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Beliefs vs Behavior of Elementary Teachers Integrating Technology in Mathematics

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This is to certify that the doctoral dissertation by

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2018

Abstract

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BEd, University of the West Indies, 1998.

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Learning, Instruction, and Innovation

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Abstract

Many elementary students struggle to meet expectations on mathematics assessments despite an increase in science, technology, engineering, and math instructional strategies. The purpose of this qualitative case study was to explore elementary math teachers' technology integration self-efficacy, their level of technology adoption, and their actual technology integration behavior. The conceptual framework used in this study included Bandura's social cognitive theory, which is often used in the investigation of self-efficacy. Additionally, the International Society for Technology Education Classroom Tool, which is in alignment with the National Educational Standards for Teachers, was used to gauge the level of technology integration in the classroom. Nine volunteer teachers in Grades 3-5 participated in surveys, observations, and follow-up interviews. Data were analyzed using open coding to identify themes and patterns. The findings from this study indicated that the teachers' perceptions were positive as they believed technology could have positive implications for the teaching and learning process. However, findings also indicated that not all the teachers in the study felt confident with using technology in their practice. These teachers indicated that there was a need for onsite support, peer mentoring and professional development geared towards effectively aligning content, pedagogy, and technology. The information from this study may add more to the body of knowledge on information and communications technologies adoption and integration. The social change potential in this study is that through confident teachers in mathematics, and technology integration, students may improve their skills to be competitive for employment and opportunities in a global marketplace.

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Dedication

This dissertation is dedicated to my husband, daughter, sister, mother, and in memory of my father. My family has been the backbone of my support. They have been a motivating factor and have inspired me in various ways, resulting in the completion of this doctoral journey. Mom and Tyler, thanks for staying up with me all night while I wrote those chapters. Carol thanks for giving a listening ear. Parry, thanks for your love and support!

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There have been many late nights and challenges faced during this doctoral journey including my dad’s diagnosis and death from brain and lung cancer. I am appreciative of my husband, Parry and my daughter Tyler for their unconditional love, support, and encouragement.

Thanks Dana Price and Cheryl Thomas for always going the extra mile to help in many ways. Also, Special thanks to my dissertation committee, Dr. Jennifer Smolka and Dr. Andrew Thomas for their expertise and guidance. Thanks to all of you for doing your part so that my dreams of attaining a doctoral degree can become a reality.

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Chapter 1: Introduction to the Study

Technology is evolving at a rapid rate and can be found in every aspect of society. It can be found in the work place as well as in homes and has an effect on the way that individuals interact, communicate, work, and learn. Technology is deemed to be an essential means to tap into students' digital world to harness and sustain their interest during the learning process (Cox, 2013; Fullan, 2013; Lui, Hsien-Chang, & Yo-Ting, 2015; U.S. Department of Education, 2010).

Research indicates that there are a countless number of instructional tools; however, a significant number of educators are not integrating technology during lessons (Darling-Hammond, Zielezinski, & Goldman, 2014; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). Additionally, there is the speculation that lack of training in best practices of technology integration is a factor impeding the technology adoption process (Jones, 2001; Morehead & LaBeau, 2005; Oliver & Townsend, 2013; Ruggiero & Mong, 2015; Sabzian, Gilakjani, & Sodouri, 2013).

Other factors that have contributed to teachers not integrating technology are challenges faced with using the equipment, time constraints, software availability, scheduling difficulties, and support through training (Abukhzam, & Lee, 2010; Agbo, 2015; Haight, 2011; Project Tomorrow, 2014; Walker 2011). Although steps have been taken to alleviate these challenges, technology integration within lessons continue to pose a challenge within schools in the United States (Darling-Hammond, Zielezinski, & Goldman, 2014; Fullan, 2013; Haight, 2011; Project Tomorrow, 2014; Zieffler, Park, Garfield, delMas, & Bjornsdottir, 2012). According to researchers, studies are needed to examine how teachers' belief about self-efficacy impacts the way technology is used in the classroom (Duffin, French, & Patrick, 2012; Dunmire, 2010; Gulbir, Cakiroglu, & Capa Aydin, 2012; Keppler, Weiler, & Maas, 2014; Kim, Kim, Lee, Spector, & DeMeester, 2013).

With this study, I intended to offer both in-depth insights into teacher's perspectives on how their self-efficacy beliefs influence the way technology is incorporated during mathematics instruction. The study provided an overall picture of where the teachers were in terms of technology adoption or acceptance, as well as provided information on how technology was currently being utilized during math lessons. Chapter 1 focuses on the background, problem statement, and rationale for conducting the study. Chapter 1 also includes the purpose of the study, research question, conceptual framework, nature of the study, definitions of key terms, assumptions, scope and delimitations, and limitations.

Background

In this study, examining teachers' beliefs about technology in relation to their actual behavior in incorporating technology in their teaching practice was central to understanding technology adoption. There has been cause for concern that students in America are performing below expectations in math when compared to their counterparts in other countries such as Japan, Germany, and Russia (National Commission on Excellence in Education, 1983; OECD, 2014). The U.S. Federal Government initiated education reform to examine the quality of education being imparted to students in the United States. Policymakers considered mathematics and science to be the deficient areas and technology was believed to be necessary to propel the change (U.S. Department of Education, 2017).

Teachers have the responsibility to come up with innovative approaches to improve learning and transform the traditional classroom from a teacher-directed environment to more of a learner-directed environment. Therefore, exploring the connection between pedagogy and technology is important. This is because technology should not be deemed as an isolated component or as an add on, but instead technology should be considered an essential element for effective instructional delivery (Francom, 2016; Moeller & Reitzes, 2011; Olnzock & Okojie-Boulder, 2006). Teachers should be cognizant of the rationale and appropriateness for incorporating technology. Bearing this in mind, teachers should select technology aligned with the objectives of the lesson, instructional methods, assessment, feedback, and follow-up initiatives (Moeller & Reitzes, 2011; Reigeluth, Beatty & Myers, 2016). Deliberating on these things will promote self-reflection and ensure that technology is integrated in lessons in a purposeful manner.

Problem Statement

Despite increased technology infrastructure and professional development, many teachers are not effectively using technology tools to enhance their mathematics instruction (Francom, 2016; Ruggiero & Mong, 2015). With the emergence of 21st century skills as a necessity to efficiently prepare students to function in college, a career, and in life (Beers, 2012; Farisi, 2016), there is also increased need for technology to be incorporated in instruction to improve student learning outcomes (Mkomange, Ilembo & Ajagbe, 2012; Reigeluth, Beatty & Myres, 2016).

Researchers such as Aslan and Zhou (2016) have indicated that teachers are willing to utilize technology. However, there are limitations such as access to hardware and software and technology devices not being in working order (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Ruggiero & Mong, 2015). Additionally, questions exist as to whether or not teachers are using technology effectively during lessons in order to create meaningful learning experiences for students (Daggett, 2010; Francom, 2016). For example, many teachers use technology to create PowerPoint presentations and use them for lectures. Some researchers believe that using PowerPoint during lecture-based lessons does not engage students in the learning process (Bishop & Verleger, 2013; Brock & Joglekar, 2011; Guy & Marquis, 2016). However, the use of technology to enhance lecture-based lessons is not considered best practices (Butt, 2014; Hamden & McKnight, 2013; Walker, 2011). Additionally, though researchers have conducted studies to investigate technology barriers, as well as supports, there is a need to gain an in-depth understanding of teachers' beliefs pertaining to self-efficacy and how it fosters or hinders technology integration in the classroom (Fullan, 2013; Ramsay, Arman, & Pursel, 2014).

Being able to understand teachers' self-efficacy beliefs is vital because technology adoption depends on the teacher (Hamden & McKnight, 2013). Teachers determine the type and quality of technology that will be used during lessons based on the technology available to them (Al-Awidi & Alghazo, 2012; Aslan & Zhou, 2016).

I conducted a qualitative case study to explore upper elementary teacher's self-efficacy beliefs and technology integration behaviors in the mathematics classroom. This may provide insights needed to design learning opportunities to increase teachers' self-efficacy and technology integration during instruction.

Purpose of the Study

The purpose of this qualitative case study was to explore the patterns between elementary math teachers' technology integration self-efficacy and their actual technology integration behavior. This purpose was divided into three components: (a) to explore teachers' beliefs about their self-efficacy and level of technology adoption, (b) to observe teachers' actual technology use during mathematics lessons, and (c) to describe in depth the relationship between teachers' beliefs and their behavior. To achieve these goals, I collected data through a self-rated survey, interviews, and observation. These instruments were aligned with each research question respectively (See Appendix A).

Research Questions

The following questions guided this study:

1) What are elementary mathematics teachers' beliefs about their technology integration self-efficacy and their stages of technology adoption?
2) How do elementary mathematics teachers demonstrate their levels of self-efficacy, adoption and use of technology in math instruction?
3) What patterns exist in the relationship between these teachers' beliefs and behaviors related to technology integration in the classroom?

Theoretical Framework

This qualitative study utilized a multidimensional theoretical framework approach that combined Albert Bandura (1977) social cognitive theory, the International Society for Technology in Education (ISTE) Standards, and the stages of adoption of technology (Christensen and Knezek, 1999). I selected Bandura's theory because my aim was to explore teachers' self-efficacy, specifically with regards to technology. Self-efficacy can be examined through the lenses of social cognitive theory, which is often used to examine how individuals acquire knowledge.

In discussing self-efficacy, Bandura (1995) speculated that self-efficacy can be realized or reinforced as individuals achieve mastery through a particular experience or accomplish a specific task. Being successful allows the person to feel a robust sense of efficacy. In contrast, if the individual experiences failure before a feeling of self-efficacy is firmly established, then failure will weaken his or her sense of efficacy (Bandura, 1995). Based on this perspective, a teacher's technology self-efficacy will influence his or her perceptions related to ease of use, as well as perceptions about the usefulness of technology integration in lessons (Ismail, Mahmud, Nor, Ahmad & Rahman, 2011).

Banduras' social cognitive theory is based on the notion that individuals are responsible for their behaviors and this is a great determinant of whether or not they will be willing to adapt to change (Bandura, 2001). Bandura's (1977) social cognitive theory was used to provide an understanding on how self-efficacy can impact an individual's psychological state, motivation, and actions. By using this theory, I was able to explore the technology integration behavior between teachers who rated themselves within the low, medium, and high efficacy categories.

I used the ISTE's national educational technology standards for teachers (NETS-T) as the other framework to examine technology integration in the classroom. The ISTE developed the standards to support K-12 schools with integrating technology in the curriculum (ISTE, 2000; 2008). ISTE defined the skills that need to be taught and learned to function in the digital era. They proposed standards for students, teachers, and administrators. However, for the purpose of this research, only the ISTE standards for teachers were discussed since my focus was on teaching with technology. In this study, I used the ISTE NETS-T standards as guidelines to explore if teachers were successfully integrating technology in their lessons. The five ISTE NETS- T performance indicators were:

1. Facilitate and inspire student learning and creativity
2. Design and develop digital-age learning experiences and assessment
3. Model digital-age work and learning
4. Promote and model digital citizenship and responsibility
5. Engage in professional growth and leadership. (ISTE, 2008, para. 1 – 5; See appendix B for a complete listing of the ISTE NETS-T standards)

There are several instruments that a researcher can use to measure technology implementation behaviors. These instruments include the concerns based adoption model (CBAM; (Hord, Rutherford, Hurling-Austin & Hall, 1987) and stages of adoption of technology tools (Christensen & Knezek, 1999). The CBAM model has three components, the innovation configuration map, stages of concern, and the levels of use. The details of these components are presented in the literature review section in Chapter 2. Hall and Hord (1987) developed the CBAM levels of use (LoU) tool to provide support to educational leaders implementing a new program or innovation. Specifically, the LoU tool was designed to measure teachers' actions or behaviors in relation to the implementation of an innovation. The LoU has eight behavioral profiles. They are "Nonuse, 0; Orientation, 1; Preparation, 2; Mechanical, 3; Routine, 4A; Refinement, 4B; Integration, 5; and Renewal, 6" (Hord, Rutherford, Hurling-Austin & Hall, 1987, pg. 703; see Appendix C for a complete description of the LOU tool). The higher on the continuum teachers are, the greater their levels of technology integration in the classroom. Teachers can progress, regress, or stay at a particular point on the continuum while integrating technology (Hord, Rutherford, Hurling-Austin & Hall, 1987).

Christensen & Knezek, (1999) designed the stages of adoption of technology model to measure the impact of technology implementation and training. Similar to the CBAM instrument, the framework presents six stages, from which an individual selects the one that best describes his or her current stage of adoption on the continuum. The levels range from "(1) awareness, (2) learning the process, (3) understanding and application of the process, (4) familiarity and confidence, (5) adaptation to other contexts, and (6) creative applications to new contexts" (Christensen & Knezek, 1999, pg. 25). Overall, the stages of adoption of technology instrument were used to examine where teachers were on the technology integration continuum (Alexander, Knezek, Christensen, Tyler-Wood, & Bull, 2014). In addition, I used the ISTE-NETs standards to determine the quality of technology infused math lessons. Determining how technology was being incorporated in relation to the ISTE- NETs standards and 21st century skills was imperative for effective technology integration in the classroom (Christensen, Knezek, Alexander, Owens, Overall, & Mayes, 2015). Based on this perspective, knowing teachers' levels of technology expertise as well as challenges could enable learning leaders to provide the support that is needed to help teachers incorporate technology effectively in their instruction.

Nature of Study

There are five approaches to qualitative research. They are grounded theory, narrative, ethnography, phenomenology, and case study. I used a qualitative case study approach because case studies are appropriate when there is a need to focus on depth and to study people (Neale, Thapa, Boyce, 2006).

My reason for electing to conduct a case study rather than grounded theory was that grounded theory is better to use when a researcher wants to discover or generate theory. Since the purpose of my study was not to discover or generate theory, I did not select grounded theory.

I did not select narrative because researchers use this approach to focus on someone's story across time (Creswell, 2007). Ethnography was not ideal either. Rogers (2014) stated that ethnography can be used when researchers want to focus on the individual setting and are seeking to tell a story within the participants' cultural context or group. My purpose for conducting the study was not to provide an in-depth description of a group so I did not select this approach.

Similarly, I did not select phenomenology because the purpose for conducting phenomenological research is to describe participants' lived experiences, and this was not my intention. Therefore, after reflecting on the rationale behind the study, which was to explore how and why questions about teachers' technology beliefs and technology integration behaviors, I felt that a case study design was most appropriate, and thus I selected the case study approach.

I surveyed, observed, and interviewed nine teachers in Grades 3, 4, and 5 to understand the relationship between elementary math teachers' technology integration self-efficacy beliefs, their levels of technology adoption, and their actual technology integration behavior. Participants completed the stages of adoption survey to measure their levels of technology adoption. The participants also completed a questionnaire composed of the CTI survey (Wang, et al., 2004) to assess their levels of technology self-efficacy. I used open coding to analyze the data.

Definition of Terms

The following terms were used throughout this research and were defined for purposes of the study:

21st century learning skills: Critical thinking, problem solving, communication, collaboration, creativity, and motivation (Partnership for 21st Century Learning, 2011)

Computer self-efficacy: An individual's beliefs about his or her capabilities to use a computer (Compeau & Higgins, 1995).

Educational Technology: Educational Technology is sometimes referred to as instructional technology. It is used during the learning process, particularly digital computer technology and its peripherals (Richey, 2008).

Information and Communications Technology (ICT): The general term used for all communication device or application which is not limited to, but includes radio, television, cellular phones, computer and network hardware and software (Dutta, Gieger, & Lanvin, 2015).

Levels of Technology Use and Stages of Technology Adoption: Levels of Use and Stages of Technology Adoption are used interchangeably within this study. The general term used when discussing where teachers are on the technology integration continuum.

Self-efficacy: An individual's belief that he or she is capable to perform in a specific manner to successfully accomplish a particular task or goal (Bandura, 1994).

Student Engagement: The general term used when students are actively involved in tasks that will lead to high-quality learning or measurable outcomes (Coates, 2009).

Technology Adoption: The decisions that individuals make each time that they consider taking up an innovation (Rangaswamy & Gupta, 2000).

Technology Integration: The implementation of technology tools and resources in daily classroom practices (Singh, 2013).

Technology Self-efficacy: Teacher's belief about his or her ability to effectively integrate technology in the classroom.

Assumptions

I assumed that all teachers in Grades 3, 4, and 5 who participated in the study have been integrating technology into the mathematics curriculum. Also, I assumed that the number of participants included in the study was enough to provide substantial data that would help me to understand the patterns that existed among teachers' self-efficacy and their actual integration of technology during the teaching of mathematics. I assumed that the teachers would not considerably modify their interactions with the students during classroom observations. Additionally, I assumed that any data collected would be of rich quality and thus serve the purpose of substantiating and responding to research questions that I posed.

Scope and Delimitations

This study was restricted to mathematics teachers in third to fifth grades within the Sun State school district (Pseudonym). Additionally, the teachers' participation in the study were based on the conditions of them (a) having at least 2 years or more teaching experience, (b) working in the Sun State School System, (c) currently teaching mathematics, (d) having access to and knowing how to use technology, and (e) currently integrating any form technology during mathematics instruction. I did not delimit the technology used by the teachers in this study to a specific range of technologies.

Limitations

During the research process, I used the stages of adoption of technology and the computer technology integration surveys. These instruments were limited to the participants' willingness to respond truthfully and accurately, as well as to complete the surveys in a timely fashion. Another limitation of the study was that the research site was one school district with a small sample of participants who were teachers teaching mathematics to Grades 3-5 students.

Significance of Study

This study is significant because it explored teachers' self-efficacy beliefs about technology integration in mathematics lessons, which was an area that was inadequately researched (Gulamhussein, 2013; Kotrlik & Redmann, 2009; Tsai & Chai, 2012; Walker, 2011). Researchers have conducted studies examining pre-service teachers' self-efficacy and their use of technology (Al-awidi & Alghazo, 2012; Kim, Kim, Lee, Spector & DeMeester, 2013; Walker, 2011). However, more studies need to be done to investigate the classroom teachers' self-efficacy beliefs on their ability to integrate technology in the classroom (Bernhardt, 2015; Fullan, 2013; Hsu, 2016; Shu, Tu, & Wang, 2011; Teo, 2009; Tsai & Chai, 2012). Bangs and Frost (2012) proposed that for a teacher to have good initiative, be competent in problem solving and be resilient, he or she must possess a positive sense of efficacy. Similarly, there continues to be the need to determine the extent to which teachers are effectively incorporating technology in their instruction (Chien, Wu, & Hsu, 2014; Cox, 2013; Ruggiero & Mong, 2015; Tour, 2015).

