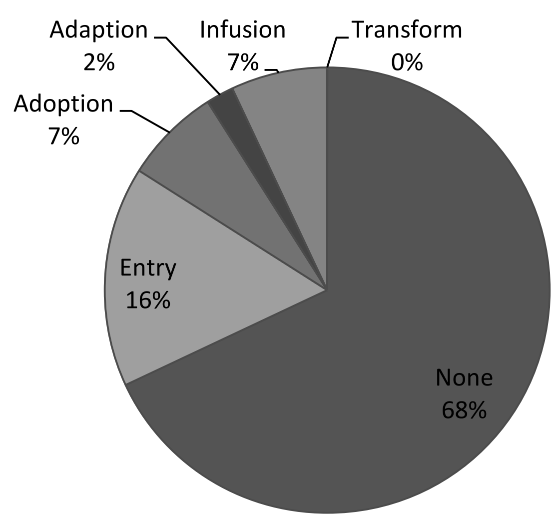

Figure 4.1 Percentage of Classroom Observations at each Level of FTIM for Iteration 1.

Lesson Plan Analysis

Lesson plan data noted in Table 4.5 indicate that 60% (12/20) of the lesson plans scored at the Entry level on the FTIM. All of the teachers scoring at the Entry level planned lessons that included the showing of video clips or the teacher use of Power Point presentations. In 70% (7/10) of the sample teachers planned lessons in which the teachers were the only ones using and controlling the technology and the release of information in the first lesson plan analysis (Aug. 24-28, 2015) and in 50% (5/10) in the second lesson plan analysis (Sept. 21-Oct. 2, 2015). None of the teachers planned lessons at the higher levels of the FTIM in the first lesson plan analysis. In the second lesson plan analysis 20% (2/10) of the teachers planned lessons at the Infusion level or higher. Figure 4.2 indicates the percentage of lesson plans at each level of FTIM for Iteration 1.

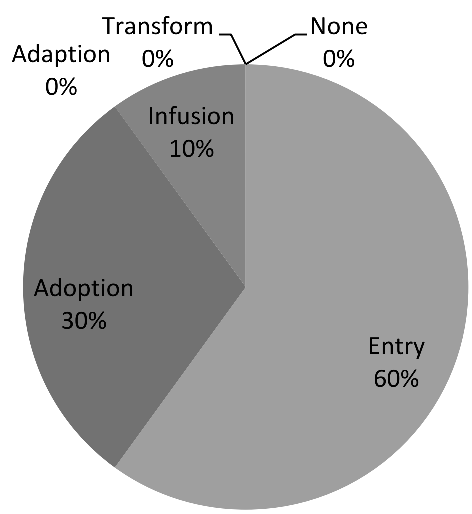

Figure 4.2 Percentage of Lesson Plans at each Level of FTIM for Iteration 1

Student Factors

How Often Are Students Engaged In Authentic Learning Using Technology?

Classroom Observations

On the FTIM the levels of Adaptation, Infusion, and Transformation reflect lessons in a classroom in which students are engaged in authentic learning. Out of forty-one classroom observations focused on Student Descriptors of the FTIM noted in Table

4.4 students were engaged in authentic learning 10% (4/41) of the time as indicated by levels of technology at the Adaptation, Infusion, or Transformation levels of the FTIM.

How Often Are Students Using Technology To Construct Knowledge?

Classroom Observations

Classroom observation data focused on Student Descriptors of the FTIM (Table 4.4) indicate that students were using technology to construct knowledge 5% (2/41) of the time in which students were at the Infusion level or higher as measured by FTIM. In these two observations students were using digital tools to demonstrate their own learning through the creation of a product.

Professional Learning

What Are The Specific Learning Targets For This Professional Learning? What Professional Development Components Will Address The Gaps Noted In Iteration 1? What Professional Development Components Should Be Included As Evidenced By The Literature?

Pre-assessment Survey

Table 4.6 indicates the questions on the Computer Technology Integration Survey administered August 18, 2015 with the lowest mean scores on the five point scale suggesting teachers were less confident in these areas. These questions were used toward the development of learning targets for the professional learning.

Table 4.6

Pre-Assessment Computer Technology Integration Survey Questions with Lowest Mean Scores

Question	Question Mean
20. I feel confident that I can develop creative ways to cope with system constraints (such as budget cuts on technology facilities) and continue to teach with technology.	3.81
14. I feel confident about assigning and grading technology-based projects.	3.65
16. I feel confident about using technology resources (such as spreadsheets, electronic portfolios, etc.) to collect and analyze data from student tests and products to improve instructional practices.	3.54

*Overall Survey Mean: 4.04

Classroom Observations

Classroom observation data (Table 4.4 and Figure 1) indicated that no technology was used at all in 68% (56/82) of the observations of the participants in the first Iteration. Seven percent (6/82) of the observations indicated teaching and learning with technology at the highest two levels (Infusion or Transformation) of the FTIM. In addition, 10% (4/41) of the observations evidenced students engaged in authentic learning experiences using technology or scoring at the Adaptation level or higher on the FTIM when looking at Student Descriptors. Five percent (2/41) of the observations using Student Descriptors evidenced students using technology to construct knowledge in which student use of technology was scored at the Infusion or Transformation levels.

Lesson Plan Analysis

The first lesson plan analysis in Iteration 1 and noted in (Table 4.5) evidenced 70% (7/10) of the teachers planning lessons in which the teachers were the only one using and controlling the technology and in 50% (5/10) in the second lesson plan analysis. None of the teachers planned lessons at the higher levels (Infusion or Transformation) of the FTIM in the first lesson plan analysis and 20% (2/10) in the second lesson plan analysis during Iteration 1. This data has implications for specific learning targets for the professional learning.

Reflection Logs

A shared vision was created for technology integration for the school by the teachers and leaders on August 4, 2015. After reviewing and discussing the shared vision for technology integration, teachers completed a reflection log entry in which they reflected on a goal they would like to achieve this year to improve their practice in integrating technology. Another reflection log entry was completed on September 29, 2015 in which teachers reflected on their current practice using technology and their work thus far toward their goals and the shared vision for technology integration.

Reflection logs were read without interruption twice prior to analysis. Then Reflection logs from the study participants were examined with the researcher noting similarities and differences. Next, they were coded using the guiding question "What are the specific learning targets for this professional learning?" Specific codes were further refined resulting in five sub-categories. From continued analysis of the sub-categories two major categories emerged from the reflection logs of the study participants. The first category was using technology for instruction and the second category was student use of technology. Specific text evidence from the reflection entries to support the first category of using technology for instruction includes one participant indicating that she is working to "become more comfortable with, not only technology in the classroom but in the instructional process." Another participant stated that she wanted to learn how to incorporate "daily use of technology" and is working toward "integrating subject areas and extending the [standards] in multiple subjects." Text evidence to support the second category of student use of technology included one participant saying she was working toward "getting more students involved" while another stated she wanted to use more "discussions and collaboration with students" using technology. The codes, sub-categories, and categories provided information toward learning targets for the professional learning. Figure 4.3 provides a visual display of the coding process.

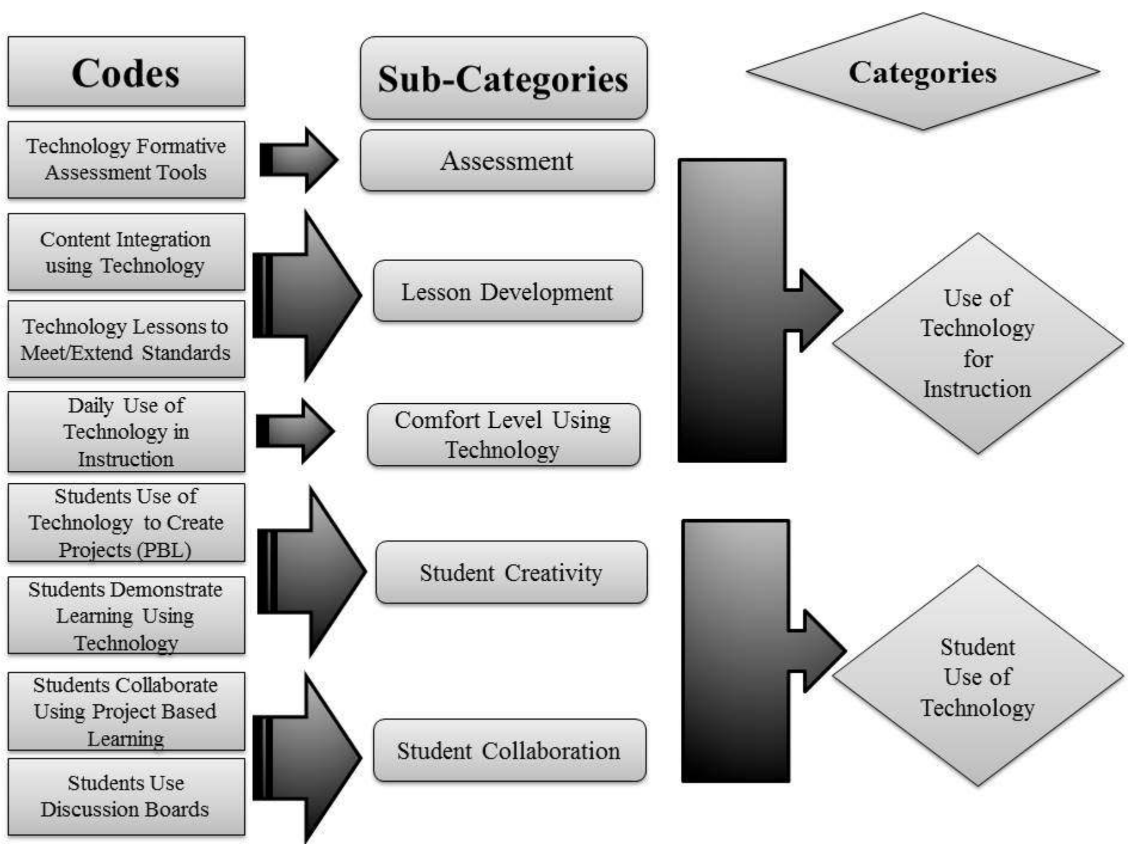

Figure 4.3 Iteration 1 Reflection Logs Codes, Subcategories, and Categories.

Data were collected from Iteration 1 and analyzed in order to create specific learning targets for the professional learning opportunity for Iteration 2. In addition, the data collected from Iteration 1 guided the redesign of the professional learning components to be provided to teachers in Iteration 2.

Iteration 2

Design changes were made to the professional learning for Iteration 2 based on the data from Iteration 1. Design changes increased the number of face to face meetings from four to ten from October 2-November 20, 2015. The additional time included and extended technology professional learning day on a teacher workday and multiple grade level planning sessions using the TPACK framework to plan and revise lessons that integrate technology. Additional professional learning components provided during Iteration 2 included modeling, observations, peer observations, coaching, accountability and reflection around personal goals, and technology support materials.

The modeling and observation components during Iteration 2 provided teachers the opportunity to watch other teachers engage in lessons using technology at the higher levels of FTIM. This was conducted using videos of teachers using technology to engage students in authentic learning and in the construction of knowledge. Teachers watched the videos in grade level teams led by either the technology coach or a teacher leader. Then they engaged in a grade level discussion about the videos and how the technology tools and strategies might be applied in their classrooms.

Teachers were provided the opportunity for peer observations of each other for technology lessons during Iteration 2. The peer observations were conducted using the protocol found in Appendix H. Hosts for the peer observations were selected by the technology coach and researcher. Teachers and hosts engaged in both planning and reflective discussions before and after observations in order to deepen their thinking and understanding.

In addition to design changes, specific learning targets were created from Iteration 1 data for the professional learning. Figure 4.4 visually displays the data sources used, the specific design changes, and the learning targets for the professional learning in Iteration 2.

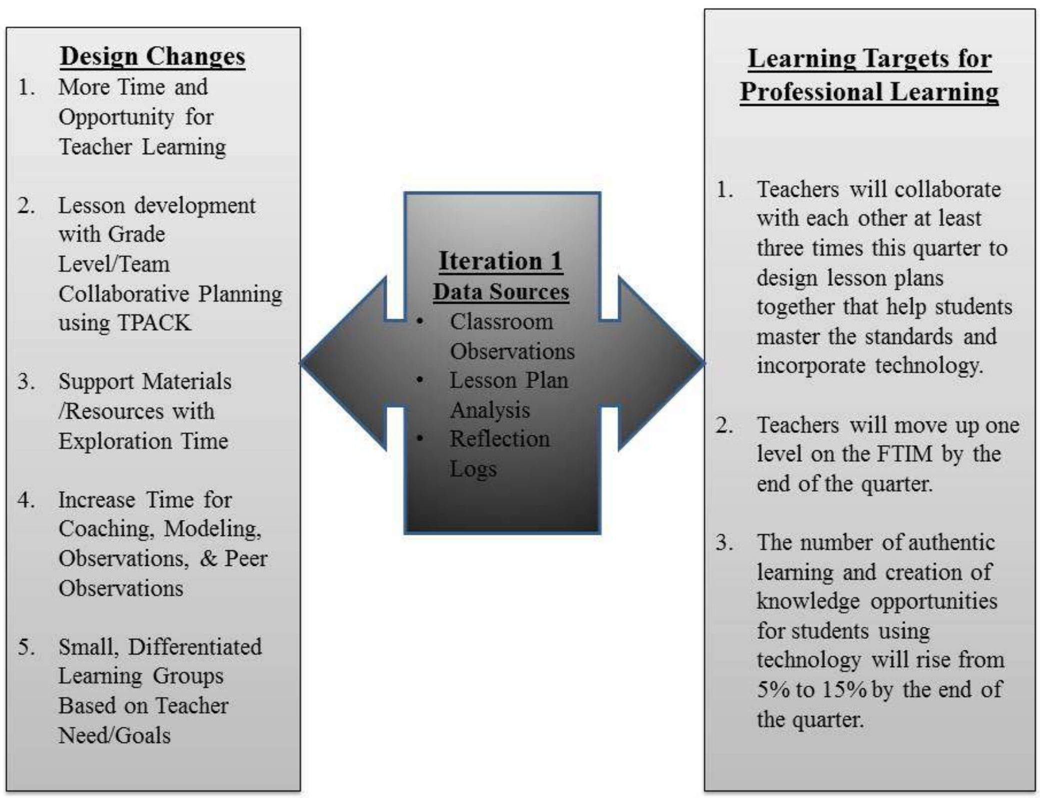

Figure 4.4 Professional Learning Design Changes and Learning Targets Iteration 2

Table 4.7 shows the professional learning components for Iteration 2. Following Table 4.7 is a description of the data collected during Iteration 2 for each category and guiding question.

Table 4.7

Professional Learning Components Iteration 2

Professional Learning Component	Mtg 1	Mtg 2	Mtg 3	Mtg 4	Mtg 5	Mtg 6	Mtg 7	Mtg 8	Mtg 9	Mtg 10
	10/8/15	10/12/15	10/15/15	10/22/15	10/27/15	10/29/15	11/5/15	11/12/15	11/16/15	11/18/15
Individual Technology Coaching	X	X	X	X		X	X	X		X
Technology Integration Support Materials Provided	X	X	X	X	X	X	X	X		X
Grade Level Collaborative Planning with Instructional and Technology Coaches Using TPACK	X	X	X	X		X	X	X		X
Technology Professional Learning Day		X								
Technology Lesson Observations		X					X			
Reflection Entry		X				X				
Peer Observations Scheduled		X			X					
Peer Observations and Debrief							X	X	X	X
Differentiated Small Group Sessions Led by Teacher Leaders and Technology Coach Based on Goals									X	
Technology Integration Support Materials Provided and Time to Work with the Materials with Colleagues		X			X				X	

Sample Characteristics

What Do Student Outcomes Reflect in the Study Participants' Classes?

Student Quarter 1 District Assessment

Students in grades 1-5 were administered a district required quarterly assessment in mathematics on September 28, 2015. This district assessment is designed to measure student mastery on all objectives for the quarter. Table 4.8 reflects the participants' mean scores on the district assessment and the grade level mean scores on this assessment.

Table 4.8

Participant Quarter 1 District Assessment and Grade Level Quarter 1 District Assessment Scores

Participant	Class Quarter 1 Mean (out of 100)	Grade Level Quarter 1 Mean (out of 100)
1	78	84
2	76	84
3	88	77
4	83	84
5	78	84
6	78	66
7	78	66
8	69	64
9	74	64
10	87	77

What Changes Are Noted in Teacher Attitudes, Values, and Beliefs?