This case study offers insights into how mathematics teachers' self-efficacy beliefs affect their self-rated levels of technology adoption. By conducting this research, it was my intention to obtain insights into how technology was utilized and the type of supports those mathematics teachers believed they needed to fully adopt technology.

This study can contribute to social change by identifying common characteristics found among teachers who are exemplary in technology integration. The school district and administrators can use the findings in my study to create action plans and implement professional development workshops. Similarly, the results of my study can facilitate improved teacher use of technology integration during instruction, which can lead to increase in student achievement. Lastly, my study can add to the body of scholarly research and literature in the field of educational technology, particularly in elementary mathematics education.

Summary

Approximately 97% of classrooms in the United States are equipped with a variety of technologies that include but are not limited to interactive whiteboards, computers, and laptop carts (Gray, Thomas, & Lewis, 2010; U.S. Department of education, National Center for Education, 2010; Williams, Warner, Flowers, & Croom, 2014). Despite having access to a wealth of technology devices that are connected to the Internet, some teachers are not utilizing technology as teaching tools during lessons. Researchers have cited first- and second-order barriers as being factors that have contributed to technology not being fully implemented within the educational system. First-order barriers are associated with external challenges such as those that include equipment and infra-structure, while second-order barriers are related to intrinsic factors such as teacher beliefs and low self-efficacy (Carver, 2016; Cox 2013; Fullan, 2103; Tella, 2011). Tsai and Chai (2012) and Francom (2016) proposed that third-order barriers can also hinder technology implementation. Third-order barriers include design thinking.

Chai (2012) further stated that design thinking involves reflection in a manner geared towards intentionally creating effective learning environments. It requires flexibility and creativity in arriving at insights in order to solve problems or to overcome challenges (Chai, 2012), in this case those related to the incorporation of technology during mathematics instruction.

However, Tsai and Chai (2012) and Carver (2016) proposed that to achieve technology integration, second-hand barriers such as those related to teacher attitude change, must first be addressed. Having a sound understanding about intrinsic barriers can lead to technology becoming an integral part of the actual teaching and learning process. This is because the insights obtained can then be tailored into programs to offer training, ongoing support, as well as disseminated through means of professional development training. In Chapter 2, the literature review, I provide support for claims stipulated in this section, as well as support for this study's research problem, purpose, and questions.

Chapter 2: Literature Review

Possessing technology skills is essential to function effectively in classrooms and the workforce (Partnership for 21st Century Learning, 2013). There is concerted focus on the need to transform classrooms into a place where students can use modern day technologies to develop critical thinking skills. Thus, technology is deemed to be an essential tool and educators are faced with the responsibility to incorporate it in their instructions to help students attain academic proficiency (Cox 2013; Gulamhussein, 2013; Rich, 2010). Since schools are deemed to be social agents of change, it is important that teachers be properly trained on how to utilize technology so that they can effectively impart the skills that are necessary for students to be successful in a competitive world (Bernhardt, 2015; Trilling & Fadel, 2009). However, a teacher's lack of confidence in how to integrate technology can be a hindrance to how technology is used during instruction (Blackwell, Lauricella, & Wartella, 2014; Ertmer, 2010). Similarly, a lack of confidence can result in avoidance of technology. The purpose of this qualitative case study was to explore the relationship between elementary math teachers' technology integration self-efficacy, their level of technology adoption, and their actual technology integration behavior.

This chapter is organized to present literature on topics framing the problem, as well as the need for exploring the patterns among teachers' technology self-efficacy beliefs and technology integration during instruction. The section begins with a description of the theoretical frameworks that guided this study. It also includes literature pertaining to self-efficacy and its implications on technology use and mathematics instruction. I also examined other relevant literature. The related literature includes 21st century learning, technology integration proficiency versus computer proficiency, barriers to technology adoption, evaluating the effectiveness of technology integration, stages of adoption of technology, technology integration as a process, mathematics and technology. These concepts help me to build a knowledge base on the subject of self-efficacy beliefs and the integration of technology in mathematics instruction.

Literature Search Strategy

I conducted a search in the Walden University databases, which included the ERIC, Education Research Complete, and Sage to source information on technology barriers and technology usage. I used keywords to search these databases. Some of the key words included *instructional technology*, *technology adoption*, *technology integration*, *technology and mathematics*, *technology* and *student achievement*, *educational technology*, *technology evaluation*, *teacher perception*, and *effective use of technology*. Additionally, I used Google and Google Scholar to retrieve resources from websites such as U.S. Department of Education and National Center for Educational Standards. Some key words that I used during the search were *self-efficacy beliefs*, *self-efficacy theories*, *technology*, *stages of adoption*, *technology in teaching and learning*, and *concerns based adoption model*.

Theoretical Framework

In this study, I used a multidimensional theoretical framework approach that combines Albert Bandura (1977) social cognitive theory, the ISTE standards, and the stages of adoption of technology. Bandura (1977) stated that the social cognitive theory can be used as a basis for explaining behavioral outcomes, whether desirable or undesirable. The theory surpasses the behavioral perspectives that behavior is influenced solely by the external environment, and instead adds the element of cognition. The thought behind this is that learners construct meaning or knowledge for themselves. The social cognitive theory includes other components including self-efficacy, which involves the individual's capabilities to complete tasks or accomplish goals successfully.

Social Cognitive Theory

Bandura (1982) stated that human actions are as a result of a variety of reasons such as behavior, cognitive, personal, and external environment factors. While behaviorists believe that environmental factors influence people's actions to a great extent; Bandura believed that individuals are responsible for making things happen and are responsible for their actions and behavior (Bandura, 2006). Self-reflection or self-regulatory processes are important aspects of the social cognitive theory as it is through such means that experiences are internalized, self-evaluation done, and perceptions and behaviors modified (Carver, 2016; Gredler, 2009; Tella, 2011). Researchers proposed that the social cognitive theory is an appropriate framework that can provide a general understanding on how to enhance learning and confidence, as well as rectify faulty perceptions and lessen or eliminate mindsets (Francom, 2016; Gredler, 2009; Tella, 2011).

Self-Efficacy Theory

In his social cognition theory, Bandura (1977) stated that there is an existing correlation between behavior, cognition, and environmental factors. An individual's perceived self-efficacy can impact behavioral change. The theory rests on the premise that an individual's self-efficacy determines how he or she feels, thinks, and behaves and that such beliefs serve as a motivating factor when faced with adversity or when the individual is required to accomplish a task. Individuals with a strong sense of efficacy will approach a difficult task with a mindset that it is a challenge worth mastering. Individuals with a weak sense of efficacy may focus on their personal deficiencies and see the same task as a threat that should be avoided (Bandura, 1994).

In discussing how self-efficacy develops, Wood and Bandura (1989) argued that people's beliefs can be enhanced four ways:(a) mastery experience or personal accomplishment, (b) vicarious experience, (c) social persuasions, and (d) somatic and emotional states. The first way self-efficacy develops is through mastery experience or personal accomplishment. Bandura (1994) stated that mastery or personal accomplishment is the most efficient means of self-efficacy development and that such experiences can lead to interpretation of actions whether successful or otherwise.

The second way self-efficacy develops is when people are placed in situations with individuals who are similar to themselves, where they are able to observe them mastering the task or accomplishing the intended goals. If the individuals are successful then the observer's self-belief will be strengthened. However if the individual being observed fails at the task, then the observers' sense of efficacy may weaken.

The third way that self-efficacy develops is through social persuasion, which involves the use of realistic encouragements (Wood & Bandura, 1989). However, this method is said to be a weaker source for promoting self-efficacy than mastery or vicarious experiences (Bandura, 1997). Social persuasion serves as the driving force for an individual exerting more effort to be successful at a task.

The final way to modify self-beliefs of efficacy is to reduce the individual's stress levels, as stress can impact how an individual feels about his or her personal abilities (Bandura, 1997). Pajares (2002) posited "When people experience aversive thoughts and fears about their capabilities, those negative affective reactions can themselves further lower perceptions of capability and trigger the stress and agitation that help ensure the inadequate performance they fear" (p.1). Similar views were shared by Shu, Tu, and Wang (2011), who theorized that "self-efficacy influences individual's feelings of stress and anxiety, including thought patterns and emotional reactions" (p. 927). However, it should be noted that Pajares (2002) also pointed out that people occasionally experience what is deemed to be usual or normal anxiety, which is generally experienced prior to an important endeavor and this is in no way an indication of low self-efficacy. On the other hand, if an individual exhibits strong emotional reactions toward a task, this can be an indicator of anticipated success or failure.

Self-efficacy & Technology

Factors such as teacher beliefs and self-efficacy can impact the decision to incorporate technology during instruction in the classroom. The current problem being faced is educators' failure to effectively utilize technology within lessons to increase student achievement (Ertmer & Ottenbreut-Leftwich, 2010; Lentz, Kyeong-Ju Seo, & Gruner, 2014; Tella, 2011). Some researchers have indicated that if teachers have a variety of technologies at their disposal, they are more likely to try them out Gruner, 2014; Tweed, 2013). As teachers use the technologies, they may practice to the extent where they experience a sense of comfort. Such comfort will give rise to ease of use and a willingness to experiment with various technology devices and tools (Fullan, 2013; Tella, 2011; Tweed, 2013). The opposite is said to be true as well: if there is limited technology available to teachers then they will not gain adequate practice and hence are less likely to experience the feeling of comfort necessary to use technology during lessons in the classroom (Tweed, 2013).

Paraskeva, Bouta, and Papagianni (2007) and Chien, Wu, and Hsu (2014) proposed that a strong sense of technology efficacy can have implications on the way, as well as the extent, that technology is used during instructional practice. Bandura (1997) theorized that there is a significant correlation between self-confidence and self-efficacy. Based on these perspectives, it is important for teachers to be provided the necessary skills that will enhance their self-perceptions as this will empower them.

Additionally, a teacher's philosophy about teaching can influence how he or she uses technology in the classroom. Teachers with constructivist philosophies have more of a tendency to incorporate technology in a manner that supports student-centered activities, while teachers who hold traditional beliefs were more apt to utilize computers to support teacher-directed activities (Akpan & Beard, 2016; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). However, not because a teacher holds a constructivist belief means that he or she can effectively incorporate technology during lessons. For teachers to be knowledgeable decision makers regarding effectively utilizing and integrating technology in lessons, research indicates that teacher educator programs and professional development activities need to be available to educators (Bernhardt, 2015; Harris & Hofer, 2011; Inan & Lowther, 2010; Kopcha, 2013).

In reference to technology training programs, Guzman and Nussbaum (2009) posited “This training should be the basis for serious reflection that will promote the transformation of teaching practices and make significant contribution to the adoption of technologies by teachers” (p. 454). Training teachers how to utilize technology during lessons is essential. However, if teachers do not perceive that integrating technology in the curriculum will be useful and that it will yield better results, then they are less likely to utilize it during the teaching and learning process (Almekhlafi, & Almeqdadi, 2010; Tella, 2011; Turel, 2014). In contrast, if teachers have a positive perception about technology integration in lessons then they are more likely to embrace technology adoption (Abbitt, 2011; Turel, 2014; Vanderline, van Braak & Tondeur, 2010).

It is important to note that having knowledge, confidence, or a positive self-perception is not sufficient because teachers often must adhere to the policies mandated by the school district. In citing the effects that school district policies have on technology integration, Barbaran (2014) stated “District mandates to raise test scores, submit reports, and complete redundant paperwork hinder efforts to encourage teachers to integrate technology into the classroom” (p.20). Barbaran (2014) further argued, “Teachers’ time is consumed by and limited to trying to learn strategies that have no technology component to achieve educational goals” (p. 20). Several researchers indicated the need for coherency among school district, administrators, and teacher preparation programs (Barbaran, 2014; Ertmer & Ottenbreit-Leftwich, 2010; Kopcha, 2013; Turel, 2014).

Self-efficacy and Mathematics

In defining mathematics self-efficacy, Burnham (2010) proposed that it involves a person's convictions pertaining to his or her ability to successfully solve mathematical problems. Mathematics literacy or numeracy is very essential in an individual's personal and career life and involves problem solving, reasoning, and analyzing information (Tanveer, Azeem, Maqbool, & Tahirkheli, 2011). However, researchers indicate that despite studies conducted at varying institutional levels, i.e. elementary, middle school, high school, and college, there are conflicting views about how females perform in mathematics in comparison to their male counterparts. Some researchers speculate that females appear to have lower self-efficacy levels than males (Rinn, Miner, & Taylor, 2013; Williams & Williams, 2010). While others reasoned that females have improved on their success in mathematics (Arhin & Offoe, 2015; Cech, 2012). Thus, based on this perspective, gender is not deemed as a crucial element in determining students' mathematics achievement, but can influence how students are treated in the classroom and can impact students' self-confidence (Arhin & Offoe, 2015; Cech, 2012).

Several researchers also indicated that many adults dislike mathematics and have a tendency to avoid it even when they are proficient (Coffey, 2011; Jameson & Fusco, 2014; Kenner & Weinerman, 2011; Zacharakis, Steichen, Diaz de Sabates, & Glass, 2011). In reflecting on reasons, stereotype is among one of the factors said to influence the avoidance of mathematics. Stereotyping is believed to be an issue that often interferes with adults' perceptions of their own ability and competence to successfully complete math tasks (Galla & Wood, 2012; Hollis-Sawyer, 2011, Jameson, 2013). Also, Jameson and Fusco (2014) attributed mathematics anxiety and low confidence as the reasons why adults dislike and avoid mathematics.

Teachers' beliefs pertaining to success, as well as failure can have implications on their instructional practices in mathematics (Celik & Yesilyurt, 2013; Middleton & Jansen, 2011; Perry, 2011). Similarly, in discussing the influence of self-efficacy, Bandura (1997) theorized that people's actions, efforts, the length of perseverance during obstacles and failures, resilience during adversity and the thought patterns occupied in terms of whether it is negative or positive, as well as level of accomplishment are all influenced by their self-efficacy. Hence teachers with low self-efficacy have a tendency to want to be in total control and so often lean towards a teacher-directed approach, utilizing the "teaching by telling" pedagogy (Patton, Parker, & Pratt, 2013). Teaching by telling is thought of as being safe, predictable, and controllable (Patton et al., 2013). On the other hand, teachers with high self-efficacy have a tendency to make students the center of the learning environment (Patton et al., 2013), thus leaning more towards a student-centered approach. Based on this perspective a teacher's efficacy belief can be a determining factor in his or her willingness to adopt mathematics reform recommendations, such as those that call for the incorporation of technology in mathematics instruction US Department of Education, 2010, Tella, 2011).

Equally, as beliefs and teaching efficacy are contributors, knowledge also informs a teacher's actions and effectiveness in the classroom (Harrell-Williams, Sorto, Pierce, Lesser, & Murphy, 2015). In such instance a teacher's lack of confidence in teaching mathematics corresponds greatly with limited or lack of familiarity with certain concepts.

In contrast, a teacher's confidence tends to be highest when there is familiarity with the topic or content being taught (Harrell-Williams et al., 2015). Therefore, teachers' belief about their own competence is a strong predictor of their effectiveness. Some criteria outline as predictor for teacher effectiveness includes always being prepared, possessing good pedagogical knowledge and classroom management skills, and engaging students in learning through interactive hands-on activities (Dibapile, 2012; Gu, Zhu, & Guo, 2013; Khan, 2011).

Overall, when individuals feel that they are becoming competent in a task, their sense of efficacy is increased, often resulting in the goal being completed or attained. Thus, self-efficacy is linked to goal completion because it fuels an individual's intention and perseverance (Bandura, 1986). A relationship exists between a teacher's self-efficacy and decision on whether or not to incorporate technology or any other instructional strategies in the classroom (Dimopoulou, 2012; Gu, Zhu, & Guo, 2013). Self-efficacy governs the extent to which knowledge and a skill are acquired and is a major predictor of competence, commitment, and accomplishments (Dimopoulou, 2012; Gu, Zhu, & Guo, 2013). Self-efficacy is a great determinant of whether a teacher will be able to successfully incorporate technology during instruction. Additionally, it is important to be able to evaluate whether technology is being effectively integrated during instruction, thus the ISTE NETS-T standards are discussed.

International Society for Technology in Education NETS-T

The ISTE NETS-T is a performance indicator and outlines the skills to be taught and learned in order to function in the digital era. ISTE NETS-T aligns with 21st century skills for preparing students to live and work in our global community. The standards include: "1) Facilitate and inspire student learning and creativity, 2) Design and develop digital-age learning experiences and assessments, 3) Model digital-age work and learning, 4) Promote and model digital citizenship and responsibility, and 5) Engage in professional growth and leadership" (ISTE, 2008, para 1, 2, 3, 4, and 5).

In discussing technology integration in classrooms, Bielefeldt (2012) theorized that the process involved more that noting the various technologies present and whether or not students are using them. Instead a variety of attributes is outlined in the NETS-T and can be used to determine effective implementation. Some of the attributes include alignment of technology with curriculum and instruction, active interaction with technology tools, and the use of technology to enhance students' cognitive skills. However, it is important to note that though NETS are deemed to be important, the standards are limited in that they do not describe how they are to be accomplished (Bielefeldt, 2012). Based on this limitation, I used the ISTE ICOT, which contained a checklist of the NETS, because using it provided a general understanding of what teachers should do and how technology should be incorporated during lesson (Penchev, 2013). The CBAM levels of use are discussed.

Concerns Based Adoption Model- Levels of Use

Teachers are the key players behind the success or failure of programs based on their willingness to adapt to change (Dimopoulou, 2012; Norton, 2013). According to Hall and Hord (1987) change encompasses perceptions and behaviors. Wang et al (2004) has been used in previous research and contributes significant descriptors that can contribute to the change process. Therefore, exploring teachers' technology self-efficacy beliefs as well as technology integration behavior is vital.

Similarly, examining frameworks such as CBAM levels of use and the stages of adoption can provide researchers with a theoretical lens as well as tools to examine data and interpret findings. In discussing CBAM, Hollingshead (2009), Khoboli, and Otoole (2011) proposed that the model can be utilized for designing trainings and programs, and thus contribute to change. The CBAM model has three diagnostic dimensions consisting of the innovation configuration map (ICM), stages of concern questionnaire, and levels of use tool. The innovation configuration map has descriptions on what a new program should look like. The stages of concern questionnaire can be used to examine the beliefs, attitudes, or concerns of staff members associated with implementing the new program. The LoU tool can be used to determine the extent to which staff members are using a new program (Hord, Rutherford, Hurling-Austin & Hall, 1987). The LoU tool will be appropriate since researchers can use it to determine teachers' actions or behaviors in relation to their levels of technology use. The LoU has eight behavioral profiles. They are "Nonuse, 0; Orientation, 1; Preparation, 2; Mechanical, 3; Routine, 4A; Refinement, 4B; Integration, 5; and Renewal, 6". (Hord, Rutherford, Hurling-Austin & Hall, 1987, pg. 703). The higher on the technology continuum teachers are, the greater will be the teachers' levels of technology integration in the classroom. Users can progress, regress, or stay at a particular point on the continuum while integrating technology (Hord, Rutherford, Hurling-Austin & Hall, 1987).

Stages of Adoption of Technology

Measuring technology integration is essential because it allows the researcher to have an idea of how teachers are incorporating certain applications during lessons, as well as see where on the technology adoption continuum teachers are. Several researchers have designed various instruments as a means to evaluate the adoption of technology within educational institutions. In Russell's (1995) study, he sought to examine the use of electronic mail by post graduate teachers as they worked with students on specific tasks, Russell theorized that it is possible that individuals can start the adoption process at any point. Additionally, Russell (1995) theorized that individuals will progress at their own rate through six stages which include: "(a) awareness, (b) learning the process, (c) understanding and application of the process, (d) familiarity and confidence, (e) adaption to other contexts, and (f) creative applications to new contexts" (pg. 173 - 178).

Christensen (1997) Christensen and Knezek (1999) adapted Russell's concept and formulated it into a self-rated survey tool designed to describe teacher's stage of technology adoption. This revised instrument was modified to include a variety of other technology tools which included computers, emails, software, and multimedia. The stages of adoption of technology instrument can be utilized to assess the influence of information technology training and trends over a period of time (Christensen, 1997; Christensen & Knezek, 1999). The instrument can be used to assess where on the technology adoption continuum teachers are based on the elements of awareness, learning, understanding, familiarity, adaptation, and creative application.

In examining the specifics for each of the stages, awareness is stage one and can be used to determine if the teachers are aware that technology exists and have used it or not. Learning the process in the second stage, is designed to determine if teachers are trying to learn the basics, are frustrated, and if they lack confidence in using computers. Understanding and application of the process is the third stage. This phase can be used to determine if teachers understand the process involved in using technology and can identify specific tasks where it can be useful. Adaptation to other contexts is the fifth stage and can be used to determine if teachers view computers as a helpful tool and can be said to be at a point where they are no longer concerned about it as solely technology. Instead, they are at a point where they are utilizing a variety of applications and now view it as an instructional tool. Creative application to new contexts is the final step and can be used to determine if teachers are able to utilize technology as an instructional tool as well as integrate it into the curriculum.

I used the stages of adoption of technology model were to select participants and to stratify them in categories. Additionally, utilizing Christensen (1997) and Christensen and Knezek (1999) stages of adoption of technology model also provided me with an understanding of where on the technology adoption continuum teachers are, as well as helped me to determine the average stage of technology adoption for the teachers participating in this study. Additionally, in conducting this research, assessing where teachers were on the technology adoption continuum, as well as determining how technology was being incorporated in relation to the ISTE- NETs standards was crucial for effective technology integration in the classroom (Christensen et al., 2015). This was significant because being knowledgeable about teachers' levels of technology expertise as well as their challenges, can help learning leaders provide the support that is needed to help teachers incorporate technology effectively in their instruction.

Generations and Attitudes towards Technology

Throughout the years as technology evolved, there has been a lot of skepticism by each generation. There is the Baby Boomer generation, those who were born between 1946 and 1964, who grew up in an era limited to technology (Rosen, 2004). According to Oblinger (2005), technology such as the World Wide Web is a bit of a mystery for this generation. Also, there are individuals who like things the way they are and so they lack awareness, as well as interest about the benefits of technology (Gu, Zhu, & Guo, 2013; Moerschell, 2009). There is also the fear of individuals being replaced by technology (Khalil, 2013). Whilst, in contrast, the attitudes of Generation X (born1965-1981) is different. They view technology (e.g. World Wide Web) as a tool (Bernstein, Alexander, & Alexander, n.d.). According to Brown and Fritz (2001), this is because individuals within this generation tend to be visual learners and as of such appreciate information via videos, images, charts, and interactive software.

In examining the technology attitudes of the Net Generation (born 1982-present), or according to Prensky (2001) "Digital Natives", these individuals rather than listening, they like to be engaged in activities. The Net Generation gravitates towards activities that require them to explore, discover, and experiment (Georgieva, 2014). These Digital Natives were born or grew up in an era with computers, video games, and cell phones (Prensky, 2001). According to Jones and Shao (2011) and Georgieva (2014), this generation feels a need to keep connected and therefore use tools such as instant messaging, cell phones, chat rooms, email, and text messages.

The various generations all have different learning styles and can benefit from the use of technology in the classroom. However, several researchers indicate that technology is not being used in a manner to significantly improve teaching and learning (Ertmer et al., 2012; Gu, Zhu, & Guo, 2013; Karsenti & Fievez, 2013). In discussing the use of the iPads, Karsenti and Fievez (2013) alluded to the fact that teachers lack the necessary training on how to incorporate technology in the day-to-day instruction, and because of this deficiency often utilize it to keep students busy when they complete assignments quickly. Teachers often utilize technology as a means of having students complete drill related tasks in order to remediate deficient skills (Ertmer et al., 2012; Morgan, Humphries, & Goette; 2015). Such skills are often thought to be necessary in order to be successful on the standardized tests (Eyyam & Yaratan, 2014; Morgan, Humphries, & Goette; 2015; Witchukriangkrai, 2011).

Similarly, Collins and Halverson (2009) pointed to the fact that technology and the schooling are not cohesive, as there remains evidence of teachers still being looked on as the sole transmitter of knowledge. Whereas, technology can be used to provide knowledge via a variety of platforms which include but is not limited to video and computers (Collins & Halverson, 2009). Additionally, technology can be utilized to customize learning based on students' specific needs. However, despite an influx of technology tools and software, the education system has remained unchanged, expecting all students to learn the same contents and be tested in the same manner (Collins & Halverson, 2009).

Another belief related to technology is that teachers only need to learn the basics of how to use the device, after which it is presumed that they will be able to utilize it within the classroom (Parker, Booney, Schamberg, Stylinski, & McAuliffe, 2013; Swan & Hofer, 2011). Kleiman (2000) posited “For technology to be used fully in K-12 schools, significant changes are required in teaching practices, curriculum, and classroom organization” (p. 5). Similarly, Dede (2007) and Anderson and Groulx (2013) proposed using the constructivist model to place learning in the students’ hands (e.g. through problem based learning). Uslu and Bumen (2012) and Mundy and Kupczynski (2013) also pointed out that significant professional development and ongoing support will be necessary to assist teachers to effectively integrate technology during their teaching instruction.

Though technology by itself is not the solution to improving learning, it can however, provide students with the skills needed to meet expectations in the 21st century world and workforce (OECD, 2014; US Department of Education, 2014). There is a need to enhance education through technology (Duncan & Barnet, 2010; Mundy & Kupczynski, 2013; Park, 2011). Thus, in an effort to transform the educational system, President George W. Bush’s No Child Left Behind Act of 2001 was established. This initiative was intended to enhance education through technology (United States Department of Education, 2002). The objectives of this initiative were:

1. To utilize technology to improve elementary and secondary school students' academic achievement.
2. To ensure that by the eighth grade all students will be technologically literate.
3. To promote the effective use of technology by providing resources, curriculum development, and teacher training through state and local education agencies, in an effort to equip teachers with research-based instructional strategies and best practices.

Since then the digital transformation has continued and current educational reform continues to be directed at the use of instructional technology to improve student academic performance. There is a push for a constructivist type of learning environment. Within this setting, the intention is for students to utilize previous knowledge and experience to formulate their own knowledge (Hao & Lee, 2015; OECD, 2014; Termos, 2012).

21st Century Learning

21st century learning is considered as an important framework to harness the skills and knowledge that students need to be successful in college, career, and life. This form of learning caters to a student's social as well as intellectual capabilities as both collaborative learning and critical thinking are promoted (Partnership for 21st Century Skills, 2009; Brun, & Hinostroza, 2014). 21st century learning is necessary to transform educational practices in today's fast paced, technology driven world, to transcend from an era of knowledge acquisition to that of knowledge creation, and to promote global learning (Bernhardt, 2015; Trilling & Fadel, 2009). According to Hovland (2014), through the use of the general education setting, a learner will be able to critically examine his or her values and attitudes, as well as develop skills to solve global issues.

However, in order for students to be able to be successful contributors to society, the classroom needs to become a place where students are motivated to learn, as well as encouraged to become active participants in the learning process (Anderson & Groulx, 2013; Gulamhussein, 2013; Rich, 2010;). Trilling & Fadel (2009) and Morgan, Humphries, and Goette (2015) proposed that providing students with opportunities to collaborate has the benefits of enhancing social development as well as academic contents. Additionally, lessons that involve students in the learning process are considered more meaningful to students than those that involve the use of drills and memorization (Ark, 2013; Kaufeldt, 2010). Bernhardt (2015) recommended the use of practices that will teach innovative and life skills.

School systems should place great emphasis on using the 21st century framework as it can be used to connect learning with other skills needed to thrive beyond the walls of the classroom. The 21st century framework is aligned to careers and encompasses many of the skills needed in today's globalized knowledge based world. Some of these skills are evident in the work place through the implementation of problem solving teams and technology tools with an emphasis to design and develop innovative ideas (Alharbi, 2013; Hodge & Lear, 2011; Trilling & Fadel, 2009). However, though there is a requirement for a more skilled workforce, research points to the fact that students are still not adequately equipped with the necessary skills needed in the workforce (Bernhardt, 2015; Nugent, Kunz, Rilett, & Jones, 2010). More specifically, when compared to their counterparts in similar countries such as Liechtenstein, Slovenia, Estonia, and Hungary, the students in America ranked lower in the subject areas of math and science (Burke & McNeill, 2011). Based on this information, a disparity exits. American Management Association (2010) and Eyyam & Yaratan (2014) theorized that to lessen the gap, students need 21st century skills, especially in problem solving, critical thinking, creativity and technological literacy.

In earlier years there use to be a concerted focus on students being competent in the subject areas of reading, writing, and math. There was much focus on the “three Rs”. However, in recent years the workforce also requires employees to competent in math, science, technology (American Management Association, 2010; Eyyam & Yaratan, 2014). Some researchers believe that incorporating technology can enhance the teaching and learning process as information can be presented in an authentic way. However, technology continues to pose a challenge for a variety of reasons which include but is not limited to the fact that it is always changing from one invention to another at a rapid rate. Such change makes it difficult to learn one innovation quick enough before it becomes obsolete or time to learn another. It also leads to the question of whether it is technology integration proficiency or computer proficiency that needs to be examined (Hammond, Matherson, Wilson & Wright, 2013).

Technology Integration Proficiency versus Technology Usage

It is important to be clear on what is being measured when examining technology integration, whether it is teacher’s ability or usage of the technology (Karaseva, Siibak, & Pruulmann-Vengerfeldt, 2015). Ability is related to one’s capability or competence

(Oliver & Townsend, 2013), thus in this study it is a teacher's capability to integrate technology in lessons that is being examined. On the other hand, usage relates to how much or how often something is used and in this study, it is associated with a teacher's frequency in using technology (Oliver & Townsend, 2013). Though both concepts are not alike, they are influenced by similar factors such as attitudes, beliefs and self-efficacy.

An examination of factors that influence teachers' use of technology revealed a relationship between the actual use and inclination to use technology was determined by interface factors. An interface factor includes but is in no way limited to issues such as ease of use, computer self-efficacy, and perceived usefulness (Hsu, 2010; Buabeng-Andoh, 2012; Kreijns, Acker, Vermeulen, & Buuren, 2013). In previous studies, researchers have examined teachers' interface factors have alluded that whether or not a teacher is competent in technology integration, it is still quite possible that he or she may not be able or willing to incorporate technology during instruction (Hsu, 2010; Kumar & Vigil, 2011; Kordaki, 2013). Similarly, DeSantis and Rotigel (2014) proposed that both pre-service and in-service teachers may be proficient in using digital technology to communicate, access services, and complete various tasks in their personal lives. However, these teachers may not feel comfortable with using sophisticated digital tools (i.e. Wikis, blogs, and Web 2.0). In this study I examined some of the issues that hinder technology adoption and acceptance.

Barriers to Technology Adoption

The adoption of innovation is a vital process when it comes on to technological change. It is through this process that both organizations and individuals utilize innovations in their practice (Anderson & Groulx, 2013). Similarly, there is a growing demand in the educational system for technology to be utilized to teach students the skills and knowledge that is essential to live and work in the 21st century (Eyyam & Yaratan, 2014; Karaseva, Siibak, & Pruulmann-Vengerfeldt, 2015, US Department of Education, 2010). However, as the education policymakers continue to reorganize the curriculum and update schools with various technology devices, researchers continue to point to a lack of technology use within the classrooms as well as a lack of information on how technology is being integrated in lessons to enhance learning (Celik & Yesilyurt, 2013; Hao & Lee, 2015; Thomas, & Lewis, 2010).

Studies such as Howley, Wood, and Hough (2011) and Mundy and Kupczynski's (2013) have found that teachers have had positive attitudes towards technology, even when instances where teachers had limited access to technology and were not adequately prepared in respect to skill levels. In contrast, schools outside of the urban regions had more access to a variety of technology tools and were better prepared. However, in spite of this, these teachers tended to have negative attitudes, therefore, this influenced technology adoption within the classroom at both the teachers' as well as the students' level (Anderson & Groulx, 2013; Brun & Hinostroza, 2014; Howley, Wood & Hough, 2011).

Additionally, there is an ongoing debate as to whether teacher beliefs and attitudes are major determinants for first-order barriers (Aldunate & Nussbaum, 2013; Blackwell, Lauricella, Wartella, Robb, & Schomburg, 2013). Ifenthaler and Schweinbenz (2013) found disparity in attitudes among teachers incorporating tablet PC devices within lessons. This is because a teacher's competence in terms of being efficient in the use of technology does not necessarily influence the notion that technology is a valuable educational tool (Anderson & Groulx, 2013; Blackwell et al, 2013). Some researchers have professed that a relationship exists between teacher attitude (e.g. confidence, anxiety) and technology usage (Anderson & Groulx. 2013; Blackwell et al, 2013; Buabeng-Andoh, 2012; Celik & Yesilyurt, 2013; Holden & Rada, 2011; Kopcha, 2012).

Another barrier affecting effective implementation of technology during instruction is related to the overuse of technology, to the extent where there is a loss of valuable learning opportunities replaced by excessive games (Hatch, 2011; Jones & Dexter 2014). In the same way, some researchers indicate that technology is being primarily used by students for the purpose of completing homework assignments and practice work such as drills (Brock, & Joglekar, 2011; Ertmer & Ottenbreit-Leftwich, 2010; Sezer, Yilmaz & Yilmaz, 2013). However, it is speculated that such practice do not constitute best practices that will empower the 21century learners (Cheung & Vogel, 2013; Gu, Zhu, & Guo, 2013; Project Tomorrow, 2011; Sezer, Yilmaz & Yilmaz, 2013) Thus, with such concerns, for the full adoption and integration of technology to take place, these factors need to be addressed.

Evaluating the Effectiveness of Technology Integration

A controversy lies in reliably evaluating the effectiveness of technology (Lim, Zhao, Tondeur, Chai, & Tsai, 2013; Mosely, 2013). Steps to measure technology effectiveness continues to prove challenging. This may be due to the fact that technology is not solely limited to computers but also includes a variety of devices including digital cameras, LCD projectors, interactive whiteboards, multimedia devices and a variety of other tools. Additionally, a teacher utilizing technology out of context or as an isolated skill is not adequate to prepare students to compete in the digital world (Tondeur, Chai, & Tsai, 2013). Consequently, when and how these are used is also another issue. Technology can be used during project-based learning, for teaching skills in context (e.g. in the context of math content), or as a means for presenting information during video-conferencing or tutorials.

Some researchers concurred that when technology is integrated with traditional instructions it is more likely to produce higher achievement than simply utilizing traditional instructions alone (Abbitt, 2011; Mosley, 2013; Reigeluth, Beatty & Myres, 2016; Vanderline, van Braak & Tondeur, 2010). Similarly some researchers claimed that students tend to be more eager to learn, learn more quickly, and retain more, including students deemed to be at risk of failing (Giesbers, Rienties, Tempelaar, & Gijselaers, 2013; Liaw & Haung, 2013; Pourciau, 2014). However, what appears to be certain is the growing need for responses to questions on how best technology can be integrated in various subject areas (Alharbi, 2013; Haung et al., 2011; Lim, Zhao, Tondeur, Chai, & Tsai, 2010; Law, Yuen, & Fox, 2011; Reigeluth & Karnopp, 2013). It is based on the need to gain insight into how technology is being incorporated in the classroom, specifically mathematics instruction that the CBAM LoU and the Christensen and Knezek (1999) stages of adoption of technology model were discussed earlier in this section. According to Handal, Cavanagh, Wood, and Petocz (2011), “One important measure of the success of any educational reform is the extent to which it is adopted by teachers" (p. 343). Utilizing the stages of adoption of technology in this research will help me to explore how teachers are adopting various technologies in the classroom.

Technology Integration as a Process

The incorporation of technology into instructions has to go through a process before full implementation occurs. In general implementation begins with teachers incorporating technology into traditional practices. Kale and Goh (2014) argued that if positive results are evident where students' learning is concerned, then teachers generally begin to explore using technology to teach in other ways. However, it is important to note that technology adoption by teachers can occur at various rates and that this acceptance is linked to teachers' beliefs about technology, technical skills, as well as various implementation factors such as technology support. Therefore, it is important for the school community and administration to provide support as this will have positive implications on teachers' beliefs and their willingness to incorporate technology (Ruggiero & Monk, 2015). A researcher's ability to stimulate dialogue among all stake holders (e.g. policy makers, school administrators, teachers, parents, and students) may help to provide insights into these questions. In this study, I examined the math achievement of American children, as well as the role that technology in transforming the teaching and learning process.