The post-assessment Computer Integration Technology Survey was administered on November 17, 2015, which was toward the end of the professional learning opportunity. The mean on the pre-assessment survey for the 48 PLO participants with matched samples was 4.04 and the mean on the post-assessment survey for these 48 PLO participants was 4.03. The difference in the pre and post-assessment survey means was .01 after 15 weeks of professional learning. A paired samples *t*-test was conducted to compare the means of the matched data. The difference (.01) between the pre-assessment survey mean (M=4.04, SE=.06) and the post-assessment survey mean (M=4.03, SE=.09) was not significant t(47)=.260, p=.796.

Table 4.9 reflects the questions from the post-assessment Computer Technology Integration Survey with the lowest mean scores on the five point scale. Two of the three questions (questions 14 and 16) were also the questions with the lowest mean on the pre-assessment survey. Question 4 replaced Question 20 ("I feel confident that I can develop creative ways to cope with system constraints [such as budget cuts on technology facilities] and continue to teach with technology.") as having the lowest mean on the post-assessment survey indicating teachers are less confident in these areas.

Table 4.9

Post-Assessment Computer Technology Integration Survey Questions with Lowest Mean

Question	Question Mean
4. I feel confident in my ability to evaluate software for teaching and learning.	3.67
14. I feel confident about assigning and grading technology-based projects.	3.67
16. I feel confident about using technology resources (such as spreadsheets, electronic portfolios, etc.) to collect and analyze data from student tests and products to improve instructional practices.	3.67

*Overall Survey Mean 4.03

Table 4.10 provides specific data on the pre/post survey for the study participants.

Table 4.10

Participants' Pre- and Post-Assessment Survey Mean Scores on the Computer Technology Integration Survey

Participant	Grade Level	Years of Teaching Experience	Computer Technology Integration Survey Mean (Pre-Assessment)	Computer Technology Integration Survey Mean (Post-Assessment)
1	Special Education	3	4.00	3.76
2	4th grade	9	4.04	3.86
3	3rd grade	6	3.76	4.14
4	2nd grade	10	4.62	4.62
5	2nd grade	7	4.04	4.19
6	5th grade	10	4.57	4.76
7	5th grade	9	3.90	3.38
8	1st grade	10	4.28	4.00
9	1st grade	7	4.00	4.00
10	3rd grade	10	4.14	4.00

Technology Integration Levels

What Are The Current Levels And Methods Of Technology Integration?

Classroom Observations

Classroom observations were conducted every other week by the researcher and two Assistant Principals for Iteration 2 beginning October 19, 2015. Observations were recorded using the FTIM. Observers noted what level of technology was being used on the rubric for both teacher indicators and student indicators. Table 4.11 indicates the primary level of technology integration as measured by FTIM of Teacher Descriptors and Student Descriptors for each observation. A hyphen indicates no technology use was observed during walkthroughs and observations.

Table 4.11

Iteration 2 Classroom Observation Results by Week

Participant	10/19/15 Teacher	10/19/15 Student	11/2/15 Teacher	11/2/15 Student	11/16/15 Teacher	11/16/15 Student
1	Adapt	Adapt	-	-	Transform	Infusion
2	Adapt	Adapt	-	-	Transform	Infusion
3	Adapt	Adapt	Adapt	Adapt	Infusion	Infusion
4	Adapt Adapt	Adapt Adapt	Infusion	Infusion	Infusion	Infusion
5	Adopt	Adopt	Adopt	Adopt	-	-
6	Transform	Transform	Transform	Transform	Transform	Transform
7	-	-	Entry Entry	Entry Entry	Entry	Entry
8	Infusion	Adapt	Adapt	Adapt	Adapt	Adapt
9	-	-	Transform	Transform	Transform	Transform
10	Adopt	Adopt	Adapt	Adapt	-	-

<u>*Lesson Plan Analysis*</u>

Lesson plans were analyzed for Iteration 2 from the week of November 15-21, 2015. Lesson plans were analyzed using the FTIM. The current levels and methods of technology integration were noted by coding any technology activity noted in the lesson plans. Then the activity was scored using the FTIM for a level using the teacher and student descriptors and an overall FTIM score for the teacher's lesson plans was assigned. Table 4.12 indicates the results of Iteration 2 Lesson Plan Analysis.

Table 4.12

Iteration 2 Lesson Plan Analysis Results

Participant	Lesson Plan Analysis 11/15-11/21/15 Teacher	Lesson Plan Analysis 11/15-11/21/2015 Student
1	Entry	Entry
2	Adoption	Adoption
3	Adoption	Adoption
4	Infusion	Infusion
5	Adaptation	Adaptation
6	Transformation	Transformation
7	Adoption	Adoption
8	Adoption	Adoption
9	Adoption	Adoption
10	Entry	Entry

Reflection Log Analysis

Reflection log entries were completed on October 12, 2015 and October 29, 2015 to reflect on teachers' current practice and any changes in practice as related to technology integration. Reflection logs were read twice prior to analysis. Then Reflection logs from the study participants were examined with the researcher noting similarities and differences. Next, they were coded using the guiding question "What are the current levels and methods of technology integration?" Codes were further examined to determine sub-categories, which included adding more technology lessons into instruction, formative assessments, and student collaboration. Further examination revealed the same two major categories emerge from the reflection logs from the study participants as in Iteration 1. The first category was using technology for instruction and the second category was student use of technology. Text evidence to support the first theme included the following quotes from participants "I am incorporating more activities/lessons that use technology" and "I am focusing on the content and integrating using sample [technology lesson] pages." Other participants stated "I am using formative assessments" and "I love the assessments!" Text evidence to support the second theme included one participant noting that she has been "adding more discussion questions" and another stated she has added "discussion posts for students." Figure 4.5 is a visual representation of the codes, subcategories, and categories that emerged in the analysis of the Reflection Logs.

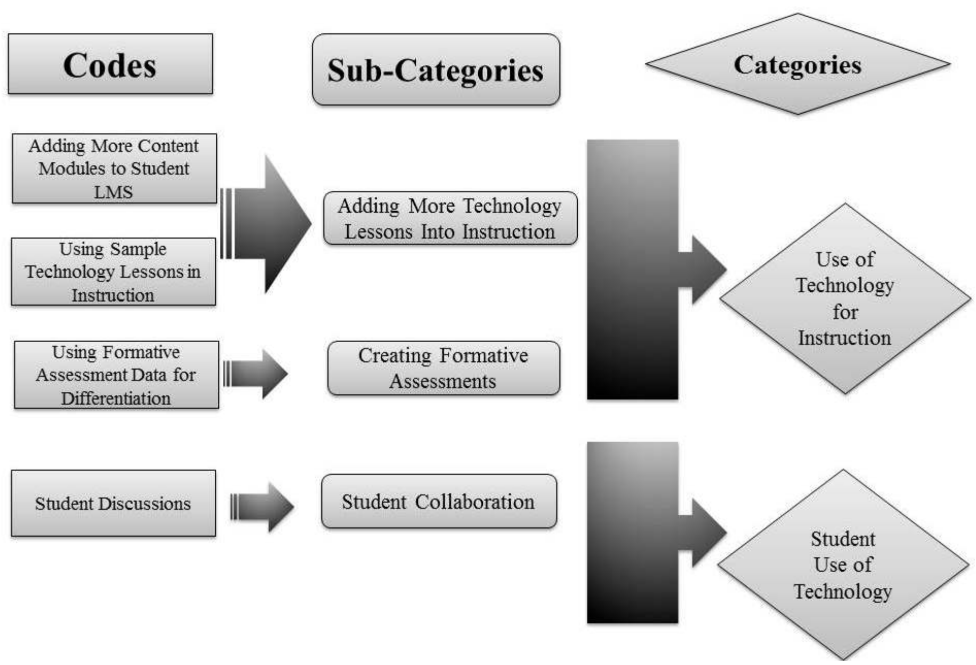

Figure 4.5 Iteration 2 Reflection Logs' Codes, Subcategories and Categories.

<u>How Are The Teachers Planning, Evaluating, And Implementing Technology Integration Levels?</u>

<u>Classroom Observations</u>

Classroom observations as indicated in Table 4.11 reflect that in 63% (40/64) of the observations in Iteration 2 evidenced teachers and students using technology at the highest three levels (Adaptation, Infusion, or Transformation) on the FTIM. Thirty-three percent (21/64) of the classroom observations were at the Infusion or Transformation levels on the continuum while 19% (12/64) of the observations reflected no technology being used in instruction at all in Iteration 2. Figure 4.6 provides a visual representation of the classroom observations at each level of the FTIM for Iteration 2.

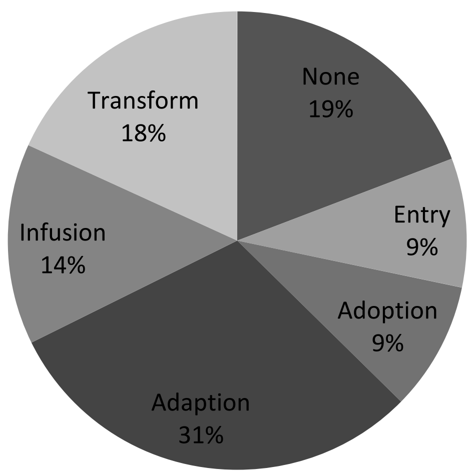

Figure 4.6 Percentage of Observations at each Level of FTIM for Iteration 2

<u>Lesson Plan Analysis</u>

Lesson plans noted in Table 4.12 and analyzed for the week of November 15-21, 2015 indicated that in 80% (8/10) of the lessons planned were at a level higher than Entry as measured by the FTIM. Thirty percent (3/10) of the lessons planned were at the higher three levels (Adaptation, Infusion, or Transformation) of the FTIM. Sixty percent (6/10) of the teachers moved up at least one level on the continuum over Iteration 1's lesson plan analysis. Figure 4.7 provides a visual representation of the lesson plans at each level of the FTIM for Iteration 2.

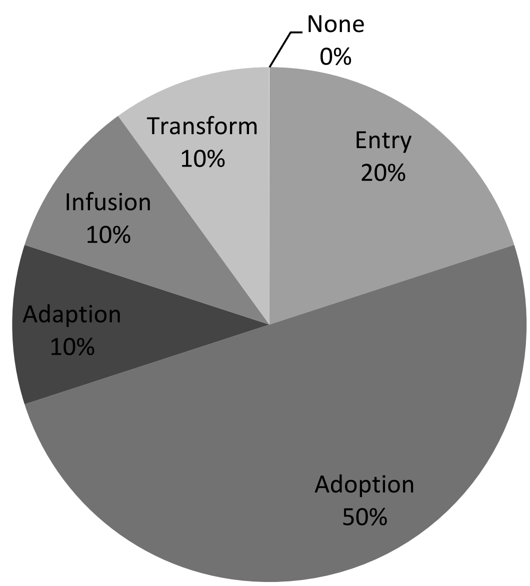

Figure 4.7 Percentage of Lesson Plans at each Level of FTIM for Iteration 2

<u>What Is The Progress Toward The Shared Vision Of Technology Integration And Transformative Practice?</u>

The shared vision for technology integration was created by teachers and leaders on August 4, 2015. The vision is organized around student engagement in the use of digital tools around communication, collaboration, critical thinking, and creativity.

<u>Classroom Observations</u>

Thirty-three percent (21/64) of the classroom observations (Table 4.11 and Figure 4.6) conducted in Iteration 2 evidenced students engaged at the highest two levels (Infusion or Transformation) of the FTIM which aligns with the school's shared vision for technology integration of engaging students in communication, collaboration, critical thinking, and creativity.

Lesson Plan Analysis

Lesson plans (Table 4.12 and Figure 4.7) examined for the week of November 15-21, 2015 indicate that 20% (2/10) of the lessons engaged students at the highest two levels (Infusion and Transformation) on the FTIM.

Reflection Log Analysis

The Student Use of Technology category emerged in the Reflection logs (Figure 4.5) completed on October 12, 2015 and October 29, 2015. Within this theme the use of student collaboration through online discussion boards emerged in the data as evidence of teachers' current practice which aligns with the shared vision for technology integration.

Student Factors

How Often Are Students Engaged In Authentic Learning Using Technology?

In Table 4.11 and Figure 4.6 the classroom observations reflect that in 63% (40/64) of the observations teachers and students were engaged at the highest three levels (Adaptation, Infusion, or Transformation) on the FTIM.

How Often Are Students Using Technology To Construct Knowledge?

Classroom Observations

Thirty-three percent (21/64) of the classroom observations (Table 4.11 and Figure 4.6) conducted in Iteration 2 evidenced students engaged at the highest two levels (Infusion or Transformation) of the FTIM.

Professional Learning

What Components Of Professional Learning Are Impacting Teacher Practice?

Reflection logs

Reflection logs completed on October 12, 2015 and October 29, 2015 were analyzed using the guiding question "What components of professional learning are impacting teacher practice?" The overarching theme that emerged from the reflection logs with regard to professional learning is time. Within the theme of time three categories were evident in which teachers noted are impacting their practice with regard to technology integration. First is team or collaborative planning time, individual coaching time, and small differentiated group learning time.

The following text evidence was extracted from the reflection logs to support the findings of the overarching theme of time to include collaborative planning time, individual coaching time, and small differentiated group learning time. Seventeen out of twenty reflections or 85% of the reflections stated that time for learning was the component impacting their practice the most. One participant indicated that she still needed the support of additional "team planning time" and another stated she needed "time to create lessons." A third participant stated that she "loves getting ideas from colleagues in the team learning time. A participant noted that "what has helped [her] the most was the differentiated small group time." Figure 4.8 represents the sub-categories, categories, and theme from the reflection logs.

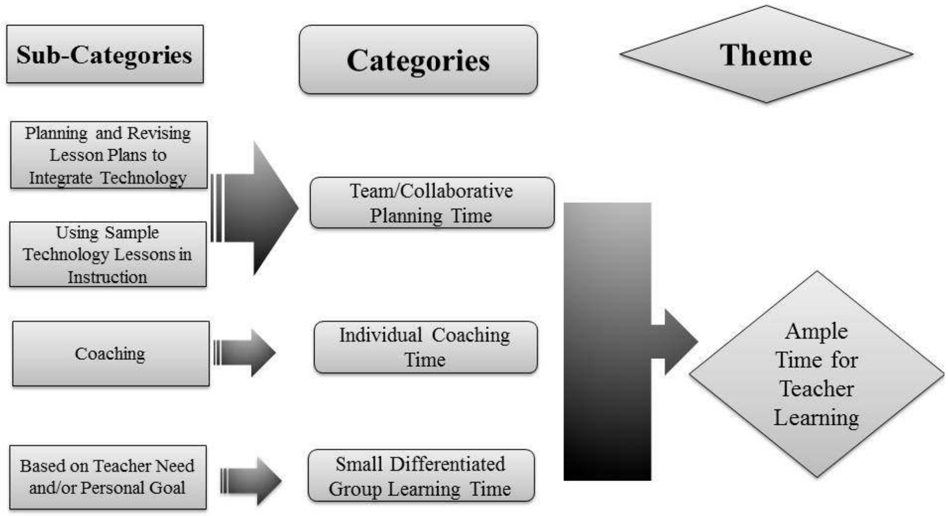

Figure 4.8 Iteration 2 Reflection Logs' Coded Themes, Categories and Subcategories for: What Components of Professional Learning Are Impacting Teacher Practice?

Interviews

Interviews were conducted with study participants the week of November 13, 2015. Interviews lasted approximately 10 minutes per participant as they were asked about the professional learning components from the professional learning for technology integration that most impacted their practice. Interviews were recorded and transcribed then reviewed against the audio file to ensure accurate transcription. Individual transcripts were provided to participant to ensure the transcription and interview information were captured accurately. The researcher read transcripts twice prior to beginning the coding process. Interview transcripts were then read as similarities and differences were noted. Next, the transcripts were analyzed for common themes that emerged and then coded again for categories and subcategories within the themes. The coding resulted in one dominant theme emerging which was time. Within the theme of time three categories emerged which included team/grade level collaboration, peer observation time, and time to explore technology resources.

Text evidence from the interview transcripts was extracted to support the theme of time and the categories of team/grade level collaboration time, peer observation time, and time to explore technology resources. One participant noted that she believed the grade level collaborative sessions impacted her practice toward teaching with technology because "having the time to sit with our grade level and talk about having our instruction drive [technology] and not the other way around so we were able to plan a lesson and then say how we incorporate [technology]." Another participant stated that the "collaborative sessions with my grade level were the most valuable….it was a very efficient use of our time." One participant noted that she believed the peer observation impacted her practice toward teaching with technology because she "was able to observe and then talk with the students…afterwards debrief [with the teacher.]" One teacher noted that she "was able to go and see another teacher do a lesson which inspired me to go and use it in the classroom." With regard to the theme of having time to explore with technology resources, one participant noted that it gave her "ideas" and she was able to "incorporate at least three of the ideas already." Another participant noted that it gave the "opportunity to really play around with some of the components." Figure 4.9 below reflects the theme, categories, and sub categories from the coding of the interviews with the question "What components of the professional learning are impacting teacher practice?"