Mathematics Education

Throughout the world, mathematics is used within many fields, but not limited to the areas of finance, engineering, social sciences, and medicine. It is a very complicated subject to describe because mathematics education is determined by the board of education within each school district as each is responsible for setting its own mathematics education program (Dossey, Halvorsen, & McCrone, 2012). However, Gilfeather and Regato (1999) defined mathematics as “an art which studies patterns for predictive purposes” (p. 1). Mathematics relate to numeracy and at the elementary school level in the United States, the curriculum includes numbers and operations, measurement of quantities, fractions, percentages, and ratios. Having knowledge about mathematics is essential for daily living as individuals will be better able to manage budgets, successfully complete home projects, as well as a variety of other endeavors. Additionally, mathematics is a requirement for various occupations that include but is not limited to being an engineer, architect, accountant, and statistician.

In examining mathematics achievement, I noted that in comparison to students around the world, American students perform below expectations in mathematics (Chappell, 2013; Coughlan, 2014). Several factors have contributed to this including a call for an instructional overhaul (Gokcek, Gunes, & Gencturk, 2013; Hudson, Kadan, Lavin, & Vasquez, 2010; McKnight, O’Malley, Ruzic, Horsley, Franey, & Bassett, 2016). In lieu of improving mathematics instruction, some researchers hypothesized that the mathematics curricula can be improved by integrating technology (Gokcek, Gunes, & Gencturk, 2013; Kadan, Lavin, & Vasquez, 2010). Likewise, in discussing the benefits of integrating technology in mathematics instruction, the national council of teachers of mathematics (2008) conjectured “These tools, including those used specifically for teaching and learning mathematics, not only complement mathematics teaching and learning but also prepare all students for their future lives, which technology will influence every day" (p.1). If technology is carefully integrated, it can spark and sustain students' interest as well as develop their understanding and result in positive academic outcomes (NCTM, 2008).

Technology tools include computers, spreadsheets, calculators, and interactive presentation devices (National Council of Teachers of Math, 2008; Turel, 2014). There is a lot of emphasis being placed on the need for teachers to establish technology-rich learning environments as well as for technology to be incorporated during the teaching and learning process. However, there is evidence indicating that a teacher's confidence and ability with both the subject and technology will impact the type of technology, as well as how and when it will be utilized during instruction (Ertmer & Ottenbreit-Leftwich, 2010, Turel, 2014). Based on this perspective, it is recommended that all teachers of mathematics, regardless of grade level, strengthen basic mathematics skills, as well as utilize technology software and programs such as PowerPoint, smart boards, calculators, Internet websites, and YouTube videos to enhance instructions (National Council of Teachers of Math, 2008; Nemcek, 2013). Therefore, in order for teachers to be knowledgeable decision makers on how to effectively utilize and integrate technology in lessons, some researchers have indicated that teacher educator programs and professional development need to be available to educators (Ertmer et al. 2014; Harris & Hoffer, 2011; Inan & Lowther, 2010; Teo & Zhou, 2016).

Technology and Mathematics

Technology can be utilized in the classroom in a variety of ways to enhance student learning. Several researchers have indicated in their studies that when teachers incorporate technology during instruction, students' attitude, self-concept and academic achievement can be positive (Michelli, 2013; Thomas & Ye Yoon, 2013). For example, technology allows students to work more independently and enables the teacher to work with individual students within small group settings. Similarly, technology can be used to transform learning by bringing into the classroom diverse materials and information via the Internet and World Wide Web.

Technology can greatly influence the teaching and learning of mathematics. It can aid simple computation, as well as provide visuals of various situations and relationships associated with math concepts (Brock & Joglekar, 2011; Francom, 2016; Goos, 2010). However, despite many studies being conducted, there is no documentation on what is constituted to be good or bad practice and researchers have speculated that this is mainly because the choice to use technology tends to be based on personal or community judgment (Brock & Joglekar, 2011; Chien, Wu, & Hsu, 2014; Francom, 2016; Goos 2010; Richardson, 2012). However, it is important to note that what really matters is not just technology being used, but instead how it is used.

In examining best practice for successfully integrating technology during instruction several researchers have put forward various ideas. Kent (2008) proposed a six-step plan the successful integration of technology during instruction. The first step includes being knowledgeable about the hardware, software, and the available website options. The second step includes using a variety of technology so as to avoid overuse and to utilize multiple resources to keep students engaged as well as to maximize learning. The third step involves limiting the use of one technology by allowing frequent breaks or breaking the activity in parts to prevent boredom. The fourth step involves setting up learning stations within the classroom and assigning projects that require students to utilize technology. The fifth step includes the use of technology as a means of assessment. Use of the student-response system and online activities that produce automatic feedback were two examples cited by Kent (2008), along with the recommendation to utilize computer-based tools to manage and store data pertaining to students' performance. The final step includes being flexible and open-minded to exploring and creating enjoyable learning opportunities.

Whilst, An and Reigeluth (2011) highlighted the fact that though there is concerted emphasis being placed on the use of incorporating technology during lessons, technology is not being utilized at a high-level. Instead, it is utilized as a means of communication, word processing, browsing websites, and for drill and practice activities (An & Reigeluth, 2011; Brock & Joglekar, 2011; Reigeluth, Beatty & Myers, 2016; Ruggiero & Mong, 2015; U.S. Department of Education, 2009). To promote critical thinking at a high level, learner-centered technology integration is recommended. An and Reigeluth (2011) and Ruggiero & Mong (2015) proposed that the learner-centered classroom allows teachers to integrate technology to make lessons more personalized and students are intrinsically motivated to learn. It provides social and emotional support as students are empowered when they are allowed to take a more active role in their learning. The learner-centered classroom allows students to collaborate, engage in project work, and decide on ways to demonstrate their learning. Thus, within this setting students are given authentic learning experiences and assessments for learning.

Also, within the learner-centered classroom, high expectations are set and consideration is given to the students learning styles. In addition, students are actively engaged in the learning process and are given an opportunity to work at their own pace (An & Reigeluth, 2011; Chien, Wu, & Hsu, 2014). This type of environment is positive in that it supports students' social and emotional growth, as teachers abide by the belief that all students have a desire to learn and thus motivates them through the use of encouragement (An & Reigeluth, 2011). Equally, Harris and Hofer (2011) and Oliver and Townsend (2013) proposed that content and pedagogy must be included when teaching lessons with technology. Reference is made pertaining to the use of technology pedagogical content knowledge (TPCK), which means that teachers need to possess in-depth understanding in the subject contents, as well as have a sound understanding about the teaching and learning process, and technology (Abbitt, 2011;Aldunate, & Nussbaum, 2013; Chai, Koh, Tsai, & Tan, 2011; Oliver & Townsend, 2013). Some researchers have proposed that in order to be successful, teachers need to keep the content in mind and teach the essential ideas embodied in the mathematical concepts in creative ways that will aid students' understanding (Edward-Groves, 2012; Harris & Hofer, 2011; Michelli, 2013).

Summary

By reviewing the literature I obtained insights into the growing need for technology to be utilized in the delivery of instruction to enhance student learning, and the need for educators to be involved in the technology transformation process. Despite the consistent effort by the education system to reorganize the curriculum and update schools with a variety of technology devices, teachers are still failing to incorporate technology during the teaching and learning process (Brun & Hinostroza, 2014; Gilakjani, Leong & Ismail, 2013; Hakverdi-Can & Sonmez, 2013). Similarly, a challenge continues to exist for teachers to keep abreast with how best to use technology to prepare students so that they will be highly skilled workers in tomorrow's society and there appears to be no one solution for this problem. Therefore, in order to provide teachers with best practices in the use of technology to enhance learning, there is a need for more technology supported learning environment both on an individual level as well as collectively (Hakverdi-Can & Sonmez, 2013; Gerard, Varma, Corliss, & Linn, 2011; Gilakjani, Leong & Ismail, 2013).

In lieu of arriving at solutions, Buebeng-Andoh (2012) and Giles and Kent (2016) speculated that any personal characteristic such as self-efficacy is worth investigating because it directly influences the adoption and integration of technology during instruction. Similarly, the literature researchers have specified that teachers will not incorporate technology during instruction if they do not feel confident (Tella, 2011, Pourciau, 2014). Thus, the challenge continues to exist in identifying factors that can induce or shape teachers' self-efficacy and lead to full technology adoption. Therefore, the purpose for my study was to examine nine grades 3-5 teachers' perspective regarding how their own self-efficacy fosters or hinders technology integration during mathematics instruction. The insights that I obtain can be documented and shared with school board and school administrators. With such insights, educational leaders may be better able to provide teachers with the needed strategies and supports. Similarly, in conducting this study, I am hoping that this action will have a domino effect as through such support, teachers will effectively incorporate technology in lessons so as to meet the needs of their diverse learners. In chapter 3, the methodology and procedures used to collect the data are presented.

Chapter 3: The Methodology

The purpose of this qualitative case study was to explore the patterns between elementary math teachers' technology integration self-efficacy and their actual technology integration behavior. This purpose was divided into three components: (a) to explore teachers' beliefs about their self-efficacy and level of technology adoption, (b) to observe teachers' actual technology use during mathematics lessons, and (c) to describe in depth the relationship between teachers' beliefs and their behavior.

In this chapter, I discuss the research method that I utilized in this study by first discussing the research design and rationale for its selection. Second, I outline my role as the researcher. Third, I describe the methodology, the participant selection logic, and instrumentation. A discussion of the data collection instruments and data analysis plan follows, and the chapter concludes with an explanation of the steps taken to ensure trustworthiness and to address ethical concerns.

Research Design and Rationale

The questions that guided the research were:

1) What are elementary mathematics teachers' beliefs about their technology integration self-efficacy and their stages of technology adoption?
2) How do elementary mathematics teachers demonstrate their levels of self-efficacy, adoption and use of technology in math instruction?
3) What patterns exist in the relationships between these teachers' beliefs and behaviors related to technology integration in the classroom?

In this qualitative case study, I collected data from a combination of surveys, observation, and interview. Later, I analyzed the data to understand the patterns between elementary math teachers' technology self-efficacy, their level of technology adoption, and their actual technology integration behavior. Prior to deciding on a research design, I considered several qualitative research approaches including grounded theory, narrative, ethnography, and phenomenology.

My reason for conducting a case study rather than grounded theory was that grounded theory is better to use when a researcher wants to discover or generate theory (Creswell 2007). Since, my purpose for doing this study was not to discover or generate theory, grounded theory was not a good fit. In contrast to other qualitative approaches, the role of theory is different in case studies as it can be used to guide the research (Yin, 1994), or utilized at the end of the research. Creswell (2003) stated that a "theory-after" perspective serves the purpose of comparing theories with those that emerged during the study. I used theory at the beginning of the research to provide a theoretical perspective.

I did not select narrative because researchers use this approach to focus on an individual's story across time (Creswell, 2007). My goal was not to focus on an individual' story across time and so I did not choose this qualitative design. I did not select ethnography either. Rogers (2014) stated that ethnography can be used when researchers want to focus on the individual setting and are seeking to tell a story within the participants' cultural context or group. My purpose for conducting the study was not to provide an in-depth description of a group so I did not select this ethnography.

Similarly, I did not select phenomenology because the purpose for conducting phenomenological research is to describe participants' lived experiences (Lichtman, 2012), and this was not my intention. My purpose for the study was to explore the how and why questions pertaining the teachers beliefs and behaviors in this study. Yin (2014) proposed that the case study design is appropriate when researchers are desirous of responding to "how" and "why" questions. Additionally, Yin (2014) stated that case studies are appropriate to use when the purpose is to explore and describe the situation within the context that the phenomenon is taking place. Similarly, Baxter and Jack (2008) asserted that case studies allow that researcher to use a variety of data collection instruments to investigate interventions, relationships, and programs. Therefore, after reflecting on the rationale behind the study, which was to explore how and why questions about teachers' technology beliefs and technology integration behaviors, I felt that a case study design was most appropriate, and therefore I selected the case study approach.

Role of the Researcher

I am a fourth-grade teacher within the Sun State School System where the research was conducted. I do not occupy any supervisory role that involves power over the participants. However, I do have a professional relationship with them because I have been working in the county for over 12 years; 8 of those years have been with Morningside Elementary School which is a school within the Sun State School System. Because a professional relationship exists between me and the staff, I used reflexivity to eliminate or lessen personal biases.

It was imperative that I rid myself of preconceived notions or assumptions related to the participants' responses prior to conducting the interviews and classroom observations. I believe that technology can be woven into the curriculum to enhance learning and student achievement. As a teacher, I rate myself as being average when it comes on to knowing how to integrate technology during lessons. Similarly, I rate myself as being among the teachers in the medium to high efficacy category. I believe that there are teachers who use technology during their instruction more than others, as well as teachers who are more technology savvy than others. I also believe that there are some teachers who eagerly seize the opportunity to attend technology professional development workshops, while others would never think of attending.

My role had no influence on the participants' knowledge, beliefs, or usage of technology. As the sole researcher in the study, I took on the role of participant observer. I was responsible for selecting the site for the study, participant selection, the instruments for collecting the data, and analyzing the data. During the data collection process, I took on the role of observer during the classroom observations and later I led the interviews.

Methodology

Participant Selection Logic

Initially, this study began with nine teachers, three from Fieldstone Elementary School and six from Morningside Elementary School. Both school sites are a part of the Sun State School System. As the data collection procedure progressed, the three participants from Fieldstone Elementary withdrew. Based on this situation, three more participants were selected from Morningside Elementary School. This action led to all participants being from the same study site. The details of the participant selection are explained below.

The purpose of my study was to explore the patterns between teachers' technology beliefs and integration behaviors rather than to generalize hypothesis statements as in the case of quantitative research. Therefore, a small sample size of teachers who teach mathematics at the elementary school level was selected. Yin (2011) stated that sample size is determined by the type of research being conducted and the emphasis of a qualitative study is on quality rather than quantity. I used a sample size of nine participants because I wanted to obtain sufficient information. My focus was on obtaining rich data from a diverse sample. This sample size was appropriate to yield sufficient information power.

To gain relevant data, it was essential to choose a diverse group of participants with different ability levels and technology integration beliefs. To do this, I utilized the stratified purposeful sampling technique to select specific participants who had accepted the invitation to participate within certain subgroups or strata. I collected data from three teachers from each grade level (Grades 3, 4, and 5) with one participant who rated themselves on the stages of adoption technology integration (Christensen & Knezek, 1999) scales as low (1-2), medium (3-4), or high (5-6).

Participation criteria. Each participant had to meet certain criteria to be invited to participate in the study. The criteria were as follows:

- Teacher in Sun State School District
- Teaching in Grades 3, 4 or 5.

- Teacher for a minimum at least 2 previous years.
- Access to technology resources.
- Integrate technology resources during math instruction.

Sampling strategy. My study was unique in that I used several types of sampling. The first step of participant selection was convenient sampling. According to Teddlie and Yu (2007), "Convenience sampling involves drawing samples that are both easily accessible and willing to participate in a study" (p. 78). Convenience sampling facilitated the purposeful selection of a subgroup from the population based on the convenience of their accessibility and their proximity to me. The convenience sampling allowed all subjects to participate based on preselected criteria (Johnson & Christensen, 2008; Lodico, Spaulding, & Voegtle, 2010; Palinkas et al., 2013).

The convenience sample consisted of elementary mathematics teachers in Grades 3, 4 and 5. The teachers who were invited to participate were all certified and working in the Sun State School District. Additionally, the teachers' participation in the study was based on the conditions of them having at least two years or more teaching experience.

After the convenience sampling for invitations, I used the purposeful and stratified sampling procedure to ensure the right mix of participants. In defining purposeful sampling, Yin (2011) stated, "The selection of participants or sources of data to be used in a study, based on anticipated richness and relevance of information in relation to the study's research questions" (p.311). I utilized the stratified purposeful sampling technique to select specific participants who had accepted the invitation to participate within certain subgroups or strata. In this study, data were collected from three teachers from each grade level (Grades 3, 4, and 5) with one participant who rated themselves on the stages of adoption (Christensen & Knezek, 1999) technology integration scales as low (1-2), medium (3-4), or high (5-6). Table 1 illustrates the stratification across grade levels and stage of technology integration. I used this data point because it facilitated stratification across the levels of technology integration and also served as a data point for analysis of the interviews and observations.

Table1. Participant Stratification

	Level of Self-Reported Self-Efficacy on the Stages of Adoption		
	Low (1-2)	Medium (3-4)	High (5-6)
Third Grade	1	1	1
Fourth Grade	1	1	1
Fifth Grade	1	1	1

I did not use snowball sampling as it was not necessary to recruit populations that were not accessible. Snowball sampling involves the researcher obtaining names of participants from each other when the population is not readily accessible (Elder, 2009). Likewise, since the purpose of collecting data in this study was not to generate theory, theoretical sampling was not utilized.

Sample size. Yin (2011) stated that sample size is determined by the type of research being conducted and the emphasis of a qualitative study is on quality rather than quantity. Based on the stratification matrix of grade levels and self-reported technology levels, the sample for this study was nine participants. Obtaining this number of participants ensured that the data obtained was rich and obtained a diverse sample. Furthermore, it allowed the researcher to conduct observation and interviews in the participants' natural setting.

Instrumentation

To answer the research questions, I selected several instruments to facilitate data collection. The instruments used in this study included surveys, observation, and interviews.

Stages of Adoption Survey. I used the stages of adoption of technology survey (Christensen & Knezek, 1999) to select and stratify the participants. I used the instrument to determine where on the technology adoption continuum teachers were. Upon return of the completed paper survey, I quantified the data and categorized participants into three levels of technology use: low-to-medium, medium-to-high, and very high. Christensen and Knezek (1999) adapted Russell's concept and formulated it into a self-rated survey tool designed to describe teacher's stage of technology adoption. The instrument can be used to assess where on the technology adoption continuum teachers are based on the elements of awareness (Stage 1), learning (Stage 2), understanding (Stage 3), familiarity (Stage 4), adaptation (Stage 5), and creative application (Stage 6). This survey was used in similar studies to determine the stage at which teachers are with integrating technology (Alexander, Knezek, Christensen, Tyler-Wood, & Bull, 2014; Christensen & Knezek, 2006; Christensen & Knezek, 1999) and was validated by a group of researchers at the Institute for the integration of technology into teaching and learning at the University of North Texas (Knezek et al., 2000). The stages of adoption of technology was used in a study with a sample size of 525 grades K-12 teachers in north Texas public school district and yielded a high test-retest reliability estimate of .91 (Knezek et al., 2000).

In conducting this research, assessing where teachers were on the technology adoption continuum, as well as determining how technology was being incorporated in relation to the ISTE- NETs standards was crucial for effective technology integration in the classroom (Christensen et al., 2015). Based on this premise using the stages of adoption of technology was appropriate for this current study. I did not make any modifications to the instrument.