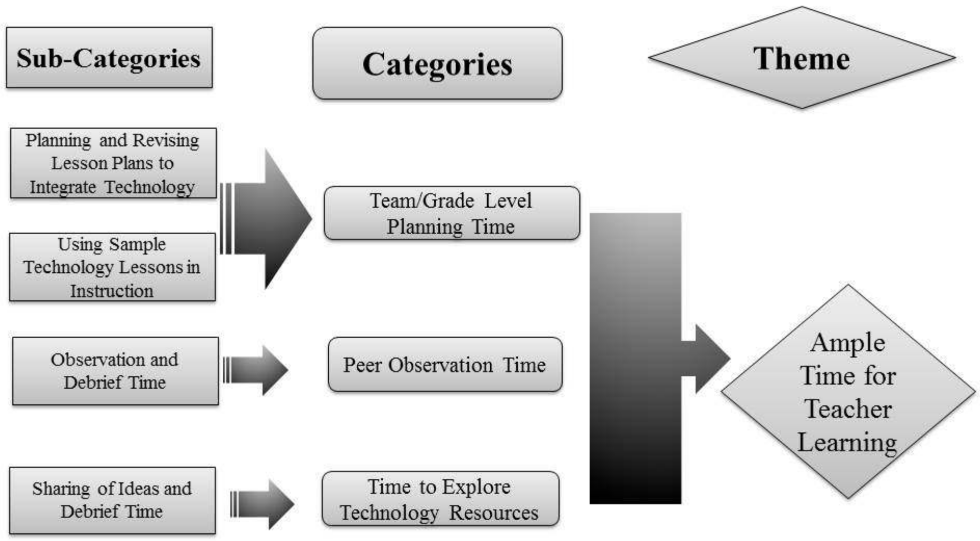

Figure 4.9 Iteration 2 Interviews Coded Theme, Categories, Subcategories for: What Components of Professional Learning Are Impacting Teacher Practice?

<u>How Effective Is This Professional Learning At Meeting The Desired Learning Targets And Goals? How Will This Professional Learning Impact Theory?</u>

Specific learning goals were developed for the professional learning based on the data collection. The following learning targets were measured: 1) Teachers will collaborate with each other to design lesson plans together at least three times this quarter that help students master the standards and incorporate technology; 2) Teachers will move up one level on the FTIM by the end of the quarter; 3) The number of authentic learning and creation of knowledge opportunities for students using technology will rise to 15% by the end of the quarter.

Classroom Observations

Classroom observations noted in Table 4.11 indicate that 100% of the teachers in the study sample have moved up at least one level as measured by the FTIM. Sixty-three percent (40/64) of the classroom observations were at the highest three levels (Adaptation, Infusion, or Transformation) on the FTIM resulting in students participating in authentic learning experiences using technology. Thirty-three percent (21/64) of the observations indicated that students were engaged in the creation of knowledge using technology as evidenced by the Infusion or Transformation levels on the FTIM.

Lesson Plan Analysis

Lesson plans noted in Table 4.12 indicated that 60% (6/10) of the teachers moved up at least one level on the continuum over Iteration 1's lesson plan analysis. In addition, 20% (2/10) of the lesson plans analyzed were at the highest two levels (Infusion or Transformation) on the FTIM in which students are participating in authentic learning experiences and constructing knowledge using technology.

Interviews

The interview data reflected in Figure 4.9 indicate a significant theme impacting teachers' practice was being provided additional time to collaborate with grade level teams and colleagues to design and revise lesson plans and review sample technology lessons.

Data collected from Iteration 2 was compiled to determine the effectiveness of the professional learning opportunity and to redesign the professional learning for the next iteration beyond this study to sustain the learning of teachers. Data collected from Iterations 1 and 2 are considered formative assessments of the effectiveness of the professional learning for teachers so far. Multiple data sources provide a comprehensive understanding of the impact of the professional learning components on teachers' practice toward the integration of technology in teaching and learning.

CHAPTER FIVE: RESEARCH FINDINGS

This chapter reports the data collected during two iterations of a design based research study implementing a professional learning experience for teachers with the goal of improving their technology integration. The chapter begins with a discussion on mitigating bias and addressing rigor in the study. Next, a summary of data sources and results is provided for the four major areas of the study: sample characteristics, technology integration levels, student factors, and professional learning. An analysis of the data with regard to the research sub questions and overall research question, as well as suggested design changes for future iterations of the professional learning opportunity, appear in the next chapter.

Rigor

Specific efforts to mitigate against researcher bias and address rigor were employed throughout the study. First, member checking of the interview data took place with all participants to ensure the accuracy of the data and information. Copies of the interview transcripts were provided to each participant for review to ensure the information was accurately included and transcribed. Second, triangulation of data through qualitative and quantitative data collection and evaluation measures took place to ensure results were cross verified. The multiple methods in this study provide many data sources for thorough analysis. Fifty-one teachers in the school participated in the 15 week professional learning opportunity, and staff volunteered to participate in the in-depth data collection activities throughout the semester. Consent for participation was received and checked with participants frequently throughout the duration of the study.

The researcher is also the principal of the school in which the professional learning opportunity was conducted. Therefore, in an effort to achieve reflexivity the following information will provide background and context for the study and interpretation of results.

The researcher has been an elementary principal in the school district for 13.5 years and in the school in which the study was conducted for 6.5 years. The researcher has a particular interest in engaging students in learning using technology for multiple reasons. First, students need to learn using technology in order to be successful in the future, and they find it highly engaging. Second, the researcher is a doctoral candidate in the field of educational technology and has a particular interest in helping teachers integrate technology into their instruction. Also, the school district in which the researcher and study participants are employed expects teachers to use the district learning management platform as an avenue for engaging students in learning. Finally, the researcher has been working to provide teachers with professional learning in the area of technology integration for several years with limited change in teacher practice. This background information provides insight as to the interpretation of data as the lens from which it was analyzed was from that of a school leader as well as researcher with a desire to impact a school, a district, and the teaching profession overall.

Data Synopsis for Areas of Study

This section provides a summary of the data sources and analysis of the information for the four main areas of the study. Questions were devised that would inform the area of study using specified data sources. A complete list of the questions and corresponding data sources are located in Appendix C. Each area within the study is described along with the data sources used and a discussion of the findings. It should be noted that data reported from Iteration 1 for each area is primarily related to contextual understanding of elements in the study and data from Iteration 2 adds elements of participants' reactions toward the professional learning opportunity.

Sample Characteristics

Sample characteristics provide a context for the teachers' self-efficacy levels in using and teaching with technology at the beginning and end of the study. In addition, the data gathered related to sample characteristics provides an understanding of the study participants as compared to the professional learning opportunity (PLOs) participants. Student achievement data provides a perspective about the student performance levels in the study participants' classroom as compared to the grade level student population. Each question within the sample characteristics area below is answered by the specific data sources used coupled with a description of the findings from these sources.

What Are The Characteristics Of The Sample Of Teachers Including Values, Attitudes, and Beliefs?

The data source used to answer this question was a pre-assessment of teachers' values, attitudes, and beliefs toward technology using the Computer Integration Technology Survey by Wang, Ertmer, and Newby (2004). The pre-survey was administered to all PLO participants at the beginning of the professional learning opportunity. The mean on the pre-assessment of the survey for the sample of 48 teachers was 4.04. A score closer to one on the five point scale indicates very low confidence levels of using and teaching with technology while a score closer to five indicates high confidence levels. The overall mean score of 4.04 indicates that teachers in this school were confident using and teaching with technology prior to the professional learning opportunity.

What Are The Current Student Performance Levels Of The Sample Classes?

The data source used to determine the current student performance levels of the sample classes was student scores on a district required mathematics assessment administered as a pre-test at the beginning of the semester on state and district standards. The data gathered for purposes of this study include the class mean of sample participants and an overall grade level mean. The assessment score is reported as the percent correct out of 100. Table 4.3 provides current student performance levels of the sample classes. Participants one and two do not have student achievement data due to the district not requiring this assessment as a pre-test in their grade level. Two participants' class pre-test means scored below the grade level mean on the pre-test. Six participants' classes scored at or above the grade level mean on this pre-assessment. This data indicates that 6 out of 10 of the sample classes performed above their grade level.

What Do the Student Outcomes Reflect in the Study Participants' Classes?

The data source used to determine student outcomes in the study participants' classes was the district required quarterly assessment in mathematics. This district assessment is designed to measure student mastery on all required objectives for the quarter. The results of the participant class means and grade level means suggests that since student performance in the sample classes is similar to the other classes on the grade level then the instruction which would include the use of technology is also similar among classrooms.

What Changes Are Noted in Teacher Attitudes, Values, and Beliefs?

The data sources used to answer this question were a comparison of a pre- and post-assessment of teachers' values, attitudes, and beliefs toward technology using the Computer Integration Technology Survey. The pre- and post-survey was administered to all PLO participants at the beginning and end of the professional learning opportunity. The mean on the pre-assessment of the survey for the sample of 48 teachers was 4.04 and the mean on the post-assessment survey for the same sample was 4.03 indicating a minute difference of .01. The overall mean score of 4.04 (pre) and 4.03 (post) indicates that teachers in this school were confident using and teaching with technology prior to the professional learning opportunity and there was little change in confidence levels on this instrument at the end of the study. A paired samples *t*-test was conducted on the 48 matched sample teacher participants taking the pre- and post-survey. On the survey's five point scale teachers' average pre-test rating was 4.04 (SD=0.44) and their average on the post rating was 4.03 (SD=0.61). The paired samples *t*-test produced a *t* value of .260 and a *p* value of .796 which is not statistically significant at the .05 alpha level. This finding suggests that the professional development opportunity did not impact teachers' confidence levels and perhaps more than 15 weeks of professional learning is needed in order to truly see a change in teachers' confidence levels using and teaching with technology.

Technology Integration Levels

Multiple data sources were used to determine the levels of technology integration in Iteration 1 and Iteration 2 to inform the study. The data sources used for each question that provided information on technology integration levels are reported in the following sections as well as an analysis of the findings for each question.

What Are the Current Levels and Methods of Technology Integration?

The data source for determining the current levels and methods of technology integration for both Iteration 1 and Iteration 2 were classroom observations. Observations were measured using the Florida Technology Integration Matrix (FTIM) (Florida Center for Instructional Technology, 2011) to determine teachers' and students' levels of use with technology in the classroom. Table 4.4 lists the results of each classroom observation for Iteration 1. Sixty-eight percent (56/82) of the observations reflected that no technology was being used by teachers or students. In Iteration 1 only 7% (6/82) of the observations reflected teachers and students using technology at the highest two levels (Infusion or Transformation) in Iteration 1. This data indicates that during Iteration 1 the majority of observations evidenced no use of technology.

In Iteration 2 classroom observation data reflected that only 19% (12/64) of the observations resulted in no technology use by students or teachers. So Iteration 2 reflected an increase in the use of technology by 49%. Sixty-three percent (40/64) of the observations in Iteration 2 were scored at the highest three levels on the FTIM (Adaptation, Infusion, or Transformation) and 33% (21/64) were at the Infusion or Transformation levels. Table 5.1 shows a comparison of the classroom observation data in Iteration 1 and Iteration 2. Classroom observation data from Iteration 1 to Iteration 2 reflect an increase in technology usage and an increase in students' use of technology at higher levels on the FTIM. This data indicates that teachers have changed their practice from Iteration 1 to Iteration 2 to increase the use of technology with students. Teachers are also using technology with students at higher levels by engaging them in authentic situations (Adaptation, Infusion or Transformation levels) and in the construction of knowledge (Infusion or Transformation levels).

Table 5.1

Classroom Observations Change from Iteration 1 to Iteration 2

	Iteration 1	**Iteration 2**
Used Technology During Observation	32% (26/82)	81% (52/64)
Students Use of Technology in Authentic Situations	9% (8/82)	63% (40/64)
Students Use of Technology to Construct Knowledge	7% (6/82)	32% (21/64)

What Are the Identified Gaps in Technology Integration?

The pre-assessment survey using the Computer Technology Integration Survey and classroom observations were the data sources used to determine the gaps in technology integration. As previously reported a pre-survey was administered to all PLO participants at the beginning of the professional learning opportunity. The mean on the pre-assessment of the survey for the sample of 48 teachers was 4.04 indicating that teachers in this school were confident using and teaching with technology prior to the professional learning opportunity. Even though the overall mean reflected high levels of confidence among teachers using and teaching with technology, the pre-assessment survey was further analyzed for the questions on the instrument with the lowest mean score. This provided information as to areas in which teachers felt less confident in their abilities.

Table 5.2 reports the three questions on the pre-assessment survey with the lowest mean score which include: Question 16: I feel confident about using technology resources (such as spreadsheets, electronic portfolios, etc.) to collect and analyze data from student tests and products to improve instructional practices; Question 14: I feel confident about assigning and grading technology-based projects; and, Question 20: I feel confident that I can develop creative ways to cope with system constraints (such as budget cuts on technology facilities) and continue to teach with technology.

Table 5.2

Pre-Assessment Computer Technology Integration Survey Questions with Lowest Mean Scores

Question	Question Mean
20. I feel confident that I can develop creative ways to cope with system constraints (such as budget cuts on technology facilities) and continue to teach with technology.	3.81
14. I feel confident about assigning and grading technology-based projects.	3.65
16. I feel confident about using technology resources (such as spreadsheets, electronic portfolios, etc.) to collect and analyze data from student tests and products to improve instructional practices.	3.54

*Overall Survey Mean: 4.04

Classroom observation data during Iteration 1 was used to determine gaps in technology integration. As reported in Table 5.1 only 32% (26/82) of the observations reflected the use of any technology at all during Iteration 1. In addition, only 9% (8/82) of the observations evidenced the use of technology at the Adaptation, Infusion, or Transformation levels on the FTIM.

The pre-assessment survey and classroom observation data reflect gaps in technology integration in the areas of using technology for formative assessment (pre-assessment survey question 16), project based learning (pre-assessment survey question 14), coping with system constraints (pre-assessment survey question 20), integrating technology into instruction, and using technology with students in authentic situations and for the construction of knowledge. In addition, a gap existed between teachers' perceptions of their technology integration as measured by the pre-assessment survey and actual classroom observation data. Teachers reported high levels of confidence on the survey yet classroom observations reflected little use of technology or technology use at lower levels of the FTIM.

How Are Teachers Planning, Evaluating, and Implementing Technology Integration?

Data sources used to determine how teachers are planning, evaluating, and implementing technology include lesson plan and reflection log analysis. Lesson plan data for both iterations will be presented and discussed so as to provide a comprehensive picture of teachers' lesson planning integrating technology and changes that occurred within the study.

Lesson plan analysis for Iteration 1 revealed that 60% (12/20) of the lesson plans were at the Entry level on the FTIM, and teachers were the only ones using and controlling the technology. Ten percent (2/20) of the lessons were at the Infusion or

Transformation levels on the rubric indicating very few lessons in which students use technology for authentic purposes or for the creation of knowledge.

Lesson plan data for Iteration 2 indicate that 80% (8/10) of the lessons planned were at a higher level than Entry. Thirty percent (3/10) of the lessons were planned at either the Adaptation, Infusion, or Transformation levels indicating higher levels of student use with technology. Table 5.3 compares the lesson plan data analysis from Iteration 1 to Iteration 2. The lesson plan data indicates that initially teachers were planning technology at the lower levels of FTIM. Sixty percent (6/10) of the teachers moved up at least one level on the continuum during Iteration 2 in terms of planning lessons at higher levels of technology integration.

Table 5.3

Lesson Plan Changes from Iteration 1 to Iteration 2

	Iteration 1	**Iteration 2**
Entry Level Lessons	60% (12/20)	20% (2/10)
Students Use of Technology in Authentic Situations	10% (2/20)	30% (3/10)
Students Use of Technology to Construct Knowledge	10% (2/20)	20% (2/10)

Reflection logs were also used as a data source to determine how teachers were planning, implementing, and evaluating lessons for technology integration. Reflection log data indicate that teachers were planning lessons to add more technology into their instruction by adding more content modules to the student learning management system and by using the sample technology lessons. They were also planning lessons using formative assessment tools and data as well as ones that incorporated student collaboration such as student discussions. As teachers planned lessons integrating more technology into their instruction using these strategies, their technology use evidenced an upturn in levels in classroom observation data as well as lesson plan data.

What Is the Progress Toward the Shared Vision of Technology Integration and Transformative Practice?

Teachers worked to create a shared vision for technology integration for the school at the beginning of the professional learning opportunity. This shared vision is organized around student engagement in the use of digital tools in communication, collaboration, critical thinking, and creativity. Data sources used to determine the progress toward the shared vision include classroom observations, lesson plan analysis, and reflection log analysis.

Classroom observation data from Iteration 1 to Iteration 2 reflect an increase in technology usage and an increase in students' use of technology at higher levels on the FTIM as noted in Table 5.1. Observations evidenced an increase in students' use of technology for authentic purposes and for the creation of knowledge. This reflects progress toward the shared vision of technology integration by the increase in student engagement using technology. In addition the classroom observation data reflects teachers moving toward transformative practice on the FTIM.

Lesson plan data reported in Table 5.3 compares the lesson plan data analysis from Iteration 1 to Iteration 2. Sixty percent (6/10) of the teachers moved up at least one level on the continuum during Iteration 2 in terms of planning lessons at higher levels of technology integration. This is evidence of teachers moving toward higher levels of student engagement in the use of digital tools as well as evidence they are moving toward transformative practice.

Reflection log data reported in Figure 5.1 indicate that teachers are working toward increased student use of technology with a particular focus on the collaboration element of the shared vision. Teachers indicated they were working toward the use of online discussions as an avenue toward more student collaboration. All data sources analyzed for this question reflect progress toward the shared vision for technology integration and transformative practice.

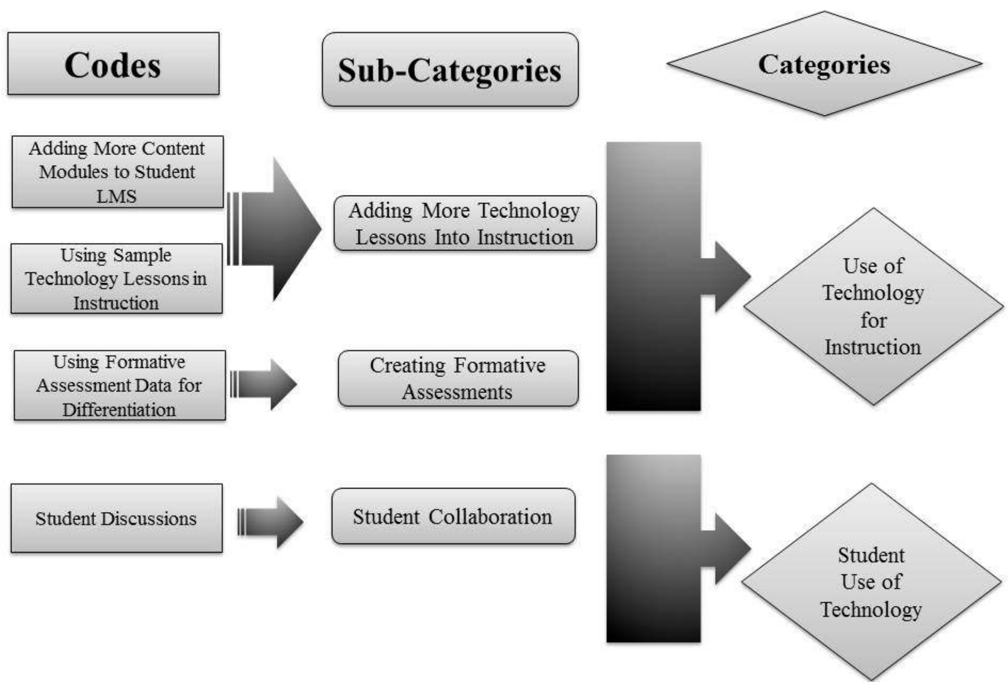

Figure 5.1 Iteration 2 Reflection Logs' Codes, Subcategories, and Categories

Student Factors

Student factors are another area that was assessed during this study to determine how often students are engaged at the higher levels of the FTIM when using technology in the classroom. The data source used to determine student factors in this study was classroom observations for both Iteration 1 and Iteration 2.

How Often Are Students Engaged in Authentic Learning Using Technology?

Classroom observations were scored as the data sources for determining how of students are engaged in authentic learning using technology with a focus on Student Descriptors of the FTIM. Students using technology at the Adaptation, Infusion, or Transformation levels were scored at using technology for authentic purposes. During Iteration 1 10% (4/41) of the observations evidenced students engaged in authentic learning experiences using technology or scoring at the Adaptation level or higher on the FTIM when looking at Student Descriptors. This information reflects that few students were using technology for authentic purposes in Iteration 1.

In Iteration 2 classroom observations reflected 80% (24/30) of the students using technology for authentic purposes as scored using the Student Descriptors on the FTIM. This demonstrates an increase in the use of technology by students for authentic purposes from Iteration 1 to Iteration 2 of the professional learning opportunity.

How Often Are Students Using Technology to Construct Knowledge?

Classroom observations were also used as the data sources for determining how students use technology to construct knowledge with a focus on Student Descriptors of the FTIM. Five percent (2/41) of the observations using Student Descriptors evidenced students using technology to construct knowledge in which student use of technology was scored at the Infusion or Transformation levels in Iteration 1. This indicates very few opportunities for students to engage with technology for the purposes of creating knowledge.

In Iteration 2 classroom observations reflected that 33% (10/30) of the classrooms engaged students in the use of technology for the construction of knowledge. The increase to 33% in Iteration 2 indicates that teachers moved toward transformative practice by having more students using technology to construct knowledge as part of the learning process.

Professional Learning

The professional learning area provided specific information about the components of professional learning and their impact as part of the design process of the professional learning opportunity.

What Are the Specific Learning Targets For This Professional Learning?

Data from the Computer Technology Integration Survey, classroom observations, and lesson plan analysis at the end of Iteration 1 provided information toward the creation of specific learning targets for the professional learning. Here is a summary of the data in these areas along with the professional learning targets that were created as a result of the findings.

The data from the Computer Technology Integration pre-survey indicated an overall mean of 4.04 for the sample of 48 teachers. This mean score indicates that teachers were confident using and teaching with technology. Even though the overall mean reflected high levels of confidence among teachers using and teaching with technology, the pre-assessment survey was further analyzed for the questions on the instrument with the lowest mean score. This provided information as to areas in which teachers felt less confident in their abilities. These results indicate lower confidence areas in the use of formative assessments, project based learning, and handling system constraints and were used in the development of professional learning targets for Iteration 2.

Classroom observations were also analyzed to provide information toward the development of specific learning targets for the professional learning opportunity. Sixty-eight percent (56/82) of the classroom observations during Iteration 1 reflected no technology use at all in the classroom. In addition, 9% (8/82) of the observations evidenced the use of technology at the Adaptation, Infusion, or Transformation levels on the FTIM. This data reflects that professional learning targets should be developed that will result in more consistent and pervasive use of technology in the classroom with students the Adaptation level or higher on the FTIM.

Lesson plan analysis for Iteration 1 revealed that 60% (12/20) of the lesson plans were at the Entry level on the FTIM and were the only ones using and controlling the technology. Ten percent (2/20) of the lessons were at the Infusion or Transformation levels on the rubric indicating very few lessons in which students use technology for authentic purposes or for the creation of knowledge. This data also indicates the need for professional learning targets to be developed that will move teachers and students toward higher levels of technology use as measured by the FTIM.

Based on the pre-survey assessment, classroom observations, and lesson plan data the following specific learning targets for Iteration 2 were created for the professional learning and design changes were made to move teachers to engage students in authentic learning and creating knowledge using technology more often. These learning targets aimed to increase teachers' confidence levels using technology in these areas. The specific learning targets were 1) Teachers will collaborate with each other at least three times this quarter (Iteration 2) to design lesson plans together that help students master the standards and incorporate technology; 2) Teachers will move up one level on the

FTIM by the end of the quarter (Iteration 2) as measured by classroom observations and lesson plan analysis; 3) The number of authentic learning and creation of knowledge opportunities will increase to 15% by the end of the quarter (Iteration 2).

What Professional Development Components Will Address the Gaps Noted in Iteration 1?

The Computer Technology Integration pre-assessment survey and classroom observations were data sources used to determine what professional development components will address the gaps noted in iteration 1 by first identifying those gaps. As previously reported the pre-assessment survey and classroom observation data reflected gaps in technology integration in the areas of using technology for formative assessment (pre-assessment survey Question 16), project based learning (pre-assessment survey Question 14), coping with system constraints (pre-assessment survey Question 20), integrating technology into instruction, and using technology with students in authentic situations and for the construction of knowledge. In addition, a gap existed between teachers' perceptions of their technology integration as measured by the pre-assessment survey and actual classroom observation data. Teachers reported high levels of confidence on the survey (M=4.04) yet classroom observations reflected little use of technology at lower levels of the FTIM. Sixty-eight percent (56/82) of the classroom observations reflected no use of technology at all and only 9% (8/82) of the observations reflected lessons at the Adaptation level or higher as measured by the FTIM.

Design changes to the professional learning opportunity were created to address professional development components that would focus on the gaps as evidenced by the pre-assessment survey and classroom observation data. Specific information on the design changes driven by Iteration 1 data can be found in the Design Changes section of this chapter. As an overview, design changes included additional time working in grade level teams to plan, revise, and evaluate lessons that integration technology at high levels on the FTIM using the Technology Pedagogical Content Knowledge (TPACK) framework. This additional time incorporated an extended Technology Professional Learning Day on a Teacher Workday. In addition, the professional learning components of modeling, observation, peer observation components, and individual coaching during Iteration 2 were included to address the gap of teachers using technology with students at high levels on the FTIM, but they will also increase teachers' confidence levels in these areas as noted in the data.

What Professional Development Components Should Be Included as Evidenced By the Literature?

Classroom observation and lesson plan analysis were data sources used at the end of Iteration 1 to determine what professional development components should be included and this data was aligned with the components recommended for professional learning for technology integration by the literature.

As noted earlier classroom observation data for Iteration 1 reflected that 68% (56/82) of the classrooms had no use of technology and 9% (8/82) used technology at the Adaptation, Infusion, or Transformation levels. Lesson plan data for Iteration 1 evidenced 60% (12/20) of the lesson plans were at the Entry level on the FTIM, and teachers were the only ones using and controlling the technology. Ten percent (2/20) of the lessons were at the Infusion or Transformation levels on the rubric indicating very few lessons in which students use technology for authentic purposes or for the creation of knowledge.

Professional development components should be included in Iteration 2 that will increase the use of technology to the Adaptation level or higher so as to allow students to use technology for authentic purposes and for the construction of knowledge. Components should also be included that will increase teachers' confidence levels with using technology at these higher levels of FTIM. Professional learning components identified in the previous section and implemented as part of the design change would address these gaps noted in the data include providing teachers with additional time working in grade levels teams to plan, revise, and evaluate lessons using TPACK, modeling, observation, peer observation, and individual coaching components.

Active learning opportunities are recommended in the literature for teachers when the goal is to move them toward higher levels of student use of technology for authentic purposes and for the construction of knowledge. Using an active, learner-centered, constructivist approach, teachers can construct their own meaning and understanding for new learning which can be more readily applied to the classroom once they experience this approach for themselves (Keengwe & Onchwari, 2009). This recommendation aligns with providing more time for teachers to collaborate on lessons using TPACK as they actively engage in designing lessons for students at higher levels technology integration. Ertmer and Ottenbreit-Leftwich (2010) note that changes occur when teachers' confidence is built with successful experiences in small instructional changes prior to moving toward larger changes. The professional development component of additional time with grade levels to plan lessons using TPACK aligns with the literature by providing teachers opportunities to plan and revise existing lessons which could begin with small instructional changes using technology.

The literature notes the importance of providing teachers with opportunities to observe classrooms that effectively integrate technology (Ertmer & Ottenbreit-Leftwich, 2010; Keengwe & Onchwari, 2009). The modeling, observation, peer observation, and individual coaching components were identified as components that would address the gaps noted in the data. These professional development components are also recommended in the literature to provide teachers with multiple examples of using technology in the teaching and learning process.

Finally, reflection of practice and toward goals is another component of professional learning that is recommended by the literature and that aligns with the gaps in the data for Iteration 1. Matzen and Edmunds (2007) note that reflection on instructional practices is a critical factor in teacher change. A continued professional development component of asking teachers to reflect on instructional practices and personal technology goals will address the identified gaps and is a recommended component from the literature.

Professional learning components that should be included for Iteration 2 as evidenced by the literature include additional time to collaborate with grade level teachers using TPACK, modeling, observation, peer observation, individual coaching, and reflection on instructional practices and progress toward goals.

<u>What Components of Professional Learning Are Impacting Teacher Practice?</u>

The data sources used to determine the components of professional learning that are impacting teacher practice were classroom observations, lesson plans, reflection logs, and interviews.

As previously reported classroom observation data from Iteration 1 to Iteration 2 reflect an increase in technology usage and an increase in students' use of technology at higher levels on the FTIM as noted in Table 5.1. The classroom observation data reflects teachers moving toward transformative practice on the FTIM.

Lesson plan data reported in Table 5.3 compares the lesson plan data analysis from Iteration 1 to Iteration 2 and reflects an increase in the percentage of lessons being planned at the higher levels of FTIM. Sixty percent (6/10) of the teachers moved up at least one level on the continuum during Iteration 2 in terms of planning lessons at higher levels of technology integration. This is evidence of teachers moving toward higher levels of student engagement in the use of digital tools as well as evidence they are moving toward transformative practice.

Reflection log and interview data provide a lens as to what professional development components teachers believe are most impacting their practice. Ample time to engage in professional learning for technology integration emerged in the reflection log data as the overarching theme or most important component impacting teachers work. The categories within the theme of needing ample time that study participants believed were most impacting their practice were team/collaborative planning time, individual coaching time, and small, differentiated learning group time. The reflection log data indicates that professional learning structured around these three components by providing teachers with ample, focused learning time most impacted their practice toward technology integration.

Interview data reflect the same common theme of the importance of ample time to engage in professional learning impacting teachers' practice in integrating technology effectively. The categories that emerged in the interview data were team/grade level collaborative planning time (same as reflection log data), peer observation time, and time to explore technology resources. The interview data results also reflect the critical importance of time being structured and allotted for teachers as an essential element to developing them in technology integration. The interview data and reflection log data both indicate the effectiveness of grade level/team collaborative planning time to plan, revise, and evaluate lessons using TPACK as the most important professional development component impacting teachers' practice.

<u>How Effective Is This Professional Learning at Meeting the Desired Learning Targets and Goals?</u>

Data sources used to determine the effectiveness of the professional learning toward meeting the specific learning targets include classroom observations, lesson plans, reflection logs, and interviews. The specific learning targets were 1) Teachers will collaborate with each other at least three times this quarter (Iteration 2) to design lesson plans together that help students master the standards and incorporate technology; 2) Teachers will move up one level on the FTIM by the end of the quarter (Iteration 2) as measured by classroom observations and lesson plan analysis; 3) The number of authentic learning and creation of knowledge opportunities will increase to 15% by the end of the quarter (Iteration 2).

Classroom observation data revealed that 100% of the study participants moved up at least one level on the FTIM by the end of the quarter (Iteration 2). Seventy percent (7/10) of the study participants moved up at least one level on the FTIM as measured through lesson plan analysis. The number of authentic learning and creation of knowledge opportunities increased to 63% (40/64) as measured by classroom observations and to 30% (3/10) as measured by lesson plan analysis by the end of Iteration 2. Reflection log and interview data indicated that the most impactful professional learning component to teacher practice was the provision of time especially time used for grade level/team collaborative planning (using TPACK).

The data from all sources noted above indicate the professional learning targets were met for Iteration 2 as teachers collaborated with each other on more than three occasions to design lesson plans together that help students master the standards and incorporate technology using TPACK which satisfied learning target one. The second learning target was met as 100% of the teachers moved up one level on the FTIM as evidenced by classroom observations and lesson plan analysis. The third learning target was met since both classroom observations and lesson plan analysis indicated learning opportunities in which students were engaged in authentic experiences or the construction of knowledge taking place greater than 15% of the time.

How Will This Professional Learning Impact Theory?

Classroom observations, lesson plan analysis, reflection logs, and interview data were all analyzed and considered for determining how this professional learning opportunity and design will impact theory.

Table 5.1 shows a comparison of the classroom observation data in Iteration 1 and Iteration 2. Classroom observation data from Iteration 1 to Iteration 2 reflect an increase in technology usage and an increase in students' use of technology at higher levels on the FTIM. This data indicates that teachers have changed their practice from Iteration 1 to Iteration 2 to increase the use of technology with students as a result of this professional learning opportunity. Teachers are also using technology with students at higher levels by engaging them in authentic situations (Adaptation, Infusion or Transformation levels) and in the construction of knowledge (Infusion or Transformation levels).