Computer Technology Integration Survey. After the participants were selected, I administered the CTI survey. Wang, Ertmer, Newby developed the CTI survey. I utilized it to determine teachers' confidence levels with integrating technology during mathematics instruction. The CTIS instrument consisted of 21 positively worded questions, each one scaled as a five-point Likert-type scale ranging from 1, SD (Strongly Disagree) to 5, SA (Strongly Agree). Higher combined totals indicated higher levels of self-efficacy towards the use of technology during teaching (Abbitt, 2011). The CTI survey was previously used by Wang et al. (2004) in a similar study to assess pre-service teachers' self-efficacy for technology integration (as cited by Farah, 2012, p.55). Wang et al. (2004) authenticated the instrument and calculated the Chronbach's alpha value for the CTI survey and it was .94 for the pre-survey self-efficacy and .96 for post- survey self-efficacy signifying high reliability and appropriateness for use in further research (Abbitt, 2011). Therefore, using the CTI survey was appropriate for a study of this nature as my goal was to assess the teachers' confidence levels with integrating technology during mathematics instruction. The CTI instrument was used without any modifications.

Observation checklist. I used the ISTE ICOT to record my observations of teachers integrating technology during math lessons. The ICOT was created in 2008. The ICOT was designed by Hewlett- Packard Company with features to help the researcher assess the learning environment based on how technology is being integrated into instruction as defined by the NETS-T. The standards include: "1) Facilitate and Inspire Student Learning and Creativity, 2) Design and Develop Digital-Age Learning Experiences and Assessments, 3) Model Digital-Age Work and Learning, 4) Promote and Model Digital Citizenship and Responsibility, and 5) Engage in Professional Growth and Leadership" (ISTE, 2008, paragraphs 1, 2, 3, 4, and 5). It is also in alignment with 21st century skills which are considered to be necessary to prepare students to live and work in the global community (Aharbi, 2013; Bernhardt, 2014; Brun & Hinostroza, 2014).

Researchers can use the features of the ICOT to examine and record student groupings, individually, in pairs, small groups, and whole class. The teacher's role can be examined and recorded as well, i.e. lecture, model, interactive direction, moderation, and facilitation. Researchers can use the features of the ICOT to examine and record the technologies used by teachers and by students and the percent of students engaged (ISTE, 2000, 2002, 2007, 2008). Researchers can use the ICOT can to examine several attributes of the technology integrated teaching and learning environment. These include student groupings, teacher roles, types of learning activities, and technologies being utilized by both teacher and students, technology use time, and the percentage of students engaged

(Bielefeldt, 2012). Thus, I used the ICOT instrument in this study to assess technology integration based on the standards of what constitutes “true integration” as specified by the NETS. To obtain the ISTE ICOT instrument as well as permission to use it, I agreed to certain conditions, one of which was not to place the instrument in my study (International Society for Technology in Education, 2014).

Interview protocol. I conducted interviews in order to gather data from the nine participants pertaining to their technology self-efficacy beliefs, stages of technology adoption and reflections on the observed behaviors. I used the interview to obtain insights on the differences between the survey and observations. I conducted the interviews at the research site using an interview protocol. The interviews consisted of six questions, which I developed in order to gain insights into the teachers’ perceptions on their technology self-efficacy and behavior (Table 2).

According to Bandura (1997), self-efficacy is grounded in social cognitive theory. Bandura’s (1977) emphasized that there is an existing connection between behavior, cognition, and environmental factors. Therefore, I developed the interview questions based on the literature associated with social cognitive theory. The theory rest on the premise that an individual’s self-efficacy determines how he or she feels, thinks, and behaves and that such beliefs serve as a motivating factor when faced with adversity or required to accomplish a task. Based on this background, I formulated questions to address teachers’ beliefs and behaviors. My dissertation committee who were content experts at Walden University validated the interview questions.

Table 2. Alignment of Interview Questions to Research Questions and Framework

Interview Questions	Alignment to Research Question	Alignment to Framework
Describe your confidence levels with regards to integrating technology during math lessons.	RQ# 1	CTI Survey (Wang et al., 2004),
How do you use technology during your math instruction?	RQ# 2	ISTE ICOT (2009).
How do you decide what you will teach in math each day?	RQ# 1	ISTE ICOT (2009).
How does your technology self-efficacy beliefs influence the way you incorporate technology during math instruction?	RQ# 2	ISTE ICOT (2009).
How does the way you rated yourself on the Stages of Adoption of Technology component of the survey measure up to the way you utilized technology during the observed lessons?	RQ# 1 & # 3	ISTE ICOT Stages of Adoption (Christensen & Knezek, 1999).
What are your perceptions about the patterns that existed in your technology integration behavior?	RQ# 1 & # 3	ISTE ICOT (2009).

Procedures for Recruitment, Participation, and Data Collection

Identification and recruitment. After receiving approval from the appropriate district personnel (Appendix D), the administrator at the research site (Appendix E), and the Walden University IRB # 06-10-16-0017019, the principal of the research site gave me the list of third, fourth and fifth grade teachers who met the initial criteria. I sought volunteers by attending a meeting held in the media center at Fieldstone Elementary School on September 19, 2016. At the meeting, I introduced myself and spoke about the purpose of my doctoral study. After the meeting, I handed out the paper invitation letter

(Appendix F), letter of consent, and the paper copies of the stages of adoption of technology survey (Appendix G). The invitation letter notified teachers that their information would remain confidential and that names, titles, and the site and location would be disguised. Teachers who were interested in participating completed the stages of adoption of technology survey to rate themselves on a six-point scale. This data point provided the stratification levels across each of the grade levels: Low (1 or 2), medium (3 or 4), or high (5 or 6). The teachers were required to write their names on the surveys so that I could contact those who were chosen for the final sample. Three teachers volunteered at the meeting and completed the letter of consent and initial survey, stages of adoption of technology.

However, after two weeks had passed I only had the three volunteers from Fieldstone Elementary School. Based on the need for more participants I sent emails to several elementary school principals within the county. After about 2 weeks of resending emails and making telephone calls, since I did not receive a favorable reply I applied to Walden University's IRB for a change of procedure to include my own work site, Morningside Elementary School. My request was approved by the Walden University's Internal Review Board -- IRB # 06-10-16-0017019 and by the principal at Morningside Elementary School (Appendix H) who gave permission for me to solicit volunteers by attending grades three, four, and five team planning held in the team leader's classrooms on October 17, 2016.

Similar to what had done during the meeting at Fieldstone; I introduced myself and spoke about the purpose of my doctoral study. After the meeting, I handed out paper copies of the invitation letter, letter of consent, and the stages of adoption of technology survey. After about two weeks I received the completed letter of consent and initial survey, stages of adoption of technology from thirteen teachers at Morningside Elementary School. After the teachers had returned the completed letter of consent and initial survey, I selected the nine teachers who met the stratification matrix as planned.

CTI Survey. I sent the computer technology integration survey to the teachers through the interoffice mail system and they completed and returned it the same way. After about two weeks I received all the surveys and stored them away in a locked filing cabinet at my home. I intentionally did not examine the completed CTI surveys as I wanted to remain objective prior to the classroom observations.

Observations. The process of observing the teachers integrating technology within their math lessons took approximately six weeks to be completed. This was because the participants were inaccessible due to a variety of reasons such as being out sick, attending professional development workshops, and school closure due to Thanksgiving and Christmas holidays. To observe and assess how teachers integrated technology in their math lessons, I used the ISTE ICOT at or near the start of the math class period and each observation lasted for a 40-minute segment. I used the ICOT to assess the learning the environment in relation to how technology was being integrated into instruction and as defined by the NETS. The standards are aligned with 21^{st} century skills which are geared towards preparing students to live and work in the global community (ISTE, 2008). I used the ISTE ICOT to maintain continuity in the data collection.

Interviews. Following the observation, I scheduled a one-on- one interview with each of the nine participants based on his or her availability (See Appendix I for Interview Questions). During the interview, I reminded the participants that all information would be held in confidence and of their rights to withdraw at any time if they chose to do so. I digitally recorded all the interviews and transcribed verbatim. Each interview session lasted for approximately 40 minutes and during that time participants were asked a series of six open- ended questions which were specifically designed to obtain information to answer the research questions. I used a semi structured approach to promote flexibility and allow participants to natural discourse. The interviews all took place over a three-week period at the participants' school site (Morningside Elementary School) after work hours. All participants were given a paper copy of their transcribed interviews to verify if their responses were accurately captured. This action provided the participants with an opportunity to communicate with me if they found errors, omissions, or if they desired to supplement answers. None of the participants made any changes to their transcripts.

I recorded my thoughts, observations, and reflections in a journal. Janesick (2011) stated that recording observations and reflections in a journal can help to control bias. My actions facilitated continuous reflection and triangulation of data, as well as helped to control possible bias. The digital recording device was stored in a locked filing cabinet at my home. I used the information collected from the interview for the purpose of obtaining answers for the research questions as evident in Table 3 below.

Table 3

Interview Questions aligned with Related Aspect of Teacher Belief and Actual Behavior

Interview Questions	Related Aspect of Teacher Belief and Actual Behavior
1. Describe your confidence levels with regards to integrating technology during math lessons	Belief
2. How do you use technology during math instruction?	Behavior
3. How do you decide what you will teach in math each day?	Behavior
4. How do your technology self-efficacy beliefs influence the way you incorporate technology during math instruction?	Belief
5. How does the way you rated yourself on the Stages of Adoption of Technology component of the survey measure up to the way you utilize technology during math lessons	Belief
6. What are your perceptions about the patterns that exist in your technology integration behavior?	Belief

Data Analysis Plan

Data analysis involved the use of a variety of methods in order to examine and interpret each type of collected data.

Survey data. After the participants were selected, I administered the CTI survey. I used this instrument to measure research question 1, what are elementary mathematics teachers' beliefs about their technology integration self-efficacy and their stages of technology adoption? I used the CTI survey component to help determine the teachers' confidence levels with integrating technology during mathematics instruction. The results on its own was not sufficient to help me determine the teachers' perceptions of their technology self-efficacy but formed a good base for me to place the participants in the technology efficacy groups (low-to-medium, medium-to-high, or very high).

In analyzing the results of the CTI surveys, I did not use software. Instead, I manually calculated by adding each participant's score (see Table 1- Participant Characteristics). For this data, I assigned codes because there were discrepant cases to document.

Observation data. After administering the CTI surveys, I used the ISTE ICOT rubric to record my observations. The purpose of the observation was to obtain responses for research question 2, how do elementary mathematics teachers demonstrate their levels of self-efficacy, adoption and use of technology in math instruction? Teachers' response to this question will provide me insights into how teachers are using technology during their math lessons.

The ICOT instrument has an Excel platform that allows the ICOT software to be used on computers with Microsoft Office. To analyze the ISTE ICOT data, I used descriptive statistics to identify the type of technology used by both the teachers and students and to further assess the learning environment (see the findings). According to Sachs, Sheeny, and Somers (2013), a teacher can structure the learning environment to build relationships with students and create high interest activities to capture and sustain student engagement.

Interview data. Research question three asked what patterns exist in the relationships between these teachers' beliefs and behaviors related to technology integration in the classroom. I used the interview data for the purpose of exploring patterns among how elementary teachers reported their use of technology, as against their observed behavior. To begin the analysis of data for the interview questions, I read each transcript multiple times and made notes of the contrasting as well as the aligned statements made by each participant. Then, I highlighted all the relevant information and assigned titles. I used open coding as this allowed the sorting through of data on a line-by-line basis. I identified and assigned codes to texts that appeared to be relevant (Table 4). This process is known as identifying segments (Merriam, 2009). The 01 represented research question one, and the numbers that follow (e.g. 01, 02, 03) represented the participants.

I used member checking to ensure that the information communicated was the intended one. According to Rager (2005) member checking is known as participant verification. I used this process as it provided opportunities for participants to determine if their views, feelings, and experiences were captured, by restating or summarizing the participants' responses. Having the participants agree or disagree helped to authenticate the data and thus made the research more credible (Lincoln & Guba, 1985; Stake, 2006). Additionally, towards the end of the analysis, I shared the data pertaining to the themes that emerged from the coding. I used this process as it allowed the participants an opportunity to clarify any misconceptions, as well as provided me with an understanding of any differences that aroused between the survey and observations. Lincoln and Guba

(1985) speculated that this action allows the participants an opportunity to review the research for authenticity.

Table 4. Sample Data Open Coding

Code	Meaning
Self-efficacy Beliefs	
0101, 0102, 0103	Confident
0104, 0105, 0106, 0107, 0108, 0109	Somewhat Confident

Note: 01 represented research question one, and the numbers that follow (e.g. 01, 02, 03) represented the participants.

Discrepant cases. It is important to identify discrepant cases in a research. Based on this premise, I included any data that differed from the research findings and from the participants. As the purpose of my study was to examine patterns between teachers' technology beliefs and their technology integration behavior, I felt that it was important to give each participant a voice and to share their perceptions regardless of how unaligned their views appeared.

Issues of Trustworthiness

White (2005) concurred that validity can be achieved through the use of a variety of data sources. While Lincoln and Guba (1985) suggested the use of audit trails, triangulation, prolonged engagement, and peer debriefing. In this study, I addressed issues of trustworthiness through the use of multiple sources of data as a means to triangulate or cross-check the findings. For example, I used self-rated reports along with observations and interviews. Utilizing multiple sources of data helped me to clarify any differences or understandings between the self-rated reports, what was seen during observations, and what was reported during the interviews.

Additionally, member checks from participants were conducted. According to Lincoln and Guba (2007), the process of member checking can help to ensure credibility. Similarly, in order to establish external validity, rich narrative descriptions were obtained through the data. Lincoln and Guba (2007) theorized that thick descriptions can enable researchers to replicate the study if desired. Also, in order to provide authenticity, I did not try to influence the participants, the study or the findings in any way. Instead, at the end of the study, I invited the participants to review the findings of my study. I used this procedure to determine if the participants' experiences were accurately captured or aligned with the data collected.

Credibility. In order to establish credibility, I used more than one data collection method to validate the study. According to Gay (2006), using several data collection methods can help to provide credibility. One data collection method that I employed was to have the participants complete a self-rated survey; Wang et al's (2004) CTI survey. Teachers rated themselves as either having low to medium (72 or below), medium to high (73-89), or very high technology efficacy (90 -105). The other data collection method involved conducting classroom observations. I used the ISTE ICOT tool to record each observation. The ICOT is designed with features to help the researcher assess the learning the environment based on how technology is being integrated into instruction as defined by the NETS. The final data collection that I employed was interviewing participants. I established credibility by triangulating survey and observation with statements collected during the interviews.

Transferability. According to Merriam (2014), transferability can be achieved when the findings of one study can be applied in similar situations. My research took place over a five-month period and I sought to establish external validity by collecting rich, thick, detailed descriptions. Patton (2002) proposed that trustworthiness can be promoted through the use of “thick, deep, and rich” descriptions. For example, in this study, there was variation in how I selected the participants. Initially, I had three volunteers from Fieldstone Elementary School and since more participants were needed for the study, I applied to and received from Walden University’s IRB for a change in procedure to include Morningside Elementary School where I work.

Dependability. In this study, I used various data tools such as surveys, observation, and interviews to triangulate findings. Ying (2009) opined that triangulation can provide dependable results when conducting research. Additionally, I tried to minimize bias by using reflexivity. For example, I made conscious notes about my own feelings and fears pertaining to the topic and participants. This approach helped me to stay focus and to listen rather than interrupt the participants’ stories. Additionally, I used prolonged engagement, member checking, and the recording of rich narrative descriptions to establish dependability.

Confirmability. I used interviews and observations to capture the beliefs and behaviors of the participants. The use of such data facilitated the process of cross checking data to ensure trustworthiness. Additionally, I also used reflexivity, which was previously described, as a means to provide objectivity in my study.

Ethical Procedures

In order to ensure ethical procedures, I completed several steps including gaining organizational agreements. Prior to the collecting data, I obtained approval from Walden University Institutional Review Board (Approval # 06-10-16-0017019). In order to conduct research in the Sun State School System, I completed and submitted the required application form to the district for approval. Additionally, I sought and obtained permission to use Christensen and Knezek's (1999) stages of adoption of technology survey (Appendix J), Wang et al's (2004) CTI survey (Appendix K), and the ISTE ICOT instruments (ISTE, 2009) (Appendix L).

The invitation to participate, letter of consent, and the stages of adoption of technology surveys were paper copies and I gave them out at the meetings. I did this procedure to recruit and determine the teachers' stages of technology adoption. This action helped me to stratify the sample and provided a comparison point for data analysis. Upon return of the completed survey, I quantified and categorized the participants' chosen level of adoption data into three levels of technology use: low-to-medium (1 and 2), medium-to-high (3 and 4), and very high (5 and 6).

I was approved to share the details of my study during the grade level meetings held on the school's site in the media center at the end of the work day. At the meeting, I informed the teachers about privacy, ethical concerns, potential risks, as well as the objective, and possible benefits to be derived from conducting the study. Additionally, the teachers were made aware that participation was voluntary and that should they choose to participate, they could withdraw from the study at any time. To indicate acceptance of these terms and a willingness to be included in the research, participants were required to sign and return the consent forms. Completion of such action served as documentation of agreement to take part in the study. Additionally, in order to protect the identity of all participants, I used pseudonyms instead of the participants' real names to maintain confidentiality.

Another ethical concern was related to treatment or protection of data. I stored all data on paper in a locked filing cabinet and those in electronic format were saved and secured in an electronic file which required a password for access. I was the only person with the key and password for accessing both locations. I will destroy the data after 5 years by erasing audio recordings, shredding written documents, and deleting electronic data. I will ensure that no identifiable information will be made available in any published report and any audio recording will not be made public.

A final area of ethical concern was a change in the sample due to a lack of participation from other schools in the school district. After I received permission from the Sunshine State School System to conduct my research in the county, I emailed several elementary schools within the school district. However, only two principals responded favorably. Both gave permission for me to attend a meeting to share the purpose of my dissertation and to seek volunteers to participate in the study. I scheduled the meetings at 2:40 PM for September 19, 2017 (Fieldstone Elementary School), September 20, 2017 (Vernbank Elementary School), and September 21, 2017 (Dakota Elementary School).

On those days, I arrived at the end of the work day and checked in the office. The principals had teachers assemble in the media center where I introduced myself and shared the purpose of my doctoral research. At the end of the meeting I handed out invitation letters, letter of consent, and the stages of adoption of technology survey. The invitation letter and letter of consent contained the details of my research as well as my contact information. By the end of the following week, I had three volunteers from Fieldstone Elementary School.