Table 5.3 compares the lesson plan data analysis from Iteration 1 to Iteration 2. The lesson plan data indicates that teachers moved from planning lessons at the lower levels of FTIM during Iteration 1 to more teachers planning lessons at the Adaptation level or higher as measured by the FTIM. In addition, 60% (6/10) of teachers moved up at least one level on the continuum during Iteration 2 in terms of planning lessons at higher levels of technology integration as a result of the professional learning opportunity.

Reflection log data indicates that the most important component impacting teachers' practice is providing teachers ample time structured around team/collaborative planning time for lesson development using TPACK, individual technology coaching time, and small, differentiated learning group time based on teacher need.

Interview data indicates the same common theme of ample time for teacher learning and practice being critical to impacting teachers' work to integrate technology. The categories that emerged in the interview data under time were team/grade level collaborative planning time (using TPACK), peer observation time, and time to explore and practice with technology resources.

These data sources indicate that teachers can move toward more effective technology integration when professional learning is designed around the essential element of providing time for teachers to engage in learning structured by grade level/team collaboration for lesson development using TPACK, individual technology coaching, small, group differentiated learning based on need, peer observation time, and time to explore and practice with technology resources. This structure provides a framework for others seeking to develop professional learning opportunities to help teachers move toward integrating technology into the teaching and learning process.

Chapter six provides further data analysis and discussion in which practical and scientific outputs of this design based research study are examined. The outputs of the study noted in the next chapter provide an answer to the question "How will this professional learning impact theory?"

CHAPTER SIX: ANALYSIS AND DISCUSSION

An analysis of the data for each research sub question and for the overall research question is provided in this chapter. In addition, as a result of the data analysis the design changes for this study and proposed changes for future iterations are examined. The outputs of the study are articulated along with a discussion on limitations of the study and possible areas for future research at the end of the chapter. To begin this chapter the three sub-questions appear in order coupled with a data analysis for each. This is followed by a discussion of the overall research question: What components of a professional learning framework are most effective in moving teachers toward transformative practice which emphasizes active learning, critical thinking, creativity, and communication?

Research Sub Question 1

What Components of Professional Learning Result in Teachers Engaging Students in Using Technology to Construct Knowledge and Apply It to Authentic Situations?

The Computer Technology Integration Survey results, classroom observations, and lesson plan data do not effectively address the research question which asks which professional development components result in teachers using technology with students to construct knowledge for authentic purposes. However, these data sources provided guidance for the study in the following way. Based on the gaps noted between teachers' confidence levels, classroom observations, and lesson plans, specific learning targets were created for the professional learning and design changes were made to move teachers to engage students in more authentic learning and in the creation of knowledge using technology more often. The professional learning design was modified based on this data to provide teachers with significantly more time working in grade level teams to collaborate on planning lessons that integrate technology at high levels in Iteration 2. In addition, the professional learning design was modified to include modeling, observations, peer observation components, additional individual coaching, and additional teacher reflection on instructional practices in technology and toward personal goals.

After the professional learning design changes, data was gathered and analyzed for Iteration 2. This data indicates that teachers have changed their practice from Iteration 1 to Iteration 2 to increase the use of technology with students and to use technology with students at higher levels of the FTIM. Table 6.1 reflects the change in technology classroom observations from Iteration 1 to Iteration 2 noting an increase in the number of opportunities students used technology to construct knowledge for authentic purposes.

Table 6.1

Classroom Observations Change from Iteration 1 to Iteration 2

	Iteration 1	**Iteration 2**
Used Technology During Observation	32% (26/82)	81% (52/64)
Students Use of Technology in Authentic Situations	9% (8/82)	63% (40/64)
Students Use of Technology to Construct Knowledge	7% (6/82)	32% (21/64)

Lesson plan data also indicates teachers have changed their practice from Iteration 1 to Iteration 2 to increase the use of technology with students and to use technology with students at higher levels. Table 6.2 reflects the percentage of lessons for each Iteration in which students are engaged in authentic learning and constructing knowledge with technology.

Table 6.2

Lesson Plan Changes from Iteration 1 to Iteration 2

	Iteration 1	**Iteration 2**
Entry Level Lessons	60% (12/20)	20% (2/10)
Students Use of Technology in Authentic Situations	10% (2/20)	30% (3/10)
Students Use of Technology to Construct Knowledge	10% (2/20)	20% (2/10)

The classroom observation and lesson plan data evidenced an increase in teachers' use of technology with students for the construction of knowledge in authentic situations after additional time was provided in Iteration 2 for teachers to engage in collaborative work in planning lessons together (using TPACK) in grade level teams, individual technology coaching, small differentiated learning groups, peer observations, and time to explore and practice with technology resources. These are the essential professional learning components that were found to engage teachers in technology integration for the construction of knowledge in authentic situations.

Research Sub Question 2

What Components Of Professional Learning Result In Changing Teachers' Beliefs, Attitudes, And Behaviors Toward Technology Integration In The Classroom?

While survey data, classroom observation data, and lesson plan data informed the study and the progress toward transformative practice, these data did not specifically address the core message asked in this research question. The qualitative data sources from this study including reflection logs and interview data were analyzed for common themes that emerged in which similar data are grouped, categorized and organized by relationship.

Conditional Relationship Guide

Scott (2004) encourages researchers to develop a conditional relationship guide and reflexive coding matrix in order to saturate the information toward deeper understanding. Table 6.3 is a conditional relationship matrix created from the reflection entries and interview transcripts in the search to understand what components of a professional learning framework are most effective in moving teachers toward transformative practice. The results have significant implications for research sub question 2.

Table 6.3

Professional Development Components Impacting Teacher Practice Toward Technology Integration Conditional Relationship Guide

Theme: Ample Time for Teacher Learning					
	What	When	Where	Why	Consequence
Team/Grade Level Planning	Plan/revise lessons Use of sample	Weekly Multiple opportunities	Team planning meetings	Consistency Relevance Integrate	Confidence

Time	lessons			content	
Individual Coaching Time	Individual needs addressed	Meets individual schedule	Specific time in teacher's classroom	To Meet Specific Technology and Curriculum Needs	Models Confidence Inspiration
Small Group Differentiated Learning Time	Based on goals/needs Small groups	Twice in 15 weeks	Led by teacher leaders & coach	To Meet Individual Needs/Goals	Models Confidence Needs/Goals Development
Peer Observation Time	Observe Technology Teacher Leader Debrief Time	Scheduled During a Tech Lesson of Interest	Technology Teacher Leader's Classroom	Observation in a Like Situation Discussion	Inspiration Confidence
Time to Explore Tech Tools & Resources	Time to Explore Technology Demonstrations	Once a quarter Many Resources Shared in a Short Period of Time	Faculty Meeting	Multiple Resource Options	Models

The Core Category for the Conditional Relationship Guide is Ample Time for Teacher Learning with Technology which is the over-arching theme of the professional learning design results. Within the theme of time, the categories emerged that most impacted teacher practice which include Team/Grade Level Planning Time, Individual Coaching time, Small Group Differentiated Learning Time, Peer Observation Time, and Time to Explore Technology Resources. After applying Scott's (2004) recommendation of asking the questions of what, when, where, why, and what consequence for each category, a specific consequence emerged. When analyzing the consequences, confidence and inspiration emerged as consequences which are related to teachers' attitudes, beliefs, and values about teaching with technology. Two out of three emerged consequences from the data (Table 6.3) were related to attitudes, beliefs, and values. The third consequence is modeling which is related to knowledge and skills.

The professional learning components that were found to result in changing teachers' beliefs, attitudes, and behaviors toward technology integration are providing ample time for grade level/team collaborative planning (using TPACK), individual technology coaching time, small group, differentiated learning time based on need, peer observation time, and time to explore and/or practice with technology resources.

Research Sub Question 3

What Components Of Professional Learning Help Teachers Effectively Plan, Implement, And Evaluate Technology Lessons That Take Into Account The Curricular Needs As Well As The Student Needs?

In order to answer sub question 3 pre- and post-survey data, student achievement data, classroom observations, lesson plans, reflection logs, and interview were used as sources. Specific questions and corresponding data sources for sub question 3 can be found in Appendix C.

Classroom observation and lesson plan data indicate that students were more engaged in using technology to construct knowledge in authentic situations in Iteration 2 after design changes provided teachers with many additional opportunities to work in grade level teams to collaborate on planning, revising, and evaluating lessons that integrate technology with the TPACK framework. Survey data, student achievement data, classroom observation data, and lesson plan data informed the study and the teachers' progress toward transformative practice. However, these data were not effective in specifically answering research question 3.

Teachers repeatedly noted throughout the data sources that they needed more time to learn to integrate technology. The professional learning components that help teachers effectively plan, implement, and evaluate technology lessons that take into account the curricular needs as well as the student needs were found to be providing ample time for grade level/team collaborative planning to plan, revise, and evaluate lessons using the TPACK framework, individual technology coaching time, small group, differentiated learning time based on need, peer observation time, and time to explore and/or practice with technology resources.

Research Question

What Components Of A Professional Learning Framework Are Most Effective In Moving Teachers Toward Transformative Practice Which Emphasizes Active Learning, Critical Thinking, Creativity, and Communication?

While survey responses and student achievement outcome data presented in Chapters 4 and 5 did not reflect significant differences after the professional learning opportunity, the classroom observation and lesson plan data reflected credible changes in teachers' practice toward transformative teaching and learning with technology after a change in the professional learning design for Iteration 2.

Reflection log and interview data were further analyzed using a Conditional Relationship Guide and represented in Table 6.3. Within the Core Category of ample time for teacher learning additional categories were identified that most impacted moving teachers toward transformative practice which include Team/Grade Level Planning Time, Individual Coaching time, Small Group Differentiated Learning Time, Peer Observation Time, and Time to Explore Technology Resources.

After the creation of a Conditional Relationship Guide, Scott (2004) advocates for the development of a Reflexive Coding Matrix to move data analysis forward. The process for creating a matrix include using the Consequences that are repeated in the Conditional Relationship Guide within the Core Category to further refine the data into Properties, Processes, Dimensions, Contexts, and Modes for Understanding the Consequences. The Consequences that were repeated and therefore used in the Reflexive Coding Matrix were confidence, inspiration, and models. Table 6.4 is the Reflexive Coding Matrix for the qualitative data collected in the study after further analysis using the Conditional Relationship Guide in Table 6.3.

Table 6.4

Professional Development Components Impacting Teacher Practice Toward Technology Integration Reflexive Coding Matrix

Core Category:	Time		
Properties	Self-Efficacy	Attitude	Knowledge & Skills
Processes	Confidence	Inspiration	Models
Dimensions	Needs Development Debrief Talk Time Multiple Opportunities Teacher Collaboration Relevance	Relevance Like Situations	Needs Development Exploration Multiple Opportunities Varied Contexts Choice
Contexts	Team/Grade Level Collaborative Planning	Individual Coaching Peer Observations	Individual Coaching Small Group Differentiated

	Individual Coaching Small Group Differentiated Learning Peer Observations		Learning Time to Explore
Modes for Understanding Consequences	Collaboration Required for Development	Relevance & Like Situations	Varied Contexts & Choice

The Reflexive Coding Analysis in Table 6.4 indicates that Confidence, Inspiration, and Modeling are key processes in impacting professional learning for teachers toward technology integration. Confidence is a process of self-efficacy. Inspiration is an attitude, and Models is part of developing Knowledge and Skills of teachers.

All of the data sources indicate that providing ample time for professional learning that is structured effectively is the main component that teachers need in order to move toward transformative practice. Professional learning time should be provided using the following structures and professional learning components in order for teachers to move toward technology integration as learned through the evaluation of all data sources in this study during Iteration 1 and after design changes in Iteration 2: 1) Ample time through multiple opportunities to create and revise lessons using TPACK as part of team/grade level collaboration; 2) Individual Coaching time; 3) Small group differentiated learning based on needs/goals; 4) Peer observation time; and 5) Time to explore technology tools and resources.

Design Changes

Design based research is different from traditional research methods in that its purpose is to improve as opposed to prove (Herrington, McKenney, Reeves, & Oliver, 2007). Changes were made in the teachers' learning environment to further address the problem based on formative data and additional changes are recommended based on the summative data for this study. Table 6.5 shows the data from Iteration 1 and the design changes made during Iteration 2 as a result of the data. Design changes are further explained in this section.

Table 6.5

Iteration 1 Data and Design Changes for Iteration 2 from the Initial Design

Iteration 1 Data Formative Evaluation	**Initial Design for Iteration 2**	**Design Changes for Iteration 2**
Classroom Observations Reflect Little Use of Technology	Four Face to Face Meetings	More Time and Opportunity for Teacher Learning
Lesson Plans Reflect Primary Use of Technology at Entry Level of FTIM	Peer Observations and Feedback	Lesson Development with Team/Grade Level Collaborative Planning Using TPACK
Reflection Logs Indicate Teachers Working On: Formative assessments Lesson Development Comfort Level Student Creativity Student Collaboration	Reflection	Support Materials/Resources with Exploration Time
	Grade Level Collaborative Planning (TPACK)	Increase Time for Coaching, Modeling, Observing, Observations, and Peer Observations

	Individual Coaching	Small, Differentiated Learning Groups Based on Teachers' Needs and Goals

Design Change 1: More Time And Opportunity For Teacher Learning

The primary design change required for Iteration 2 as evidenced by the data sources was the need for more time and opportunity for teachers to learn how to integrate technology. Four face to face meetings did not provide the level of change in instruction, if any, toward transformative practice using technology. Therefore, the master school calendar was revamped to provide ten face to face professional learning sessions as opposed to four as planned in the original design for Iteration 2. One of these sessions was an extended time of three hours on a Teacher Workday to focus on technology integration with the following professional learning components: grade level/team collaborative planning for lesson development using TPACK, individual coaching, observations of technology lessons, and support materials/resources.

Design Change 2: Lesson Development With Grade Level Planning Using TPACK

Classroom observation data, lesson plan data, and reflection data indicated the need for more of a focus on lesson development integrating technology that engages students in the use of technology for authentic purposes and for the construction of knowledge. Therefore, design changes to address this formative information included the addition of weekly collaborative planning sessions in grade levels to engage in planning, revising, and evaluating lessons using the TPACK framework which engages teachers around the standards, instructional strategies, assessment, and technology. The original design called for this collaboration to take place four times as opposed to nine in Iteration 2.

Design Change 3: Support Materials/ Resources Exploration Time

Support materials and resources were only scheduled to be provided to teachers as part of Iteration 1 in the original design. However, based on the formative data teachers needed to focus on lesson development, formative assessments, student creativity, and student collaboration in order to move their instruction toward transformative practice. Therefore, resources were provided to teachers in these areas to show them sample lesson plans that integrate technology, sample formative assessment tools and reporting, sample projects that tap into student creativity using technology, and examples of how teachers use technology for student collaboration to engage in learning. Resources were provided on ten occasions and teachers were given one dedicated professional learning time to just explore the resources either individually or in teams. Other resources needed include release time to conduct and debrief with technology coaches or peers as a professional learning component. These components are further explained in Design Change 4. However, it should be noted that support/resources were needed as part of the professional learning components in Design Change 4.

Design Change 4: Increased Time For Coaching, Modeling, Observations, And Peer Observations

Modeling, observations of technology lessons, and peer observations are all professional learning components noted in the literature as being effective in helping teachers successfully integrate technology into their classrooms. Since the formative data from Iteration 1 indicated that teachers needed to focus on the development of lessons and increasing their level of comfort with using technology daily in their instruction, these components were added to the design for Iteration 2. Coaching provides models for teachers to observe with their own students and with relevant lessons that are important to them. Coaching was provided to teachers on three occasions during the first Iteration. However, coaching was provided to teachers weekly during Iteration 2 in an effort to provide them with models, inspiration, and sample lessons for technology integration.

Peer observations were also offered during Iteration 2 as another form of modeling and observing in order to increase teachers' levels of technology integration into their instruction. Release time and scheduling assistance was provided for teacher observers and for those teachers being observed to engage in a structured protocol conversation to debrief about the instructional and student engagement strategies using technology.

Design Change 5: Small, Differentiated Learning Groups

Small, differentiated learning groups were not scheduled to be part of the professional learning design during Iteration 2. This professional development component was provided during Iteration 1 to address teachers' individual goals for technology integration. Due to the fact that the data indicated multiple areas of need for teacher development during Iteration 1, a small differentiated learning group component was added to Iteration 2 to allow teachers to attend a professional learning session specific to their individual needs/goals. Teacher reflection toward their goals and on current practice is an important component in the creation of small, differentiated learning groups and assigning teachers to the group that best meets their needs.