Since more participants were needed, I reached out via email and telephone calls to the elementary school principals within the district. This action served as a second attempt to secure participants. Most principals did not respond except for one who responded to inform me that she was denying her teachers the right to participate in the study. Since all attempts to secure participants failed, I applied to Walden University's Internal Review Board and requested a change in procedure. I was granted permission to include my school (Morningside Elementary) in the study. I was also given approval by the school's principal. In order to obtain volunteers, I was given permission to meet with grades three, four, and five teachers during their scheduled planning time. Based on this agreement, I visited each grade level, introduced myself, and explained the purpose of my study. At the end of the meeting, I handed out invitation letters which had the details of my research as well as my contact information. By the end of the following week, I had twelve volunteers from Morningside Elementary School.

In order to select nine participants for the study, I requested that volunteers sign and return the informed consent forms along with the completed Christensen and

Knezek's (1999) stages of adoption of technology survey. Upon receipt, I quantified and categorized the survey into three levels of technology efficacy categories: low-to-medium, medium-to-high, and very high technology self-efficacy.

The first phase of the data collection process then began and involved the teachers completing the CTI survey (Wang et al., 2004) which were sent via interoffice mail. Within a two week period the teachers completed and returned the surveys. I sorted the surveys based on three levels of technology self-efficacy. Teachers who scored 72 or below were regarded as being in the low-to-medium, 73 -89 were medium-to-high, and 90 –105 were very high efficacy group.

The second data collection phase involved classroom observation. I observed each of the participants as they used technology during their math lessons. I used the ISTE ICOT tool to document my observations (ISTE, 2008). I conducted observations on the days and times agreed on by the participants. After the observations were conducted, I conducted interviews with each of the participants to discuss their perceptions of their technology self-efficacy.

The final data collection phase involved conducting face-to-face interviews with each of the teachers. Each interview that I did lasted for approximately 40 minutes and was done after the participant's work hours in the teachers' classrooms or the school's conference room.

Summary

My purpose for conducting this qualitative case study was so that I could explore the patterns between elementary math teachers' technology integration self-efficacy and their actual technology integration behavior. I used selected response surveys in combination with qualitative semi-structured interviews to allow the participants to provide in-depth descriptions of their technology self-efficacy beliefs towards the adoption and use of technology. In this section, I will provide an explanation of the research procedures that were proposed for this study and also address the measures for ensuring anonymity and confidentiality of the participants.

Chapter 4: Results

The purpose of this qualitative case study was to explore any patterns that existed between teachers' technology self-efficacy beliefs and their actual technology integration behavior during math instruction within the classroom. I used surveys, observation checklist, and semi-structured interviews to collect data. The information that I obtained provided viable means to explore how teachers' general beliefs influenced or hindered the way technology was used during math lessons. This study was guided by the following research questions:

1. What are elementary mathematics teachers' beliefs about their technology integration self-efficacy and their stages of technology adoption?
2. How do elementary mathematics teachers demonstrate their levels of self-efficacy, adoption, and use of technology in math instruction?
3. What patterns exist in the relationship between these teachers' beliefs and behaviors related to technology integration in the classroom?

This chapter includes a description of the participants, details concerning data collection and procedures, and a summary of the findings. Themes that arose during data analysis are also presented as they relate to the research questions. This chapter also includes an assurance of trustworthiness of these procedures and an explanation on how the results for each of the three research questions aligned to the theoretical framework.

Research Setting

I conducted the study at Morningside Elementary School within the Sun State School System. At the time that I conducted the study, there were no apparent personal or organizational conditions that appeared to influence participants or their experience or the interpretation of the study results. Initially, I excluded Morningside Elementary from the study. However, I obtained IRB approval to include this school because of the low participation rate from three other locations. Of the nine participants required for the study, only three teachers volunteered from Fieldstone Elementary School. Based on this, six other volunteers were needed and so I requested a change in procedure to include my place of employment. I selected both study sites due to the extensive technological resources available to teachers that included, but were not limited to lap tops, iPads, and active boards.

Demographics

Eight women and one man were included in this study and their ages ranged from 25 -55. The average age of the participants was 42. Six of the participants were African American and three were Caucasian. In order to be included in the study participants had to meet the criteria of (a) teacher in Sun State School District, (b) teaching in Grades 3, 4, or 5, (c) teacher for a minimum of at least two previous years, (d) currently teaching mathematics, (e) have access to technology resources, (f) integrate technology resources during math instruction.

Grade 3 Participants

The third-grade teachers included three African American women, Karen, Paula, and Laura (pseudonyms). Karen rated herself as having low to medium technology levels of use and 23 years of teaching experience. Paula rated herself as having medium to high levels of technology use with 9 years teaching experience, and Laura rated herself as having very high levels of technology use with 8 years teaching experience.

Grade 4 Participants

The fourth-grade participants included two African American, one woman, Sandra, and one man, Tom (pseudonyms). The third participant was a Caucasian woman, Joan (pseudonym). Based on the self-rated technology use survey, Tom had very high technology use with 12 years teaching experience, Sandra medium to high with 20 years teaching experience, and Joan low to medium levels of technology use with 15 years teaching experience.

Grade 5 Participants

The fifth-grade participants included two Caucasian women, Lindsay and Ashley, and an African American woman, Marsha (pseudonyms). Lindsay reported very high technology use with 4 years teaching experience, Ashley reported medium to high with 10 years teaching experience, and Marsha reported low to medium technology levels of use with 8 years teaching experience. Table 5 provides a summary of participants' characteristics with a breakdown of gender, race, age, instructional level, years and years of teaching experience, technology self-efficacy score, and technology self-efficacy level.

Table 5

Participant Characteristics

Participant	Gender	Race	Age	Grade Level	Years of Teaching	Technology self-efficacy Score	Technology self-efficacy Level
Karen	Female	Black	55	3	23	53	Low
Paula	Female	Black	44	3	9	85	Medium
Laura	Female	Black	45	3	8	102	High
Joan	Female	White	43	4	15	62	Low
Sandra	Female	Black	45	4	20	89	Medium
Tom	Male	Black	40	4	12	104	High
Marsha	Female	Black	38	5	8	68	Low
Ashley	Female	White	43	5	10	87	Medium
Lindsay	Female	White	25	5	4	101	High

Data Collection

Data collection took place over 3 months, beginning in October 2016 and ending in January 2017. I started data collection by sending emails to several elementary school principals within the district. Only three principals responded favorably with the understanding that it was up to the teachers to decide whether or not they wanted to participate. Based on the response, I requested a face-to-face meeting in lieu of making an introduction and discussing the purpose of the research. At the meetings, I handed out invitation letters with my contact number and email along with the consent forms, and the stages of adoption of technology survey. Three teachers from one school, Fieldstone

Elementary (pseudonym) located in the Sun State School District, volunteered to participate. They completed and returned their consent forms and the stages of adoption of technology survey after the meeting.

Approximately 2 weeks after the meeting with no additional participants, I requested a change in procedure from Walden University's IRB to seek additional participants from Morning Side Elementary which is my place of employment. My request was approved by the Walden University's Internal Review Board (IRB; # 06-10-16-0017019).

Stages of Adoption Data Collection

Fifteen participants from two schools (three teachers from Fieldstone and twelve teachers from Morningside Elementary School) accepted and completed the stages of adoption survey. All volunteers had to sign a consent form and complete paper copies of the stages of adoption of technology survey which was a self-rated single item survey. The teachers selected the stage that best described their level of use of technology. After completing the stages of adoption of technology survey, I used stratified purposeful sampling to select the participants within certain subgroups or strata. I collected data from three teachers from each grade level (Grades 3, 4, and 5), who fit the following criteria: rated themselves low (1-2), medium (3-4), or high (5-6) on the technology integration continuum. Fifteen teachers completed and submitted the stages of adoption of technology survey within a 2 week period. Of the 15 participants that returned the stages of adoption of technology surveys, four rated themselves as having low to medium technology use, five rated themselves as having medium to high use, and six as having very high technology use. I used the stratification technique to select nine participants, three from each category befitting the levels of low to medium, medium to high, and very high technology use.

CTI Data Collection

A week later, the nine participants that I selected were given paper copies of the computer technology integration survey which were sent through interoffice mail. All nine teachers completed and returned the surveys within 2 weeks and I stored them in a locked filing cabinet at my home. I did not review the CTI survey until after I conducted the classroom observations because I wanted to remain as objective as possible and not be influenced by the participants' responses on the CTI survey.

Observation Data Collection

To conduct the classroom observations, I contacted each of the participants via telephone or email and requested a day and time to come in and observe for the purpose of research and data collection. Each of the participants was also asked to provide a time that would be convenient to conduct the interview outside of the instructional hours. Response from the teachers at Morningside was favorable; however, I was unable to secure a date and time to observe the participants at Fieldstone Elementary School. After multiple attempts and without response from the three participants at Fieldstone, they were removed from the study. Three other participants from Morningside Elementary School were selected from the pool of teachers who had already completed the consent form and the stages of adoption of technology survey. The three teachers were given paper copies of the CTI survey which they completed and returned within 3 days. They were also contacted and asked to provide a day and a time that would be convenient for the classroom observation, as well as for the interview.

Following the return of the CTI survey, the observation phase of data collection began. This process of observing the teachers integrating technology within their math lessons took approximately 6 weeks to complete. This was as a result of the participants being inaccessible due to a variety of reasons such as being out sick, attending professional development workshops, and school closure due to Thanksgiving and Christmas holidays.

I used the ISTE ICOT to facilitate the observation and assessment of how teachers integrated technology in their math lessons and to maintain consistency and continuity in data collection. Each observation occurred at or near the start of the math class period and lasted for 40 minutes. Because ISTE requested, I did not include the full instrument in my study.

Interview Data Collection

After the observation, I scheduled one-on-one interview with each of the nine participants based on his or her availability. During the interview, I reminded the participants that all information would be held in confidence and of their rights to withdraw at any time if they chose to do so. I digitally recorded all interview sessions and transcribed verbatim. Each interview session lasted for approximately 40 minutes. During that time participants were asked a series of six open-ended questions. I specifically designed questions to obtain answers about the teachers' technology beliefs and their technology integration behaviors. I used a semi structured approach to promote flexibility and natural discourse. The interviews all took place over a 3-week period at the participants' school site after work hours. The information collected from the interview served the purpose of obtaining answers for the research questions.

Data Analysis

I used a variety of methods to examine and interpret the collected data. I recorded the interviews and then transcribed them within four to five days. My goal behind the interview questions was to explore patterns among teachers' self-efficacy beliefs and their actual use of technology during math instruction in the classroom. To begin the analysis of data for the survey, interview questions, and observation checklist, I utilized open coding as this allowed the sorting through of data on a line-by-line basis.

However, prior to the coding process, I first established a story line by writing down the key essence behind the study (Lofland & Lofland, 1995; Miles, Huberman, & Saldana, 2014). This essence was the teachers' general beliefs about technology, how they use it during math lessons, and whether or not a pattern existed between teachers' beliefs and their behavior.

I began with pre-set or a priori codes, which included words such as confidence and comfort level, benefits of technology, and planning technology infused lessons. As I read and re-read each transcript, other codes emerged such as the need for support. I continued to read each transcript multiple times and made notes of the contrasting as well as the aligned statements made by each participant.

In addition to jotting down codes, I also made personal notes pertaining to my reactions as the data began to unfold. For example, I wrote down, "What does technology effectively integrated in lessons look like?" As I analyzed the data, I revisited my notes to obtain insights on this question based on participants' responses. Miles, Huberman, and Saldana (2014) referred to this action as writing out loud and an opportunity to come up with logical explanations. After completing the process of coding, I highlighted examples within the transcripts that were aligned with the respective codes, and then I determined themes. Several themes were derived based on the codes that emerged. Some of these codes were comfortable, somewhat comfortable and technology support. Some themes that emerged from coding the data were teachers need to be comfortable with technology, need for more computers and technology resources, need for onsite support and professional development. These themes are organized by research questions in the results section, which follows a discussion of the trustworthiness of the data and the analytical process.

Discrepant Cases

Two discrepant cases were identified. The first was that two of the nine participants shared that they were concerned that too much emphasis was being placed on technology and very little on students using their minds to arrive at solutions to problems. One example that Joan shared was, "I see students using their iPhone to ask Siri answers to questions instead of actually trying to use what they have been taught to help them figure it out".

Similarly, Marsha shared, "The students that we are teaching today are unable to spell or write a complete sentence with proper grammar and mechanics, and likewise, they struggle with calculating simple math problems and tend to rely too heavily on calculators". Marsha also added "It is my personal belief that technology is great, but we should also continue teach students the way we use to in days gone by. Teach them with textbooks as well, instead of removing textbooks from the classroom". However, both teachers stated that they use technology in the classroom as it is a requirement and is recorded by administrators on the teacher's observation forms during walkthroughs.

The other discrepant case was that two teachers felt the need to have more computers in the classroom, as well as a repertoire of technology resources. The teachers felt that having five computers in the classroom was not sufficient and that even though they can check out iPads from the media center, the process of scheduling was time consuming. Joan mentioned how difficult it was to get sufficient computers to teach her lessons:

> I find the whole process of not having a classroom set of computers available for my students during math lesson. We are only given five computers for each classroom. My days are very busy with teaching and running around non-stop supervising students and very often attending meetings, therefore, even when I book the use of iPads I often forget or just don't have the time to go and collect them. For me, it would be easier to have my own class set of computers readily available to my lessons rather than having to share with the rest of the school.

For Marsha, it was the need to have a list of websites and educational applications. She stated:

> I wish there was a list of educational websites and apps readily available for each lesson, as having to source my own is time consuming and sometimes confusing.

> Many times when I find a website I have to be careful of the contents when commercial pops up. I have no way of filtering the ads and this leaves me scared to death about the kind of trouble that I can get myself in. Technology can be pretty scary.

Evidence of Trustworthiness

It is important that studies be conducted in an ethical manner. I sought to do so by collecting data from multiple sources to triangulate or cross-check the findings. I used the code recode strategy, as well as a combination of data sources such as surveys, interviews, and classroom observations in order to achieve triangulation.

Credibility

I employed a variety of measures to ensure accuracy and credibility. One such measure was that I consistently sought to remain neutral by attempting not to involve personal feelings which would influence responses from the participants. I employed the use of field notes to remain focus on the data as it arose. Doing so also helped me to eliminate personal biases pertaining to the topic being studied and to present information as unveiled by the data collected. Additionally, I used more than one data collection method to validate the study. Gay (2006) stated that using several data collection methods helps to provide credibility.

Transferability

According to Merriam (2014), transferability is the likelihood that the findings in one study can be applied in other similar situations. Researchers suggested using detailed descriptions and content in order achieve validity. Based on this premise, I tried to present a rich narrative description on order to achieve external validity. Additionally, I sought to obtain a diverse background of participants by including teachers of gender, various age groups, and ethnic demographics.

Dependability

In qualitative research, the researcher plays a key role in how the data is collected, analyzed, and interpreted. To eliminate or lessen bias, Creswell (2007) and Lincoln and Guba (2007) advised the researcher to provide clear description between data collection, analysis, and interpretation. Based on this recommendation, I tried to provide concise details of each process, ones free from personal bias. Additionally, to control personal bias, I kept a journal with my notes as it related to my thoughts as well as reflections.

Confirmability

To establish confirmability, I used triangulation (White, 2005; Yin, 2009). I used this strategy to lessen bias and increase objectivity and neutrality when collecting, analyzing, and interpreting the research data. I achieved triangulation by using a multidimensional framework approach that combined Bandura’s (1977) social cognitive theory, the ISTE standards (ISTE, 2008, paragraph 1 - 5), and the stages of adoption of technology (Christensen & Knezek, (1999). I used Bandura’s (1977) social cognitive theory to examine how self-efficacy can influence an individual’s psychological state, motivation, and actions. Additionally, examining this theory provided me with the lens to explore the technology integration behavior between teachers who rated themselves within the low, medium, and high efficacy categories. I used the ISTE-NETs standards (ISTE, 2008, paragraph 1 - 5) as guidelines to determine the teachers’ quality of technology infused math lessons and I used the stages of adoption of technology (Christensen & Knezek, 1999) model to explore where teachers see themselves on the technology implementation continuum. I used this approach as lens to examine, interpret, and support the data.

Another approach that I used was data triangulation where I collected evidence through different types of data sources which included surveys, observation, and interviews. This process helped me to triangulate or cross-check the findings as using multiple sources of data helped to clarify any differences or understandings between the self-rated reports, what was seen during observations, and what was reported during the interviews. For example, the teachers' self-reported technology levels did not always match up to what was observed during their math instruction. When this occurred, I was able to use the third data point of an interview to delve deeper into self-efficacy levels, stages of adoption and how this impacts the teacher's integration of technology into the classroom. I used multiple forms of data to provide stronger lines of reasoning for the findings. Additionally, I kept a journal with my notes as it related to my thoughts as well as reflections to help control personal bias.

Results

The purpose of this qualitative case study was to explore the patterns between elementary math teachers' technology integration self-efficacy, their level of technology adoption, and their actual technology integration behavior. To develop an understanding of participants' self-rated technology self-efficacy versus their observed technology behavior, data were explored using a multidimensional conceptual framework approach that combined Albert Bandura's (1977) social cognitive theory, the ISTE standards, and the stages of adoption of technology. Data from surveys, observations, and interviews were explored to identify themes and relationships among the sources of data collected. The results are outlined below.

Research Question 1

The first research question asked what are elementary mathematics teachers' beliefs about their technology integration self-efficacy and their stages of technology adoption. This research question served the purpose of exploring teachers' general beliefs about using technology during math lessons. In order to obtain these answers, teachers' responses to the interview questions were explored to identify themes. Two themes were identified from the data: (a) teachers need to be confident with using technology and (b) teachers need onsite technology training and professional development.

Teachers need to be confident with using technology. Teachers are expected to integrate technology in lessons as it is a state education requirement to prepare students to meet the demands of living and working in the 21st century. Teachers have common perceptions despite their varying levels of technology efficacy. A common theme voiced was the need to feel more confident and at ease when using technology to teach. The participants stressed the need and their willingness to learn more ways to infuse technology in their practice. According to the data, Karen scored 53 out of a possible 105 points on the self-rated CTI survey, which placed her in the low efficacy category. During the interview, in describing her confidence levels with incorporating technology in math lessons, Karen stated "I can confidently teach math, but I feel a bit apprehensive about integrating technology in the lesson, because I think I could get some more help on how to do so effectively".

Paula scored 85 out of a possible 89 points on the self-rated CTI survey, which placed her in the medium to high efficacy category. During the interview, in describing her confidence levels with technology integration, Paula stated "I am confident with integrating technology during my math lesson. I am very good at assigning work for students to do on the internet sites; however, I would like to know how to do more.