Future Iterations

As a result of the summative findings in this study the following changes are recommended for future professional learning opportunities that are designed to help teachers integrate technology into the teaching and learning process effectively. All recommended design changes are based on the data gathered in this study.

Provide Ample Time And Opportunity For Teacher Learning

For subsequent iterations a clear focus on providing ample, structured and focused time for learning to teach and practice with technology should be provided.

Time For Collaborative Lesson Design

Weekly collaborative planning time for grade level/collaborative teams should be implemented using TPACK. Continued use of the TPACK framework will help teachers see the relationship between content, pedagogy, and technology and how they all three work together for student learning and mastery. This framework was found to help build teachers' confidence and helped them plan, revise, and evaluate lessons that integrate technology. In addition, the grade level collaborative planning sessions using TPACK engages teachers in active learning opportunities consistently at each meeting in an effort to model constructivist practices for teachers.

Time For Individual Coaching

Individual technology coaching provides teachers with support in teaching with technology at their individual levels. Technology coaching meets teachers where they are in their understanding and implementation of teaching with technology to engage students in constructing knowledge for authentic purposes. Individual coaching also provides teachers with models for lessons that integrate technology and inspiration to emulate these lessons in their classroom.

Time For Peer Observation

Peer observations are structured between a host teacher for implementing a technology lesson and an observer. A critical component is the planning of the observation and the debrief session between participants. This provides a common understanding of the lesson to be observed and can help address any concern, questions, or reservations the observer may have about implementing a similar lesson in his/her classroom. Peer observations also build confidence, provide inspiration, and provide models for teaching with technology at high levels among colleagues.

Time For Small, Group Differentiated Learning

Small, group differentiated learning is an important way to meet teachers' individual needs as teachers have varied needs along the spectrum of integrating technology. By having teachers set a goal for themselves and to periodically reflect on their progress toward the goal, professional developers can determine what the needs are and divide teachers into small groups of learning led by teacher innovators on topics that teachers have noted in their reflections that they are still working toward. This type of learning time addresses the individual goals and needs of teachers within a group learning session.

Time To Explore Support Materials/Resources

Support resources should be provided consistently throughout the professional learning opportunity and could range from printed material about transformative practice to video links to observations of teaching with technology. In addition, exposure to multiple technology tools and how they can be implemented into the teaching and learning process is another valuable idea for support materials/resources that could be provided to teachers. Release time or scheduling assistance to allow individual coaching and peer observations is another resource that will benefit teachers work toward technology integration and is another example that falls within that umbrella of teachers needing ample time to learn to teach and practice with technology. Time to explore resources with colleagues is also an important component that should be woven throughout the learning opportunity as teachers in this study identified through data collection that this component as important for their development in technology integration.

Provide Structures For Teacher Reflection

An important component for the development of teachers and to move forward teacher learning is to continue to have them reflect on their learning, their current practice, and their progress toward achieving their goals. Reflection entries were key pieces of data in this professional learning which provided insights as to what was working with the teachers to impact their practice and what needed to be adjusted. Goal setting can be used for reflection and is a recommended practice for professional learning designs for technology integration. Reflection is a component within the learning design standard from Learning Forward's Standards for Professional Learning (2011) that the literature notes impacts teacher practice, and one the researcher recommends continuing in the professional learning design. Holland (2001) and King (2002) note that the best models for professional development ensure that teachers are reflective practitioners as they study their actual classroom practices.

Consider Outcomes and Evaluation of the Professional Learning

Changes in the design need are recommended for the evaluation component since several data sources were not effective at assessing the impact of professional learning as discussed for each research sub question. Reeves (2011) notes that in education we often focus on those things that are easy to measure as opposed to what is really important to measure. Assessing the impact of professional learning is complex and challenging. Killion (2008) advocates for evaluation that focuses on specific actions of an implementation with specific results that are expected for that implementation. The systematic approach to look for specific results with each implementation strategy allows the evaluator to make adjustments as needed which improves the likelihood of achieving the intended results. Killion calls this approach a "glass-box evaluation" in which resources are provided and specific action steps for implementation are created along with projected changes expected in teachers' practice in order to achieve specific student learning results. A model can be created for the professional learning which ties the goal, inputs, activities, outcomes and results to change theory over time. This includes the creation of clear specific learning targets for the professional development.

Some of the evaluation components of this design based study such as the pre-post- survey of teachers and the student achievement data components did not yield results that provided information about the impact of the professional learning. A design change for using a "glass-box evaluation" (Killion, 2008) of professional learning components may allow future professional developers to better assess the impact of their professional learning.

The vision for moving teachers toward transformative practice which emphasizes active learning, critical thinking, creativity, and communication should remain the same, but the levels of support should change over time based on specific desired short term outcomes to better assess the impact of the professional learning.

Design Components

The emphasis on design based research is on being relevant to the work of others in the field. This study is relevant in that the findings can guide future professional learning for technology integration. This design based research study is a development study aiming to develop and improve a professional leaning opportunity that will be relevant for educators in their work toward transformative practice using technology. Design based research can result in both practical outputs that will benefit practitioners for future iterations and scientific outputs that are articulated as design principles (Herrington, McKenney, Reeves, & Oliver, 2007). These two types of outputs are described and presented in the following section.

Practical Outputs

The practical outputs of the study are outlined in Figure 6.1 below. The professional learning design for technology integration for future iterations should include individual as well as group components that are supported by resources and materials. The group components are more heavily weighted in the design as a result of the high yield impact of these strategies in this design based study. The original design called for equal individual and group strategies for teacher learning. A practical implication of this study would be to implement a professional learning following the structure including a "glassbox" evaluation component for each professional learning component on the figure.

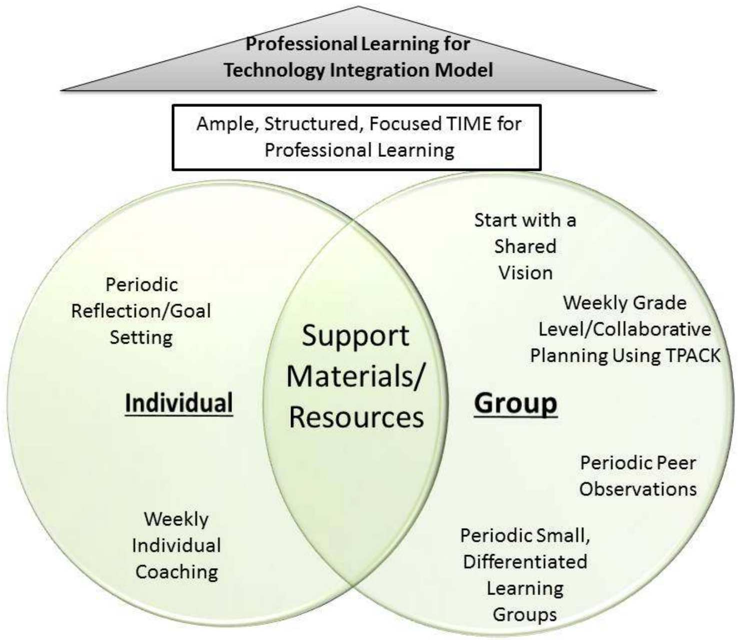

Figure 6.1 A Professional Learning Model for Technology Integration

<u>Scientific Outputs</u>

Design principles are a result of the design based process and they can inform the future development and implementation of professional learning for teachers in technology integration. Plomp and Nieveen (2007) state that design based research development studies seek to solve educational problems with practical interventions implemented in multiple contexts that result in broad design principles as a means of scientific output. They recommend the development of a heuristic statement for articulating design principles in design based research. Here are the recommended design principles or scientific outputs for this study: If you want to design a professional learning for technology integration, then you are best advised to give the professional learning a structure of the following components:

- grade level/team collaborative planning time using the TPACK framework to plan, revise, and evaluate lessons
- peer observation time
- individual technology coaching time
- small, group differentiated learning time based on teachers' needs/goals
- support materials/resources within each component

This should be accomplished via the provision of providing teachers with ample, structured, consistent and focused time for professional learning in order to develop teachers' attitudes, self-efficacy, and knowledge and skills for transformative practice using technology. While these principles cannot guarantee success, they support future professional learning designs for moving teachers toward more student centered technology integration.

Figure 6.4 provides a visual of the recommended design components that emerged as a result of this design based research study. In the figure the ultimate goal is to move teachers toward transformative practice in the center of the figure. Transformative practice can be achieved by impacting the three properties that emerged from the reflexive coding matrix in Table 5.4, which include teachers' attitudes, self-efficacy, and knowledge/skills. These three properties can be addressed through the four components of professsional learning found in this study to most impact teachers' practice toward technology integration: grade level/team collaborative lesson planning using the TPACK framework, individual coaching, peer observations, and small differentiated groups based on goals/needs. Intertwined around all components is time for teachers to explore technology resources that should be provided throughout the professional learning experience. The overarching need that must be provided in order for teacher learning with technology to occur is ample, structured, focused time for professional learning. Time for teachers to preview technology, plan lessons, and collaborate with others on technology is the second most common external factor or barrier impacting technology integration according to the literature (Richardson et al., 2008; Kopcha, 2010). Time for teacher learning emerges in this study as a critical professional learning component and not just a barrier to technology integration. Ample time for learning should be viewed as a component essential to the development of teachers' practice using technology when planning for professional learning.

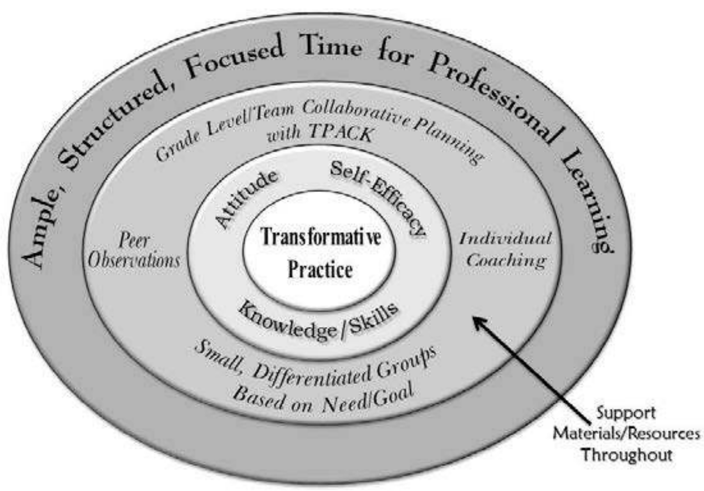

Figure 6.2 Visual Representation of Design Principles

Limitations of the Study

The limitations of this study include the number of weeks of the study. The 15 week study was a short amount of time for high levels of change to take place in teacher development and classroom application. While this semester long professional learning reflected some initial results in moving teachers toward transformative practice with technology, continued learning for an additional semester and even beyond following this design would yield more data for analysis. Both the literature and this study note the critical importance of time needed in order for true change to occur.

While the researcher is working in the school in which the study took place Herrington, McKenney, Reeves, and Oliver (2007) note that most design based research includes participants in the researcher's own practice due to the fact that this type of research cannot be conducted in isolation of practice. In this study the researcher was also the principal in the school in which the study took place. It was a function of leadership to provide the time for the professional learning and to rearrange schedules to provide additional time structured in a way that teachers noted impacted their practice. Leadership is a key component to ensure the focus stays on the professional learning and that time is embedded within the structures of the school day or teachers' working hours in order to implement this design. Leadership also required all teachers to participate in the professional learning opportunity as it was a schoolwide goal and expectation. A suggestion for future professional learning developers is to propose a technology integration schoolwide goal be considered by leadership as part of a formal school improvement plan. This would ensure leadership stays focused on the professional learning experience and provides the time necessary for teacher learning.

Wachira and Keegwe (2011) note the importance of external (first order) factors that impact technology as being primarily school level factors. Since the principal was also the researcher, school level factors were already addressed such as appropriate and consistent access to technology through the implementation of a strong infrastructure, time, technology support, and technology leadership. These factors would need to be addressed first and foremost in future studies. Learning Forward (2011) cites leadership as an important standard for professional learning implementation. While a limitation of this study is that the leadership standard with regard to technology integration was automatically addressed with the principal as researcher, the literature notes the importance of technology leadership needing to be both top down and bottom up meaning that teachers have key roles in leading technology integration in schools along with the principal (Laferriére, Hamel, & Searson, 2013).

Areas for Future Research

Future research ideas in this area include using this design for an entire school year or potentially multiple years to track the growth and change in teachers' instruction over time. Additional research ideas would be to focus on one of the two elements that emerged from the data in terms of teacher focus toward improving their practice. A study could be completed on the impact of professional learning using various forms of data collection on student outcomes for students' use of technology. Another study could focus on teachers' use of technology in their instruction to integrate content, use a learning management system, or use formative assessment tools to differentiate learning.

Multiple sources were used to evaluate this professional learning design which assisted in the design changes between Iterations 1 and 2. The data sources reflect that the provision of ample time for teachers to learn and practice with technology is the main factor teachers need to impact their beliefs, attitudes, and values in order to design lessons that integrate technology that will engage students in the construction of knowledge through authentic learning opportunities. The time provided for the professional learning must be carefully structured so as to provide ample opportunities for teachers to engage in team/grade level planning using the TPACK framework to plan, implement, and evaluate lessons. Other structures of time should include individual coaching, peer observations, and small differentiated learning groups based on goals/needs. Woven throughout the professional learning experience teachers need time to explore with technology tools and resources to support their instruction. This structured time in the professional learning design has the potential to develop teachers' confidence and change teachers' practice as they learn new skills in how to integrate technology into their instruction. A professional learning design using these design components applied systematically and sustained over time has the potential to impact technology integration in today's classrooms so more students are authentically engaged in using technology to demonstrate their learning and construct knowledge.

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APPENDIX A

Electronic Search Information

Table A.1

Electronic Search Information for Education Research Complete Database (March 2015) & Education & Information Technology Digital Library Database (May 2015)

Keyword	Date	Number of Articles
Professional Development for Technology Integration	2010-2015 2000-2009 1990-1999	51 72 3
Teacher Professional Development Models	2010-2015 2000-2009 1990-1999	117 155 7
Staff Development in Technology	2010-2015 2000-2009 1990-1999	16 46 9
Instructional Models for Transformative Teaching Practices (Thesarus terms: education, teachers, teacher training, transformative learning, educational technology)	2010-2015 2000-2009 1990-1999	443 240 16
Transformative Learning with Technology (Thesaurus terms: educational technology)	2010-2015 2000-2009 1990-1999	58 40 1
Teacher Change (Thesaurus terms: teacher training, teacher development, educational technology)	2010-2015 2000-2009 1990-1999	278 450 72
Teacher Technology Integration (Thesaurus terms: educational technology, educational technology-	2010-2015 2000-2009 1990-1999	167 168 5

research, teacher development, teaching methods)		
Evaluating Professional Development	2010-2015 2000-2009 1990-1999	37 71 6
Technology Integration Matrix	2010-2015 2000-2009	7 1
SAMR	2010-2015	8
TPACK	2000-2009 2010-2015	36 230
Technological pedagogical content knowledge	2010-2015	275 194 6

APPENDIX B

Professional Learning for Technology Integration Design Considerations, Guiding Questions, and Data Collection Methods

Table B.1

Professional Learning for Technology Integration Design Considerations, Guiding Questions, and Data Collection Methods

	Iteration 1		Iteration 2		
Timeline	August (2 weeks)	Sept/Oct (6 weeks)	October (2 weeks)	November (3 weeks)	December (2 weeks)
Mtg Date(s)	8/4/2015	9/1, 9/15, 9/29/2015	10/20, 10/27/2015	11/17/2015	12/3/2015
Design Considerations (Draft of ideas only based on research. Iteration data will drive exact design changes.)	Informed Exploration • Shared Vision of Tech Integration • Goal Setting • Reflection on Current Practice • Explicitly state/examine beliefs, values, & attitudes as related to tech integration • Support materials on tech integration & transformative practice	Enactment • Collaborative Planning • Individual coaching • Reflection Toward Goal • Observations of Tech Lessons • Support materials on content specific lessons integrating tech • Create content specific lessons	• Revise existing lesson plans • Peer observations • Peer feedback on desired teacher goal • Individual reflection on lesson, beliefs, attitudes, values, & student outcomes • Collaborative Planning • Reflection Logs	• Revise existing lesson plans • Collaborative planning • Peer feedback on lesson plans • Individual coaching feedback on lesson plans • Individual Reflection Toward Goal & of revised lesson plans • Observations & Reflection of Tech Lessons	Additional focus on effective professional development components as evidenced by previous design cycles

Iteration 1			Iteration 2		
Month/ Timeline	August (2 weeks)	Sept/Oct (6 weeks)	October (2 weeks)	November (3 weeks)	December (2 weeks)
Mtg Date(s)	8/24/2015	9/1, 9/15, 9/29/2015	10/20, 10/27/2015	11/17/2015	12/3/2015
Guiding Questions	• What are the identified gaps in technology integration? • What are the characteristics of the sample of teachers including values attitudes & beliefs? • What are the current student performance levels of the sample classes? • What are the current levels and methods of tech integration? • How often are students engaged in authentic learning using technology? • How often are students using technology to construct knowledge?	• What prof dev components will address the gaps noted in iteration 1? • What prof dev components should be included as evidenced by the literature? • What are the specific learning targets for the teachers for this prof learning?	• What are the current levels of technology integration? • What components of prof learning are impacting teacher practice? • How often are students using technology to construct knowledge? • How often are students engaged in authentic learning? • What are the student achievement results in the designated content?	• How are teachers planning, evaluating, and implementing technology integration lessons? • What is the progress toward the shared vision of tech integration and transformative practice? • How effective is this professional development at meeting the desired learning targets and goals?	• What changes are noted in teacher beliefs, attitudes, and values? • What do student outcomes reflect in the sample classes? • What are the current levels of technology integration? • What components of prof dev are impacting teacher practice? • How often are students using tech to construct knowledge? • How often are students engaged in authentic learning? • How will this prof learning design impact theory?

	Iteration 1		Iteration 2		
Month/ Timeline	August (2 weeks)	Sept/Oct (6 weeks)	October (2 weeks)	November (3 weeks)	December (2 weeks)
Mtg Date(s)	8/24/2015	9/1, 9/15, 9/29/2015	10/20, 10/27/2015	11/17/2015	12/3/2015
Data Collection Methods	• Pre-assess-ment of teachers' values, attitudes, & beliefs • Student Pre-Test on District Assessment (DA) (Grades 1-3)	• Classroom Observations (FTIM) • Lesson Plan Analysis • Reflection Logs	• Student 9 week DA results • Reflection Logs	• Classroom Observations (FTIM) • Lesson Plan Analysis • Interviews	• Post-assessment of teachers' values, attitudes, & beliefs • Reflection Logs

APPENDIX C

The Relationship Between Research Questions and Iteration Guiding Questions

The Relationship Between Research Questions and Iteration Guiding Questions

Research Question: What components of a professional learning framework are most effective in moving teachers toward transformative practice which emphasizes active learning, critical thinking, creativity, and communication?

Subquestion 1: What components of professional learning result in teachers engaging students in using technology to construct knowledge and apply it to authentic situations?	
● ●	What are the identified gaps in technology integration?
●	What are the current levels and methods of tech integration?
●	How often are students engaged in authentic learning using technology?
●	How often are students using technology to construct knowledge?
● ● ●	What professional development components will address the gaps noted in iteration 1?
● ●	What professional development components should be included as evidenced by the literature?
● ● ●	What are the specific learning targets for the teachers for this professional learning?
● ● ● ♦	What components of professional learning are impacting teacher practice?
● ● ● ♦	How effective is this professional development at meeting the desired learning targets and goals?
●	What do student outcomes reflect in the sample classes?
● ● ● ♦	How will this professional learning design impact theory?
Subquestion 2: What components of professional learning result in changing teachers' beliefs, attitudes, and behaviors toward technology integration in the classroom?	
●	What are the characteristics of the sample of teachers including values attitudes & beliefs?
● ● ●	What professional development components will address the gaps noted in iteration 1?
●	What professional development components should be included as evidenced by the literature?
● ● ●	What are the specific learning targets for the teachers for this professional learning?
● ● ● ♦	What components of professional learning are impacting teacher practice?
● ● ●	What is the progress toward the shared vision of tech integration and

	transformative practice?
● (purple) ● (orange) ● (black) ♦ (blue)	How effective is this professional development at meeting the desired learning targets and goals?
● (pink)	What changes are noted in teacher beliefs, attitudes, and values?
● (purple) ● (orange) ● (black) ♦ (blue)	How will this professional learning design impact theory?
Subquestion 3: What components of professional learning help teachers effectively plan, implement, and evaluate technology lessons that take into account the curricular needs as well as the student needs?	
● (purple) ● (pink)	What are the identified gaps in technology integration?
● (purple)	What are the current levels and methods of tech integration?
● (green)	What are the current student performance levels of the sample classes?
● (purple) ● (orange) ● (black)	What are the current levels and methods of tech integration?
● (purple) ● (pink)	What professional development components will address the gaps noted in iteration 1?
● (purple) ● (orange)	What professional development components should be included as evidenced by the literature?
● (purple) ● (pink) ● (orange)	What are the specific learning targets for the teachers for this professional learning?
● (purple) ● (orange) ● (black) ♦ (blue)	What components of professional learning are impacting teacher practice?
● (green)	What are the student achievement results in the designated content?
● (orange) ● (black)	How are teachers planning, evaluating, and implementing technology integration lessons?
● (purple) ● (orange) ● (black) ♦ (blue)	How effective is this professional development at meeting the desired learning targets and goals?
● (green)	What do student outcomes reflect in the sample classes?
● (purple) ● (orange) ● (black) ♦ (blue)	How will this professional learning design impact theory?

<u>Data Collection Key</u>

- ● (pink) Pre/Post assessment of teachers' attitudes, values, and beliefs
- ● (green) Student achievement data
- ● (purple) Classroom observations
- ● (orange) Lesson Plan analysis
- ● (black) Reflection Log
- ♦ (blue) Interviews

APPENDIX D

The Technology Integration Matrix Table of Teacher Descriptors

The Technology Integration Matrix Table of Teacher Descriptors

This table contains teacher descriptors for each cell of the Technology Integration Matrix (TIM). Other available resources include a tables detailing student activity, instructional settings, and a table of summary indicators for each TIM cell.

	Entry	Adoption	Adaptation	Infusion	Transformation
Active	The teacher may be the only one actively using technology. This may include using presentation software to support delivery of a lecture. The teacher may also have the students complete "drill and practice" activities on computers to practice basic skills, such as typing.	The teacher controls the type of technology and how it is used. The teacher may be pacing the students through a project, making sure that they each complete each step in the same sequence with the same tool. Although the students are more active than students at the Entry level in their use of technology, the teacher still strongly regulates activities.	The teacher chooses which technology tools to use and when to use them. Because the students are developing a conceptual and procedural knowledge of the technology tools, the teacher does not need to guide students step by step through activities. Instead, the teacher acts as a facilitator toward learning, allowing for greater student engagement with technology tools.	The teacher guides, informs, and contextualizes student choices of technology tools and is flexible and open to student ideas. Lessons are structured so that student use of technology is self-directed.	The teacher serves as a guide, mentor, and model in the use of technology. The teacher encourages and supports the active engagement of students with technology resources. The teacher facilitates lessons in which students are engaged in higher order learning activities that may not have been possible without the use of technology tools. The teacher helps students locate appropriate resources to support student choices.
Collaborative	The teacher directs students to work alone on tasks involving technology.	The teacher directs students in the conventional use of technology tools for working with others.	The teacher provides opportunities for students to use technology to work with others. The teacher selects and provides technology tools for students to use in collaborative ways, and encourages students to begin exploring the use of these tools.	Teacher encourages students to use technology tools collaboratively.	The teacher seeks partnerships outside of the setting to allow students to access experts and peers in other locations, and encourages students to extend the use of collaborative technology tools in higher order learning activities that may not have been possible without the use of technology tools.

	Entry	Adoption	Adaptation	Infusion	Transformation
Constructive	The teacher uses technology to deliver information to students.	The teacher provides some opportunities for students to use technology in conventional ways to build knowledge and experience. The students are constructing meaning about the relationships between prior knowledge and new learning, but the teacher is making the choices regarding technology use.	The teacher has designed a lesson in which students' use of technology tools is integral to building an understanding of a concept. The teacher gives the students access to technology tools and guides them to appropriate resources.	The teacher consistently allows students to select technology tools to use in building an understanding of a concept. The teacher provides a context in which technology tools are seamlessly integrated into a lesson, and is supportive of student autonomy in choosing the tools and when they can best be used to accomplish the desired outcomes.	The teacher facilitates higher order learning opportunities in which students regularly engage in activities that may have been impossible to achieve without the use of technology tools. The teacher encourages students to explore the use of technology tools in unconventional ways and to use the full capacity of multiple tools in order to build knowledge.
Authentic	The teacher assigns work based on a predetermined curriculum unrelated to the students or issues beyond the instructional setting.	The teacher directs students in the conventional use of technology tools for learning activities that are sometimes related to the students or issues beyond the instructional setting.	The teacher creates instruction that purposefully integrates technology tools and provides access to information on community and world problems. The teacher directs the choice of technology tools but students use the tools on their own, and may begin to explore other capabilities of the tools.	The teacher encourages students to use technology tools to make connections to the world outside of the instructional setting and to their lives and interests. The teacher provides a learning context in which students regularly use technology tools and have the freedom to choose the tools that, for each student, best match the task.	The teacher encourages innovative use of technology tools in higher order learning activities that support connections to the lives of the students and the world beyond the instructional setting.
Goal- Directed	The teacher uses technology to give students directions and monitor step-by-step completion of tasks. The teacher monitors the students' progress and sets goals for each student.	The teacher directs students step by step in the conventional use of technology tools to either plan, monitor, or evaluate an activity. For example, the teacher may lead the class step by step through the creation of a KWL chart using concept mapping software.	The teacher selects the technology tools and clearly integrates them into the lesson. The teacher facilitates students independent use of the technology tools to set goals, plan, monitor progress, and evaluate outcomes. For example, in a given project, the teacher may select a spreadsheet program that students use independently to plan and monitor progress. The teacher may provide guidance in breaking down tasks.	The teacher creates a learning context in which students regularly use technology tools for planning, monitoring, and evaluating learning activities. The teacher facilitates students' selection of technology tools.	The teacher creates a rich learning environment in which students regularly engage in higher order planning activities that may have been impossible to achieve without technology. The teacher sets a context in which students are encouraged to use technology tools in unconventional ways that best enable them to monitor their own learning.

The Technology Integration Matrix was developed by the Florida Center for Instructional Technology at the University of South Florida College of Education and funded with grants from the Florida Department of Education. For more information, visit http://mytechmatrix.org.

APPENDIX E

The Technology Integration Matrix of Table Student Descriptors

The Technology Integration Matrix of Table Student Descriptors

This table contains student descriptors for each cell of the Technology Integration Matrix (TIM). Other available resources include a tables detailing teacher activity, instructional settings, and a table of summary indicators for each TIM cell.

	Entry	Adoption	Adaptation	Infusion	Transformation
Active	Students receive information from the teacher or from other sources. Students may be watching an instructional video on a website or using a computer program for "drill and practice" activities.	Students are using technology in conventional ways and the locus of control is on the teacher.	Students work independently with technology tools in conventional ways. Students are developing a conceptual understanding of technology tools and begin to engage with these tools.	Students understand how to use many types of technology tools, are able to select tools for specific purposes, and use them regularly.	Students have options on how and why to use different technology tools, and often extend the use of tools in unconventional ways. Students are focused on what they are able to do with the technology. The technology tools become an invisible part of the learning.
Collaborative	Students primarily work alone when using technology. Students may collaborate without using technology tools.	Students have opportunities to use collaborative tools, such as email, in conventional ways. These opportunities for collaboration with others through technology or in using technology are limited, and are not a regular part of their learning.	Students have a beginning level of conceptual knowledge of using technology tools for working with others.	Technology use for collaboration by students is regular and normal in this setting. Students choose the best tools to use to accomplish their work.	Students regularly use technology tools for collaboration, to work with peers and experts irrespective of time zone or physical distances.

	Entry	Adoption	Adaptation	Infusion	Transformation
Constructive	Students receive information from the teacher via technology.	Students begin to utilize technology tools (such as graphic organizers) to build on prior knowledge and construct meaning.	Students begin to use technology tools independently to facilitate construction of meaning. With their growing conceptual understanding of the technology tools, students can explore the use of these tools as they are building knowledge.	Students consistently have opportunities to select technology tools and use them in the way that best facilitates their construction of understanding.	Students use technology to construct and share knowledge in ways that may have been impossible without technology. They have a deep understanding of the technology tools that allows them to explore and extend the use of the tools to construct meaning.
Authentic	Students use technology to complete assigned activities that are generally unrelated to the world beyond the instructional setting.	Students have opportunities to apply technology tools to some content-specific activities that are related to the students or issues beyond the instructional setting.	Students begin to use technology tools on their own in activities that have meaning beyond the instructional setting.	Students select appropriate technology tools to complete activities that have a meaningful context beyond the instructional setting. Students regularly use technology tools, and are comfortable in choosing and using the tools in the most meaningful way for each activity.	Students explore and extend the use of technology tools to participate in projects and higher order learning activities that have meaning outside of school. Students regularly engage in these types of activities that may have been impossible to achieve without technology.
Goal- Directed	Students receive directions, guidance, and feedback via technology. For example, students may work through levels of an application that provides progressively more difficult practice activities.	Students follow procedural instructions to use technology to either plan, monitor, or evaluate an activity. For example, students may begin a K-W-L chart using concept mapping application.	Students have opportunities to independently use technology tools to facilitate goal-setting, planning, monitoring, and evaluating specific activities. Students explore the use of the technology tools for these purposes.	Students regularly use technology tools to set goals, plan activities, monitor progress, and evaluate results. The students know how to use, and have access to, a variety of technologies from which they choose. For example, students may choose to write a blog for peer mentoring toward self- selected writing goals.	Students engage in ongoing metacognitive activities at a level that may have been unattainable without the support of technology tools. Students are empowered to extend the use of technology tools and have greater ownership and responsibility for learning.

The Technology Integration Matrix was developed by the Florida Center for Instructional Technology at the University of South Florida College of Education and funded with grants from the Florida Department of Education. For more information, visit http://mytechmatrix.org.

APPENDIX F

Computer Technology Integration Survey

Computer Technology Integration Survey

from "Increasing Preservice Teachers' Self-Efficacy Beliefs for Technology Integration," by L. Wang, P.A. Ertmer, & T.J. Newby, 2004, *Journal of Research on Technology in Education, 36,* pp. 245-246. Copyright 2004 by The International Society for Technology in Education. Used with permission.

Direction:
The purpose of this survey is to determine how you feel about integrating technology into classroom teaching. For each statement below, indicate the strength of your agreement or disagreement by circling one of the five scales.

Below is a definition of technology integration with accompanying examples:

<u>Technology integration:</u>
Using <u>computers</u> to support students as they construct their own knowledge through the completion of authentic, meaningful tasks.

<u>Examples:</u>
Students working on research projects, obtaining information from the Internet.
Students constructing Web pages to show their projects to others.
Students using application software to create student products (such as composing music, developing PowerPoint presentations, developing HyperStudio stacks).

Using the above as a baseline, please circle one response for each of the statements in the table:

SD = Strongly Disagree, D = Disagree, NA/ND = Neither Agree nor Disagree,
A= Agree, SA= Strongly Agree

1. I feel confident that I understand computer capabilities well enough to maximize them in my classroom.	SD	D	NA/ND	A
2. I feel confident that I have the skills necessary to use the computer for instruction.	SD	D	NA/ND	A
3. I feel confident that I can successfully teach relevant subject content with appropriate use of technology.	SD	D	NA/ND	A
4. I feel confident in my ability to evaluate software for teaching and learning.	SD	D	NA/ND	A
5. I feel confident that I can use correct computer terminology when directing students' computer use.	SD	D	NA/ND	A
6. I feel confident I can help students				

when they have difficulty with the computer.	SD	D	NA/ND	A
7. I feel confident I can effectively monitor students' computer use for project development in my classroom.	SD	D	NA/ND	A
8. I feel confident that I can motivate my students to participate in technology-based projects.	SD	D	NA/ND	A
9. I feel confident I can mentor students in appropriate uses of technology.	SD	D	NA/ND	A
10. I feel confident I can consistently use educational technology in effective ways.	SD	D	NA/ND	A
11. I feel confident I can provide individual feedback to students during technology use.	SD	D	NA/ND	A
12. I feel confident I can regularly incorporate technology into my lessons, when appropriate to student learning.	SD	D	NA/ND	A
13. I feel confident about selecting appropriate technology for instruction based on curriculum standards.	SD	D	NA/ND	A
14. I feel confident about assigning and grading technology-based projects.	SD	D	NA/ND	A
15. I feel confident about keeping curricular goals and technology uses in mind when selecting an ideal way to assess student learning.	SD	D	NA/ND	A
16. I feel confident about using technology resources (such as spreadsheets, electronic portfolios, etc.) to collect and analyze data from: student tests and products to improve instructional practices.	SD	D	NA/ND	A
17. I feel confident that I will be comfortable using technology in my teaching.	SD	D	NA/ND	A
18. I feel confident I can be responsive to students' needs during computer use.	SD	D	NA/ND	A
19. I feel confident that, as time goes by, my ability to address my students' technology needs will continue to improve.	SD	D	NA/ND	A
20. I feel confident that I can develop				

creative ways to cope with system constraints (such as budget cuts on technology facilities) and continue to teach effectively with technology.	SD	D	NA/ND	A
21. I feel confident that I can carry out technology-based projects even when I am opposed by skeptical colleagues.	SD	D	NA/ND	A

Name of Teacher Completing Survey:___________________________________-

Please check the box below and sign if you would like for your data on this survey to NOT be included in the research study data collection.