Ashley scored 87 out of a possible 105 points on the self-rated CTI survey, which placed her in the medium to high efficacy category. During the interview, in describing her confidence levels with technology integration, Ashley stated "I am confident that during my teaching I integrate technology within my math lessons. My students seem to enjoy using it as well. Similarly, Sandra who scored 89 (medium to high efficacy), Joan who scored 62 (low to medium efficacy), Marsha who scored 68 (low to medium efficacy), and Lindsay who scored 101 (high efficacy) shared their concerns with wanting to learn more. In her personal interview (Lindsay, personal communication January 5, 2017), who rated herself as having very high efficacy stated:

> I am confident with integrating technology. However, I would like to learn about new ways to implement it during my lessons. I think the ability to do so will definitely increase student achievement and students will be more interested as they explore other innovative ways of learning with technology.

In contrast, Laura scored 102 out of a possible 105 points on the self-rated CTI survey, which placed her in the very high efficacy category. During the interview, in describing her confidence levels with technology integration, Laura stated "I believe I am confident that math is integrated with technology. I believe that students are highly engaged utilizing technology during math lessons. Similarly, Tom scored in the high efficacy category as he earned 104 out of a possible 105 points on the self-rated CTI survey. In his personal interview, Tom stated:

> When it comes on to using technology to teach math, I am extremely confident in using it. I believe my students are actively engaged utilizing technology during math lessons. I believe that my training in technology makes me very capable of accessing resources and activities that will help my students to achieve academic success.

In comparing and contrasting responses, I noted that of the nine teachers, seven expressed feeling somewhat capable in their ability to integrate technology in their math lessons, while two expressed that they felt very confident.

Teachers need onsite technology support and professional development. Three of the nine teachers felt that on-site technology support and professional development were needed to prepare teachers more effectively to implement technology in math lessons. Karen stated, "Personally, during trainings, I need more than simple demonstrations. I need to learn how to use technology to teach a specific math lesson like measurement or geometry." Similar to Karen, during her interview, Ashley stated:

> The way I feel about technology makes me more eager to use it on a daily basis, as well as more likely to find resources for the students to use as well. However, at times I feel limited by my technology skills. Training is provided at times

> which is often about a new website or education resource such as Discovery Education, or NEWSELA. This is a good thing, but I think I need help with sharpening my technology skills through regular training or professional development. I think this would increase my confidence and ability to use it as well.

Sandra shared somewhat similar concern pertaining to needing on-site support and additional technology. Sandra stated:

> Since I believe I am very capable of incorporating technology during my math instruction I look for activities that can engage my students. I often improvise since there seems to be a limited amount of resources to teach math lessons. I often create flip charts for the activeboard to assist with lesson delivery, but I think there needs to be on-site support like mentors available for showing or helping teachers incorporate technology during math lessons. Mentors could help to show us new ways to use technology and innovative activities that can be incorporated in our lessons. (Sandra, personal communication, January 6, 2017)

Research Question 2

Research question two asked how elementary mathematics teachers demonstrate their levels of self-efficacy, adoption, and use of technology in math instruction. This research question served the purpose of exploring how teachers integrated technology during their math lessons. In order to obtain these answers, data from interviews and observations were explored to identify themes and relationships among the sources of data collected. Two themes emerged from the data: (a) Teachers use common lesson plan and administrator-recommended resources to teach math and (b) Teachers use whole group and small group instruction to integrate technology.

Teachers use common lesson plans and administrator-recommended resources to integrate technology. Teachers reported that they met as a grade level one day each week to plan and that county's curriculum guide is used to determine what to teach on a weekly basis. Lindsay explained:

> As a team, we meet on Mondays to plan the following week's lessons. The curriculum map lets us know what exactly to teach and then we brainstorm ideas that incorporate 21st century competencies and agree on resources that will help students the most. When we meet we also take into consideration our students' ability and create centers for remediation as well as enrichment.

Similarly, Tom shared that administrators determine the length of time allotted to each subject, and provided recommendations on approved resources to be utilized during instruction. He shared:

> Our administrators give us a schedule at the beginning of school, so we know when and how long our math segments are. They also have a major input on the resources that we use to teach math. We cannot use any random game. Instead, we have websites such as Math Antics, Learnzillion, Mobymax, and Illuminate that are recommended.

Teachers used the interactive whiteboard to introduce and present lessons in a whole group setting which lasted for 20 minutes. The most common technology tools and applications used by teachers were PowerPoint, flipcharts, videos and websites. After whole group lessons, students transitioned through three centers, each lasting for approximately twenty minutes. The small group settings consisted of a teacher-directed center, a math practice center in which students completed tasks with manipulatives, and a technology center in which students worked on computer-based math activities online (i.e. MobyMax, Prodigy).

Teachers use whole group and small group instruction to integrate technology. Despite the varying efficacy levels reported by teachers, they presented lessons in a similar manner. All nine teachers were observed first using the interactive whiteboard to teach in whole group and then transitioning to small group setting where the classroom desktop computers were used. The small groups consisted of a center where the teacher provided explicit instructions, a center where students worked with pairs or a group, and a center where students worked independently on the computer. There was uniformity in lesson presentation among the teachers as well as the type of technologies used. Students at the computers worked at their own pace and that web apps such as Mobymax provided students with individualized instruction. Additionally, as students worked within such setting, the teacher was given the opportunity to work with students who needed additional support. The lessons appeared to promote 21st century competencies as students were seen in the learning centers communicating and collaborating in order to construct knowledge. For example, an activity noted was one where students used a regular menu from a local restaurant to take each other's order and then added up the cost for the selected meals. Some students did the calculation manually while others used calculators. During the process, students were seen collaborating to solve the problem and arrive at their answers.

Research Question 3

To observe and assess how teachers integrated technology in their math lessons, I used the ISTE ICOT at or near the start of the math class period which lasted for a 40-minute segment. The ICOT is designed with features to help the researcher assess the learning the environment based on how technology is being integrated into instruction as defined by the NETS. The standards include: 1) Facilitate and Inspire Student Learning and Creativity, 2) Design and Develop Digital-Age Learning Experiences and Assessments, 3) Model Digital-Age Work and Learning, 4) Promote and Model Digital Citizenship and Responsibility, and 5) Engage in Professional Growth and Leadership. It is aligned with 21st century skills which are geared towards preparing students to live and work in the global community. Features of the ICOT help the researcher to examine and record student groupings, individually, in pairs, small groups, and whole class. The teacher's role can be examined and recorded as well, i.e. lecture, model, interactive direction, moderation, and facilitation.

Research question three asked what patterns exist in the relationships between these teachers' beliefs and behaviors related to technology integration in the classroom. This research question served the purpose of exploring patterns among how elementary teachers reported their use of technology, as against their observed behavior. In order to obtain these answers, data from surveys, interviews and observations were explored to identify themes and relationships among the sources of data collected. Four themes emerged from the data: (a) teachers' confidence levels does not necessarily influence technology use, (b) during whole group teachers with low to medium efficacy levels used multi-media presentations while teachers with high efficacy levels used web-based resources, (c) teachers in high efficacy category acted more as facilitators than teachers in the low to medium efficacy categories, and (d) teachers with high efficacy levels reported participating in technology training outside of school hours.

Teachers' confidence levels do not necessarily influence technology use. All nine teachers expressed confidence to various degrees during the interviews. In expressing their confidence levels, Paula (medium efficacy) and Joan (low efficacy) used terms such as somewhat confident, sort of confident, and kind of confident. While, Tom used the term extremely confident. In examining the patterns between how they rated themselves as against how they used technology, the teachers' responses were similar in that they felt that their efficacy levels were aligned with their technology integration behavior. However, despite the teachers' varying efficacy levels and beliefs, they all used the same format of whole group instruction using the interactive whiteboard and small group instruction where students rotated through three centers, one of which required them to use the five classroom desktop computers to complete computer-generated activities. Teachers reported during the interview that the school's administrators require the use of whole group and small group format during math instruction.

Paula had rated herself as having medium technology self-efficacy. Paula (medium efficacy) stated "I believe the way I rated myself on the stages of adoption of technology, which was level 3, matches up with how I really use technology as I teach my math lessons. My confidence level is aligned with my technology integration behavior. Because I am somewhat confident, however, I believe my technology use can be enhanced". During the observation, while in the whole group instruction segment, Paula used a Powerpoint presentation on the interactive whiteboard to introduce the lesson. Then during small group instruction, Paula had students use the classroom desktop computers to engage in individualized practice through computer generated activities on a web app called Mobymax.

Similarly, Joan (low efficacy) stated, "I rated myself low because I tend to stick with technology that I am confident with using". For example, I am comfortable with using flipcharts on my active board as a means of showing students how to think out loud to solve math problem. I feel that for me there is room for improvement to get outside my comfort zone". During observation, while in the whole group instruction segment, Joan used a flip chart on the interactive whiteboard to review previous lessons, as well as to introduce the new content. Then during small group instruction, Joan had students rotate through the same three centers consisting of a teacher-guided center, collaborative center, and computer center. At the computer center, students used the five classroom desktop computers to engage in individualized practice through computer generated activities on a web app called Mobymax.

Tom (high efficacy) also reported that he believed the way he rated himself on the stages of adoption of technology survey was aligned with his technology integration behavior. Tom stated:

> I rated myself at stage six on the stages of adoption of technology survey. When it comes on to using technology to teach math, I am extremely confident in using it. I believe my students are actively engaged utilizing technology during math lessons. I believe that my training in technology makes me very capable of accessing resources and activities that will help my students to achieve academic success. I believe how I rated myself is aligned with my practice in the classroom.

During observation, similar to Paula and Joan, while in the whole group instruction segment Tom used the interactive whiteboard to introduce the lesson. However, unlike Paula and Joan, he did not use multi-media presentation such as Powerpoint or flip chart. Instead, Tom used Math Antics which is a web-based resource. After whole group instruction, similar to Paula and Joan, Tom had the students transition to small groups. During this segment, students also rotated through the same three centers, one of which facilitated individualized practice through computer generated activities called Mobymax.

Patterns of technology use. During observation, all nine teachers utilized the same type of technologies within the classroom which consisted of the interactive white board and five desktop computers. However, what was different is that Joan (low efficacy), Marsha (low efficacy), Paula (medium efficacy), Sandra (medium efficacy), Ashley (medium efficacy) and Karen (low efficacy) used multi-media presentations such as PowerPoint and flip charts on the interactive whiteboard, while Laura (high efficacy), Tom (high efficacy), and Lindsey (high efficacy) used web-based resources such as videos projected from the interactive whiteboard. Details of what was seen during the observation are presented below.

In Karen (low efficacy) and Paula's (medium efficacy) third-grade classrooms, during whole group instruction, I witnessed the teachers using PowerPoint presentations to introduce and practice mixed reviews with students. The mixed review included a variety of topics including word problems, area and perimeter. Laura (high efficacy) was seen using Learnzillion videos to introduce and access prior knowledge through discussion on similar concepts. After the whole group segment, students transitioned into centers. There were three centers consisting of a teacher guided center, a collaborative center, and a technology center. In the teacher guided centers, Karen (low efficacy), Paula (medium efficacy), and Laura (high efficacy) were seen differentiating instruction according to students' need and ability (low, medium, high). All three teachers worked with students using anchor charts and manipulatives to solve word problems, area, and perimeter. However, in Laura's (high efficacy) classroom, the students in the collaborative group were allowed to choose activities from pockets. The group selected an activity with a regular menu from a local restaurant. The students used the menu to take each other's order and then added up the cost for the selected meals. Some students did the calculation manually while others were allowed to use calculators.

In Karen (low efficacy) and Paula's (medium efficacy) classroom, the students in the collaborative group were assigned specific tasks to complete. The task required students to play the game "I have, who has….Perimeter". The rules for the game required the cards to be distributed, one student read his or her card aloud, and the student with the card with the answer to the previous student’s question reads his or her card aloud. Students must listen for their turn to not break the chain. When the chain reaches the student with the last card, the game is over. In the third-grade, the students at the computer center were seen completing individualized instruction on the Mobymax website.

During the fourth-grade observation, Joan (low efficacy) used flipcharts and Sandra (medium efficacy) used PowerPoint during whole group instruction. Both teachers used multi-media presentations to introduce new contents and access prior knowledge on adding and subtracting fractions with like denominators. Tom (high efficacy) was seen using Math Antics videos to introduce and sustain students’ attention by pausing the video at times to engage students in a discussion on fractions.

After the whole group segment, students transitioned into centers. Similar to third-grade teachers, the fourth-grade teachers had three centers that consisted of a teacher guided center, a collaborative center, and a technology center. In the teacher guided centers, Joan (low efficacy), Sandra (medium efficacy), and Tom (high efficacy) differentiated instructions according to the students’ ability. Joan (low efficacy) and Sandra (medium efficacy) presented students with problems on a chart and encouraged the use of manipulative to solve the problems. However, Tom (high efficacy) had pizzas which he used to model adding and subtraction fractions. In Joan (low efficacy) and Sandra’s (medium efficacy) classroom, the students in the collaborative group selected math problem cards to solve. While in Tom’s (high efficacy) classroom the students in the collaborative group were given an opportunity to select activities of their choice from a tub. The group selected an activity that required them to identify attributes of quadrilaterals. Students appeared very interested as they engaged in discussions, drew quadrilaterals and wrote the attributes on chart paper. In Joan (low efficacy) and Sandra's (medium efficacy) classroom, the students in the collaborative group were assigned specific tasks to complete. Students were assigned task cards with fraction problems. Within the fourth-grade, the students at the computer center were seen completing individualized instruction on the Mobymax website.

In Marsha (low efficacy) and Ashley's (medium efficacy) fifth-grade classrooms, during whole group instruction, I witnessed the teachers using PowerPoint presentations to introduce and provide instructions on changing mixed fraction to improper fractions and vice versa. Lindsay (high efficacy) was seen using Learnzillion videos during whole group instruction, after which students transitioned into centers, consisting of a teacher guided center, a collaborative center, and a technology center. In the teacher guided centers, all three teachers differentiated their instructions by providing students with the same content but different tasks. The activities were presented on chart paper. All three teachers worked with students using anchor charts and manipulative to solve problems with mixed and improper fractions.

However, in Lindsay's (high efficacy) classroom, the students in the collaborative group were given an opportunity to select activities from paper bags. The group selected an activity on a worksheet that required them to cut out tiles and glue them into boxes with the equal improper fraction or mixed number. Within the fifth-grade, Marsha (low efficacy) and Ashley's (medium efficacy) students who were at the computer were seen completing individualized instruction on the Mobymax website. Lindsay's (high efficacy) students who were at the computer also completed adaptive math activities on a similar adaptive math website called Prodigy.

Mobymax focuses on Common Core Standards and is an adaptive curriculum designed to create an individualized plan for each student. Lessons are differentiated and geared to meet the students' learning needs by providing activities for enrichment, as well as remediation (Gibson, 2016). Comparably, Prodigy is an adaptive math game that is also aligned with Common Core standards and is set up using modern day Pokemon theme. As students progress through the activity, the level of difficulty is increased or decreased based on their academic need. Prodigy has a tutorial and virtual manipulative. Both Prodigy and Mobymax have diagnostic tests and curriculum aligned questions. Additionally, teachers can examine the reports to obtain information pertaining to the skills that students have covered and the areas where they need additional support.

Teachers in high efficacy categories as facilitators. Based on the observation data, teachers who reported having high efficacy levels appeared to play the role of facilitators. Even though all the teachers engaged students in student-centered learning by having the students work in small groups, it was noted that Tom (high efficacy), Lindsay (high efficacy), and Laura (high efficacy) provided opportunities for students in the collaborative group to choose activities. For example in Tom's (high efficacy) class he had choice tubs from which students made selections. Lindsay (high efficacy) had paper bag centers with a variety of activities such as domino math and word problems. Laura's (high efficacy) classroom had activity pockets attached to the walls in her math center.

During the observation students were seen selecting activities of their choice. One activity noted was a regular menu from a local restaurant that students used to take each other’s order and then added up the cost for the selected meals. Some students did the calculation manually while others used calculators.

Similarly, Tom (high efficacy) acted as facilitator and made conscious efforts to link classroom learning to the real world. During the interview, he discussed his lesson on adding and subtracting with fractions. Tom stated, “I used pizzas to teach my students how to add and subtract. This way, students based on their experiences can identify with the topic as they examine the concept of whole versus parts of a whole”.

Teachers in high efficacy category reported attending training outside school hours. All nine teachers reported participating in technology professional training during their planning time and after school. However, two of the nine teachers who were in the high efficacy category reported that they sought opportunities to stay abreast with technological resources and changes by attending professional development workshops, often held outside of the school day, like on the weekend and during the summer break. Tom (high efficacy) mentioned:

> Technology intrigues me! I don’t know how I use to teach without it in previous years as it a necessary component for student achievement. I get excited when I hear there is a new cutting-edge device or technology resource around. This makes me use my own personal time to learn about technology.

Laura (high efficacy) shared similar perspectives when she stated:

> I can never get bored with learning about how to use technology. I am one of those persons who are consistently downloading new apps. I have a degree in technology and I am always going to technology workshops even after regular school hour and during my summer break.

Summary

This section was a presentation of the study findings. In summary, the goal of this research was to explore teachers' beliefs about their self-efficacy and technology use. Despite being on various rungs of the technology implementation continuum, the teachers in this study all had positive beliefs about infusing technology in math instruction. Each research question and the results were clearly identified and analyzed.

Research question one addressed teachers' feelings about their technology self-efficacy. The results revealed that within this study some teachers were still not comfortable with infusing technology. Two of the nine teachers believed that there was too much emphasis on the use of technology and that students should be encouraged to use their minds to solve problems. Additionally, teachers voiced that they had needs. They believed that having more access to computers in the classroom, as well as having a possible list of technological resources would help to make them feel better prepared. In addition to this, teachers' perceptions were that they could benefit from onsite support and professional development geared towards teaching ways to effectively infuse technology in lessons.

Research question two addressed how elementary teachers demonstrated their levels of self-efficacy, adoption, and use of technology during math instruction. The teachers at Morningside elementary school shared that they met weekly to plan. Based on this, they used grade level plans and administrator-recommended technology resources (websites) during their math lessons. Similarly, the teachers use whole group and small group settings to integrate technology as this is required by the school's administrators.