☐ I would prefer that my data not be used for the research study data collection.

____

Signed   Date

APPENDIX G

Interview Protocol: Professional Development for Technology Integration

Interview Protocol: Professional Development for Technology Integration

Time of Interview:

Date:

Place:

Interviewer:

Interviewee:

Position of Interviewee:

(Briefly discuss the study)

Questions:

1. Which components of the professional learning in technology did you find most valuable? Why?
2. Which components of the professional learning in technology did you find least valuable? Why?
3. Which components of the professional learning do you believe impacted your practice toward teaching with technology the most? Why?
4. Which components of the professional learning do you believe had the least impact on your practice toward teaching with technology? Why?
5. What else should have been included in the professional learning on technology? Why?

APPENDIX H

Peer Coaching Protocol

Peer Coaching

Observer as Coach

Developed in the field by educators.

Receiving real feedback can be threatening to the receiver, therefore **an important principle in this process is that at all times the person who is being observed is the one who is in control of the situation.**

Guidelines

1. Each person should choose the person with whom they will work. They should agree to take turns being the observer and the observed.
2. The pair should establish ground rules for giving and receiving feedback. For example: "Our observation data will remain confidential"; "We will meet to follow up on the observation within 24 hours of the observation."
3. The person asking for feedback specifies the areas in which they want feedback. For example: "Track the kinds of questions I ask (are they memory questions, or do they require evaluation)"; "Do I give enough time for students to answer?"; "Do I ask boys more questions than girls?"
4. The observer, armed with a short list of what to look for from the person being observed, comes and watches the class or meeting for a short time (15-20 minutes at first, longer as the pair becomes more comfortable with both observation and feedback).

5. The two people meet afterwards — *undisturbed.* During this meeting:
    - the partners should sit with the data between them.
    - the observed should refocus on the questions s/he asked. That is, reflect on the questions in light of the data brought back by the observer.
    - **the observer should share the things s/he saw, heard, and tracked rather than what s/he thought about them.** Allowing the observer to evaluate or judge the observed will poison the process quickly.
    - there should be some talk of what did and didn't happen and how the observed could make it happen next time.
    - the observed should encourage the observer to reflect on the relevance of the data to the questions.
    - both observer and observed should watch for defensive behavior.
    - the observer should check for signals to see if the other has had enough.

Protocols are most powerful and effective when used within an ongoing professional learning community and facilitated by a skilled facilitator. To learn more about professional learning communities and seminars for facilitation, please visit the School Reform Initiative website at www.schoolreforminitiative.org.

Person Observed as Coach

Developed in the field by educators.

This model is similar to Observer as Learner and as such is intended primarily to increase the learning of the person doing the observing. The debriefing is intended to help the observer learn more about the reasoning, strategies, and results of the work designed by the person observed.

Coaching Steps

- Each person should choose the person with whom they will work. This choice should be based on a sincere desire to learn something in particular from that person. (For example: "I have a hard time getting the kids to talk to each other rather than running everything through me. I know that you have a lot of success doing that, and I want to find out how.")

- Observer and coach (the person who is observed) should have a pre-conference, in which the coach helps the observer specify what s/he wants to learn more about. It may be helpful for the coach to give the observer relevant materials to review before the observation.

- The observer comes to the observation with a clear idea of what to look for, watches the session, and takes careful notes. It is important to remember where to focus — if you are looking for participant behaviors, you have to watch the participants, not the person leading the session. (For example, an observer interested in how an administrator manages a meeting to maximize faculty participation in decision-making will look closely at the points where interaction is highest, and note the administratorgenerated activities and presentations that seem to trigger that behavior.)

- After the observation, the observer and the coach meet (15-30 minutes, depending on how many questions the observer has). During this meeting:
- The observer should lead the discussion, so as to gain the maximum amount of learning from it.
- The observer should refocus on the original purpose of the observation, noting what s/he wanted to learn in the first place.

- The observer should share the things s/he saw, heard, and tracked that were relevant to his or her learning area.
- The observer should avoid evaluation or judgment, focusing on what s/he learned, not on what worked better or not as well.
- The observer should ask questions about things that s/he wants to know more about – for instance, strategies that s/he found especially interesting or puzzling, or incidents where more seemed to be going on than met the eye.
- The coach should add any relevant explanation of decisions, share other strategies that have worked in the past, or offer any materials or ideas that might help the observer.

Note: All questioning needs to be done carefully, with an eye to enhanced observer learning. It should not be allowed to turn into an unprepared peer supervision session, where the focus is on improving the practice of the observed.

Protocols are most powerful and effective when used within an ongoing professional learning community and facilitated by a skilled facilitator. To learn more about professional learning communities and seminars for facilitation, please visit the School Reform Initiative website at www.schoolreforminitiative.org

APPENDIX I

Grade Level Planning Examples Using TPACK

Grade Level Planning Examples Using TPACK

MATH THIRD GRADE 10-8-15 and 10-15-15

Standard or Indicator:
5.OA.5 apply commutative, associative, and distributive properties as strategies to multiply and divide (e.g., If 6 x 4 = 24 is known, then 4 x 6 = 24 is also known (commutative property of multiplication); 3 x 5 x 2 can be found by 3 x 5 = 15, then 15 x 2 = 30, or by 5 x 2 = 10, then 3 x 10 = 30 (Associative property of multiplication), knowing that 8 x 5 = 40 and 8 x 2 = 16, then one can find 8 x 7 as 8 x (5 + 2) = (8 x 5) + (8 x 2) = 40 + 16 = 56 (Distributive Property))

Embedded Learning Targets
What are the knowledge, reasoning, performance/skill, or product targets underpinning the standard?

Knowledge Targets *(What must students know?)*	**Reasoning Targets** *(How are students using knowledge to solve a problem, make a decision, etc.? What kind of cognitive demand is needed beyond recall?)*	**Performance/Process Skill Targets** *(What must students be able to do? How are they using knowledge and reasoning to perform a task? Is a real-time demonstration required to assess mastery?)*	**Product Targets** *(What are students asked to produce or create?)*
	I can solve multiplication problems by switching the order of the factors. I can solve multiplication problems by grouping factors in different ways. I can solve multiplication problems by decomposing a factor by multiplying each part and adding the partial products. I can determine appropriate strategies for division problems that relate to multiplication.	Content Knowledge	

<u>What academic language do students need to know?</u> Decompose, dividend, division, divisor, quotient, regroup, reorder, factor, product, multiplication, partial products, partial quotients, strategy, whole numbers, associative, commutative, distributive, property

Which type of learning target best represents the level of rigor required by the Standard? (Knowledge) (Reasoning) (Performance/Skill) (Product)

Assessment Decisions				
Most Appropriate DOK Level(s) for Assessing the Standard	**Learning Target**	**Learning Target Type** (Knowledge, Reasoning, Skill, or Product)	**Assessment Method Match to Learning Target** (Selected Response, Written Response, Performance, or Personal Communication)	**Draft of Assessment Item** (Formative or Summative)
Level 2	I can solve multiplication problems by switching the order of the factors. I can solve multiplication problems by grouping factors in different ways. I can solve multiplication problems by decomposing a factor by multiplying each part and adding the partial products. I can determine appropriate strategies for division problems that relate to multiplication.	All reasoning	Selected response Written response	If 3x5=15 then __x3=15. What is ___? #16 on the county created test needs to have parentheses AND #s in the same order #6, 9, 17, 18 on the county created test #1, 3, 7, 11 on the county created test

What are potential misconceptions that might arise in student learning?

Multiplication and division are not related
If there are 3 factors, it is automatically associative property
You can decompose factors into only 2 addends
Commutative property only applies to 2 factors

Strategic Instructional Decisions
What instructional strategies, instructional activities, or sequencing are needed to guide students toward mastery? Build an array, then separating into two separate parts Build an array, and turn it sideways Properties game Teach commutative property first Lessons from book on distribution Roll and cover to fill the grid What technology can be integrated to support the instructional strategies selected? Online manipulatives Excel http://www.haelmedia.com/OnlineActivities_txh/mc_txh3_002.html http://www.k-5mathteachingresources.com/ - Jack's Rectangles http://nlvm.usu.edu/en/nav/frames_asid_192_g_2_t_1.html?from=category_g_2_t_1.html

Pedagogical Knowledge

Technology Knowledge

2nd grade Lesson Plan Revision Using TPACK during Grade Level Plannng Social Studies, Reading, and Research through Informational Writing

I can do shared research to write a biography about an American Hero.

AS: Show student an example of what thier finished Buncee will look like.https://www.edu.buncee.com/buncee/v2/171801/?share_key=fed0a6b0715511e59eff00185179db73 The students already have partners and a person picked for their biography. Their next step is to research using provided books and PebbleGo. They will take their notes on the provided graphic organizer and use the organizer to plan their slides on Buncee. After each section of note taking the students will write a complete paragraph about using the information from their research.

Day 1- Early Life

TP: Once the studnets have completed their research and graphic organizer they will log on to https://www.edu.buncee.com/ and create a Buncee slide show based on the reasearch and graphic organizer they completed. Email: drvanbeurden@gmail.com Password: vanBeurden2. They are still responsible for all parts of informational writing.

S: Students will share completed projects at the biography buffet in November.

Standards:

The student will read about and describe the lives of historical figures in Georgia history.

Identify the contributions made by these historic figures: James Oglethorpe, Tomochichi, and Mary Musgrove (founding of Georgia); Sequoyah (development of a Cherokee alphabet); Jackie Robinson (sports); Martin Luther King, Jr. (civil rights); Jimmy Carter (leadership and human rights).

Describe how everyday life of these historical figures is similar to and different from everyday life in the present (food, clothing, homes, transportation, communication, recreation, rights, and freedoms).

Describe how place (physical and human characteristics) had an impact on the lives of each historic figure.

Describe how each historic figure adapted to and was influenced by his/her environment.

Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section.

With guidance and support from adults and peers, focus on a topic and strengthen writing as needed by revising and editing.

May include prewriting.

With guidance and support from adults, use a variety of tools to produce and publish writing, including digital tools and collaboration with peers.

Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).

Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text.

Identify the main topic of a multi-paragraph text as well as the focus of specific paragraphs within the text.

Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text.

Know and use various text features (e.g., captions, bold print, subheadings, glossaries, indexes, electronic menus, icons) to locate key facts or information in a text efficiently.

Explain how specific images (e.g., a diagram showing how a machine works) contribute to and clarify a text.

By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 2-3 text complexity band proficiently, with scaffolding as needed at the high end of the range.

Identify the main purpose of a text, including what the author wants to answer, explain, or describe.

APPENDIX J

IRB Approval Letter

BOISE STATE UNIVERSITY
RESEARCH AND ECONOMIC DEVELOPMENT

Date: August 25, 2015

To: Donna Ledford cc: Ross Perkins

From: Social & Behavioral Insitutional Review Board (SB-IRB)
c/o Office of Research Compliance (ORC)

Subject: SB-IRB Notification of Approval - Original - 104-SB15-150
Professional Learning for Technology Integration

The Boise State University IRB has approved your protocol submission. Your protocol is in compliance with this institution's Federal Wide Assurance (#0000097) and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46).

Protocol Number:	**104-SB15-150**	Received:	8/17/2015	Review:	Expedited
Expires:	**8/24/2016**	Approved:	8/25/2015	Category:	7

Your approved protocol is effective until 8/24/2016. To remain open, your protocol must be renewed on an annual basis and cannot be renewed beyond 8/24/2018. For the activities to continue beyond 8/24/2018, a new protocol application must be submitted.

ORC will notify you of the protocol's upcoming expiration roughly 30 days prior to 8/24/2016. You, as the PI, have the primary responsibility to ensure any forms are submitted in a timely manner for the approved activities to continue. If the protocol is not renewed before 8/24/2016, the protocol will be closed. If you wish to continue the activities after the protocol is closed, you must submit a new protocol application for SB-IRB review and approval.

You must notify the SB-IRB of any additions or changes to your approved protocol using a Modification Form. The SB-IRB must review and approve the modifications before they can begin. When your activities are complete or discontinued, please submit a Final Report. An executive summary or other documents with the results of the research may be included.

All forms are available on the ORC website at http://goo.gl/D2FYTV

Please direct any questions or concerns to ORC at 426-5401 or humansubjects@boisestate.edu.

Thank you and good luck with your research.

Mary E. Pritchard

Dr. Mary Pritchard
Chair
Boise State University Social & Behavioral Insitutional Review Board

1910 University Drive Boise, Idaho 83725-1139
Phone (208) 426-5401 orc@boisestate.edu

This letter is an electronic communication from Boise State University

APPENDIX K

Permissions

From: Paul Wurster <pwurster@iste.org>

To: "donna_ledford@gwinnett.k12.ga.us"

<donna_ledford@gwinnett.k12.ga.us>

Date: 07/13/2015 05:36 PM

Subject: RE: Permissions and Reprints Request from DonnaLedford

Donna,

Thank you for requesting permission to use content from ISTE's Journal of Research on Technology in Education. ISTE permits your use of this content (limited, noncommercial within K-12 classrooms, schools or districts, or for research) at no cost as long as there is no monetary gain.

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Please let me know if I can be of additional assistance.

Kind regards,

Paul Wurster

Editor

Books & Journals

pwurster@iste.org

cid:image001.png@01CF231E.C25BF070

On 7/9/15, 3:30 PM, "iste@iste.org" <iste@iste.org> wrote:

A request to reprint ISTE material has been submitted from Donna Ledford

1. What material are you interested in? Check one or more:

Article(s) from Journal of Research on Technology in Education

Wang, L., Ertmer, P.A., & Newby, T. A. (2004). Increasing preservice teachers' self-efficacy beliefs for technology integration. Journal Of Research on Technology in Education, 36(3), pp.245-46.

I would like to request permission to use the Computer Technology Integration Survey on these pages as part of my dissertation from Boise State University in Educational Technology

2. Are you requesting (check all that apply):

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20

Electronic rights (If for a website, is the site password protected?)

Dissertation

3. How do you intend to use the material? (The more detail you provide, the faster we will be able to process your request.)

I would like to use the survey with 10 teachers as a pre and post assessment of their attitudes and self-efficacy toward technology integration. This will serve as part of the data collection for my dissertation: Professional Learning for Technology Integration from Boise State University. I anticipate using the survey in August and December 2015.

4. Is there a commercial aspect to this use? (ie. product charges,

subscription fees, admission charges, etc.)

No

---------- Forwarded message ----------

From: **Info** <info@aace.org>

Date: Thu, Jul 9, 2015 at 11:21 AM

Subject: Re: Request Permission to Use a Figure for Dissertation

To: Donna Ledford <donnaledford@u.boisestate.edu>

We do n to have a formal process for permission. If this email will not work for your school please let me know.

Thank you

Casey Eaker, Business Office
Email: Business@aace.org
Phone:828-246-9558Fax: 703-997-8760
AACE--Association for the Advancement of Computing in Education; http://AACE.org
SITE--Society for Information Technology and Teacher Education; http://SITE.aace.org
AACE, PO Box 719, Waynesville, NC USA

On Jul 9, 2015, at 11:04 AM, Donna Ledford <donnaledford@u.boisestate.edu> wrote:

Thank you for the quick response. I am expected to include the approval form in my dissertation. Is there a formal process for your organization or will your email suffice as permission. Thank you again.

On Thu, Jul 9, 2015 at 8:34 AM, Donna Ledford <donnaledford@u.boisestate.edu> wrote:

Good morning. I would like to request permission to use a figure from a CITE issue in my dissertation at Boise State University. Could you please point me in the direction for how to go about this process? Here is the reference that I am requesting. The figure is on p. 63. Thank you for your assistance.

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

Donna Ledford
Doctoral Candidate
Educational Technology
Boise State University

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