Research question three addressed patterns that exist between these teachers' beliefs and behaviors related to technology integration in the classroom. The first pattern noted was that teachers' confidence levels did not necessarily influence their technology use. Instead, administrators' requirement appeared to be one of the determining factors that influenced the teachers' use of technology during math instruction. The second pattern was that teachers who rated themselves in the low to medium efficacy categories used multi-media presentations such as PowerPoint and flip charts during whole group instruction. While teachers who rated themselves in the high efficacy category used web-based resources such as Learnzillion and Math Antics websites to view tutorials.

The third pattern noted was that teachers in the high efficacy category acted more in the role of facilitators than teachers in the low to medium efficacy categories. Teachers in the high efficacy categories were not always in control; instead students were encouraged to choose activities and to be active participants in the learning process.

The final pattern noted was all the teachers in the study shared that the participated in onsite technology professional development. However, of the nine teachers, two of the teachers shared that they sought opportunities to stay abreast with technological resources and changes by attending technology training often held outside of school's campus and school hour (e.g. weekend and summer break).

Chapter 5 will present a summary of the finding from this study which explored elementary teachers' beliefs versus their behavior when integrating technology in math instruction at Morningside Elementary School. It also contains limitations, recommendations, and implications gleaned from the emergent themes detailed in chapter 4.

Chapter 5: Interpretation of Findings and Recommendations

Possessing technology skills is essential to function effectively in classrooms and the workforce (Partnership for 21st Century Learning, 2013). There is concerted focus on the need to transform classrooms into a place where students can use modern day technologies to develop critical thinking skills. Therefore, technology is deemed to be an essential tool and educators are faced with the responsibility to incorporate it in their instructions to help students attain academic proficiency (Gulamhussein, 2013; Rich, 2010).

However, a teacher’s lack of confidence in how to integrate technology during instruction can be a hindrance to the learning process (Blackwell, Lauricella, & Wartella, 2014; Ertmer, 2010; Project Tomorrow, 2014). Similarly, a lack of confidence can result in avoidance of technology. The purpose of this qualitative case study was to explore the relationship between elementary math teachers’ technology integration self-efficacy, their level of technology adoption, and their actual technology integration behavior. To accomplish this goal, I used a qualitative approach to explore patterns between teachers’ beliefs and behaviors.

The key findings for the research question that focused on teachers’ perception about their technology efficacy were (a) teachers need to feel confident with using technology and (b) teachers need onsite technology support and professional development. Two teacher behavior themes emerged for research question two: (a) teachers use common lesson plans and administrative recommended resources to teach math and (b) teachers use whole group and small group instruction during math lessons to integrate technology. There were four themes that emerged for research question three: (a) teachers' self-efficacy and beliefs do not necessarily influence technology use, (b) teachers in the low to medium efficacy category used multi-media guided lessons (powerpoint/ flip charts), while teachers in the high efficacy category used web-based guided instructions (videos), (c) teachers with high efficacy levels acted more as facilitators than teachers with low to medium efficacy levels, and (d) teachers with high efficacy levels reported that they sought opportunities to keep abreast of technology resources and changes outside of regular school hours.

Interpretation of Findings

I explored teacher technology self-efficacy beliefs, their stages of adoption, and technology integration behavior. In this research technology integration is defined as any digital tools used during the teaching and learning process. I used Bandura's (1997) social cognitive theory to examine teachers' self-efficacy beliefs. I used the theory to examine self-processes derived or influenced by both internal and external factors. This theory states that an individual's self-efficacy can affect how he or she behaves.

Research Question 1 was: What are elementary mathematics teachers' beliefs about their technology integration self-efficacy and their stages of technology adoption? The response to this question was that teachers are at various stages of technology proficiency on the technology implementation continuum.

The study began with 13 teachers completing and submitting the stages of adoption of technology survey. From the stages of adoption of technology surveys returned I noted that of the 13 participants, three rated themselves as having low to medium technology use, four rated themselves as having medium to high use, and six as having very high technology use.

Despite being on various levels of the technology integration continuum, all the teachers who participated in the study believed that using technology in lessons can lead to positive outcomes. However, many of the teachers are still not completely confident with integrating technology in lessons. Gilakjani, Leong, and Ismail's (2013) research findings were similar to my study that indicated teachers' technology perceptions remain an issue and many teachers feel ill-equipped to incorporate technology during lessons. This often results in teachers failing to use technology or using it in an effective way (Gilakjani, Leong, &Ismail, 2013; Project Tomorrow, 2014; Wachira & Keengwe, 2011). Karaseva, Siibak, and Pruulmann-Vengerfeldt's (2015) research findings were similar to those in my study that indicated teachers who have positive convictions towards technology integration are more likely to use technology for instructional purpose. Bandura (1997) speculated that self-efficacy can be realized or reinforced as individuals achieve mastery through a particular experience or accomplish a specific task.

In this study, the teachers who rated themselves in the high category appeared more at ease with integrating technology during lessons. When an individual is successful the person is more likely to feel a robust sense of efficacy. On the other hand, if the individual experiences failure before a feeling of self-efficacy is firmly established, then failure will weaken the person's sense of efficacy (Bandura, 1995).

The teachers in this study shared that they need more access to computers and technology resources. They believed that not having enough computers in the classroom made it a challenge to plan lessons that were technology-based. The teachers shared that having a list of technology resources that are aligned to specific math concepts would help them to feel better prepared. They felt that having access to more computers and technology resources would increase their technology self-efficacy, as well as enable them to infuse technology effectively in lessons. Research such as Tweed's (2013) study confirmed that if teachers have a variety of technologies at their disposal then they are more likely to try them. This action will result in teachers experiencing a sense of comfort, possibly to the extent where they will experience ease of use (Tweed, 2013).

Because schools are deemed to be agents of social change, it is important that teachers be properly trained on how to utilize technology so that they can effectively impart the skills that are necessary for students to be successful in a competitive world (Bernhardt, 2015; Cox 2013; Partnership for 21st Century Learning, 2013). The teachers in my study reported that that they needed more than simple demonstrations during training.

During the interview, the participants shared that they needed onsite technology support and professional development on how to use technology to teach specific math lessons. My study supports research findings such as Cox (2013) and Schrum's (2013) research, which showed that teachers need professional support on how to effectively infuse technology in lessons. Teachers need training not only those that apply to pedagogical practices with using technology, but those that are aligned with 21st century learning requirements and that meets the NETS requirements. Based on this criterion, it is imperative that when the subject-area curriculum is being developed, technology coordinators, computer-lab teachers, administrators, specialists, and teachers are present together to exchange ideas (Aldunate & Nussbaum, 2013). This action of bringing these participants together will facilitate the sharing of ideas in lieu of mapping out content specific ways to integrate technology in math lessons. Pannen (2014) recommended that teachers be afforded training on not just an abundance of internet resources, but on information evaluation skills as well. Such skills will prepare teachers to select resources carefully, thus ensuring that the selected resource is of quality.

Research Question 2 was: How do elementary mathematics teachers demonstrate their levels of self-efficacy, adoption and use of technology in math instruction? I used the ISTE ICOT checklist to measure the participants' technology behavior. Findings revealed that teachers are on varying points on the technology integration continuum. However, this may be less evident because teachers use common lesson plans. In addition to this, the school's administration sets the parameters of the types of resources (e.g. Mobymax app and Learnzillion videos) and the method of instruction (whole and small group) when integrating technology in math lessons.

The teachers in this study used such technology resources in their math instruction in both whole group and small group settings. This action indicated that the school's administration at Morningside Elementary School was involved in promoting the use of technology to aid instruction. It is important that principals be involved in creating and implementing technology plans for their schools (Chang, 2012). The findings in my study disconfirm the notion that there is a lack of technology use within classrooms as was asserted by Celik and Yesilyurt (2013). The findings of this study were also inconsistent with the literature, because all the teachers were observed integrating technology in their lessons.

During whole group settings, teachers placed great emphasis on teacher-centered methods such as lecturing, as well as modeling and coaching. Additionally, during the whole group segments, teachers used the classroom interactive whiteboard as the main platform to introduce and present lessons, often through the use of flipcharts and PowerPoint presentations. In other studies, the researchers had similar findings that teachers often relied on PowerPoint presentation as a means of technology integrated lessons (Alley, Garner, Wolfe & Sawarynski, 2013; Brock & Joglekar, 2011; Hill, Arford, Lubitow, & Smollin, 2012;).

In lieu of examining how effectively technology is being used in math lessons, researchers such as Fisher and Waller (2013) proposed that generic models and strategies that are multipurpose are appropriate as teachers need to readily access them during lessons. A few of these models include but are in no way limited web-based lessons (e.g. WebQuest), multimedia presentations, tele-computing projects, and online discussions. Using such models can help to provide students with opportunities to collaborate, develop self-regulation, and construct knowledge (Microsoft, 2014). The teachers in this study used web-based lessons and multi-media presentations.

Research Question 3 was: What patterns exist in the relationships between these teachers' beliefs and behaviors related to technology? The first pattern that I examined was confidence. Teachers' perceptions were that their technology self-efficacy beliefs had some influence on the way that they incorporated technology in their math lessons.

However, based on their response to the interview, teachers who rated themselves as not being in the high efficacy category were not as confident with integrating technology in comparison to teachers who rated themselves as being in the high technology efficacy category. In my study this finding was contrary to the findings in studies such as Karaseva, Siibak, and Pruulmann-Vengerfeldt's (2015), which proposed that self-efficacy and confidence levels influence technology use. In my study, it was administrators' expectation that appeared to be the motivating factor behind the teachers' technology integration behavior.

The second pattern that I detected was that teachers within the high technology efficacy category tended to be more flexible and acted as facilitators. These teachers provided students with opportunities to choose activities, as well as encouraged students to collaborate and communicate in order to solve real world problems. Based on the need to integrate 21st century competencies, it is imperative for teachers to be open and willing to adjust their beliefs and practices (Frost & Durant, 2013).

The third pattern was derived from two teachers who were in the high efficacy category. These teachers shared that they sought opportunities to stay abreast with technological resources and changes by attending professional development workshops, often held outside of the school day. The findings from studies similar to Clark's (2013) confirmed that teachers with exemplary technology use tend to use a lot of their own personal time to sharpen their technology skills.

Limitations of the Study

The first limitation of this study was that the participants in the study were my colleagues which could have resulted in bias when selecting the participants and collecting data. To minimize such bias I used a variety of measures to facilitate accuracy and credibility. One such measure was that I consciously sought to remain neutral by attempting not to involve personal feelings that would influence responses from the participants. I employed the use of field notes to remain focused on the data as they arose. Using the field notes helped me to eliminate personal biases pertaining to the topic being studied and to present information as unveiled by the data collected.

The second limitation was the teachers' self-rated reports about their technology self-efficacy and stages of adoption. I used the stages of adoption of technology and the computer technology integration surveys during the research process. The veracity of these instruments is limited to participants' willingness to respond truthfully and accurately. I used multiple sources of data which included surveys, an observation checklist, and transcripts from the teacher interviews. This process allowed me to triangulate or cross-check the findings as using multiple sources of data provided me with an opportunity to clarify any differences or understandings between the self-rated reports, what was seen during observations, and what was reported during the interviews.

The third limitation was that I used purposeful sampling of a small group of nine participants who represented grades three through five teachers within one elementary school and within one school district. Therefore, results cannot be generalized and do not represent schools within the district as a whole. Additionally, the research was limited to the content area of math.

Recommendations

Teacher technology perceptions remain an issue and many teachers still feel ill equipped to incorporate technology during lessons. The need for teachers to infuse technology in lessons continues to be a concern, as well as the extent to how effectively technology is implemented. Therefore, based on the findings of this study, further research is needed to examine teachers' technology integration beliefs and behaviors.

I only explored the teachers' beliefs and behaviors at one school within one school district, therefore findings cannot be generalized and do not represent schools within the district as a whole. However, conducting a qualitative research at multiple school sites may provide the researcher with an opportunity to explore the disparities, if any exist, between teachers' technology beliefs and behaviors. Additionally, as the participants were colleagues of mine, further research should be conducted outside of the researchers' immediate worksite. This action may help to reduce or eliminate possible bias, as well as threat to the study's validity.

Implications

In my study I addressed social change by increasing the knowledge of the patterns that exist between elementary math teachers' technology beliefs and behaviors. I concluded that teachers believe that using technology in lessons can lead to positive outcomes. However, many teachers are still not completely confident in integrating technology in lessons. Some researchers theorized that teachers will not incorporate technology during instruction if they do not feel confident (Tella, 2011; Project Tomorrow, 2014; Pourciau, 2014).

Now that this issue is evident, positive social change may be realized if the school system administrators can design professional development workshops geared towards building teachers' technology self-efficacy. In doing so, they should ensure that professional development trainings move beyond simple demonstrations. Instead, trainings should focus on how to use technology to teach specific math lessons, particularly those aligned with 21st century learning competencies and that meets the NETS requirements (Fullan, 2013; Welsh & Papke, 2013). These trainings should include information evaluation skills, as this may place teachers in a better position to select resources carefully, and help to ensure that the selected resource is of quality (Bernhardt, 2015; Gulamhussein, 2013).

Similarly, administrators can provide coaching through the use of mentor teachers who have been identified to be effective in using technology during their instruction. These mentors can provide one-on-one assistance to teachers who need support in this area. School systems should utilize teachers who effectively infuse technology in lessons, as mentors for teachers who need support. According to Bandura (1986), individuals acquire information to determine efficacy beliefs through four ways: (a) actual performance, (b) observing others, (c) persuasion, whether verbally or otherwise, and (d) physiological. However, the most influential source of efficacy is thought to be derived from actual performance. Verbal persuasion has its place, but Bandura (1987) cautions that overemphasizing verbal persuasion methods will prove unsuccessful. Thus, similar to the use of mentors, professional development programs should be designed to not overemphasize verbal persuasion, but instead should be geared towards providing opportunities for teachers to achieve authentic mastery (Bandura, 1977; Bandura, 1987).

To reiterate, implications for positive social change may occur when professional development trainings are specially designed and mentor teachers are available to empower teachers in the use of best practices. Similarly, the ability to increase teachers' technology self-efficacy and integration behavior may have positive effects on students learning and academic achievement because with the emergence of 21st century skills, teachers are required to provide students with technology infused lessons. Such lessons are a necessity to efficiently prepare students with skills needed to function in college, a career, and in life (Beers, 2012; Farisi, 2016; Reigeluth, Beatty & Myres, 2016).

Conclusion

My purpose for this qualitative case study was to explore any patterns that existed between teachers' technology self-efficacy beliefs and their actual technology integration behavior during math instruction within the classroom. The findings were that teachers believe that using technology in lessons can lead to positive outcomes; however, some teachers are still not completely confident in integrating technology in lessons. By examining Bandura's (1987) social-cognitive, I obtained insights that possessing knowledge and skills are not sufficient to perform a task. Instead, it is equally important for teachers to have the belief that they can successfully accomplish the task of integrating technology effectively in lessons. Similarly, Isiksal-Bostan, Sahin, and Ertepinar (2015) theorized that teacher beliefs are pivotal to the success of any reform in the educational field. This is because individuals who possess well-developed sense of self-efficacy have a tendency to be more motivated and therefore will put forth more effort when faced with new and challenging tasks (Pourciau, 2014). In my study teachers' self-efficacy and beliefs did not appear to be the sole factor that influenced teachers' technology integration practice. Instead the school's administrators also seemed to be another motivating factor behind technology implementation at Morningside Elementary School, as the teachers reported that administration expected them to infuse technology during whole group and small group instruction.

The findings from my study are that proper supports need to be afforded to teachers according to their beliefs of where they are on the technology implementation continuum in order to authentically move them forward towards full implementation. This action can be realized through the use of professional development geared towards building teachers' technology self-efficacy and teaching specific math lessons, particularly those aligned with 21st century learning competencies and that meets the NETS requirements. These trainings should include information evaluation skills that will teach educators how to select resources that are of quality. This action may help to build teachers' technology self-efficacy. Similarly, these trainings may provide teachers with best practices when infusing technology in their instruction and may have positive implications on student achievement (Fullan, 2013; Hughes, 2015).

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Appendix A: Research Questions Aligned with Data Collection Instruments

Research Question	**Instrument**
Research Question 1: What are elementary mathematics teachers' beliefs about their technology integration self-efficacy and their stages of technology adoption?	The Computer Technology Integration Survey (Wang et al., 2004), the Stages of Adoption of Technology Survey (Christensen and Knezek, 1999). Personal Interview Questions
Research Question 2: How do elementary mathematics teachers demonstrate their levels of self-efficacy, adoption and use of technology in math instruction?	ISTE Classroom Technology Tool Checklist (2009). Personal Interview Questions
Research Question 3: What patterns exist in the relationships between these teachers' beliefs and behaviors related to technology integration in the classroom?	ISTE Classroom Technology Tool Checklist (2009). Personal Interview Questions.

Appendix B: ISTE NETS –T

The Refreshed ISTE NETS and Performance Indicators for Teachers (NETS•T)

Effective teachers model and apply the National Educational Technology Standards for Students (NETS•S) as they design, implement, and assess learning experiences to engage students and improve learning; enrich professional practice; and provide positive models for students, colleagues, and the community. All teachers should meet the following standards and performance indicators. Teachers:

1. Facilitate and Inspire Student Learning and Creativity

Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments. Teachers:

a. promote, support, and model creative and innovative thinking and inventiveness
b. engage students in exploring real-world issues and solving authentic problems using digital tools and resources
c. promote student reflection using collaborative tools to reveal and clarify students' conceptual understanding and thinking, planning, and creative processes
d. model collaborative knowledge construction by engaging in learning with students, colleagues, and others in face-to-face and virtual environments

2. Design and Develop Digital-Age Learning Experiences and Assessments

Teachers design, develop, and evaluate authentic learning experiences and assessments incorporating contemporary tools and resources to maximize content learning in context and to develop the knowledge, skills, and attitudes identified in the NETS•S. Teachers:

a. design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity
b. develop technology-enriched learning environments that enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress
c. customize and personalize learning activities to address students' diverse learning styles, working strategies, and abilities using digital tools and resources
d. provide students with multiple and varied formative and summative assessments aligned with content and technology standards and use resulting data to inform learning and teaching

3. Model Digital-Age Work and Learning

Teachers exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society. Teachers:

a. demonstrate fluency in technology systems and the transfer of current knowledge to new technologies and situations
b. collaborate with students, peers, parents, and community members using digital tools and resources to support student success and innovation

c. communicate relevant information and ideas effectively to students, parents, and peers using a variety of digital-age media and formats
d. model and facilitate effective use of current and emerging digital tools to locate, analyze, evaluate, and use information resources to support research and learning

4. Promote and Model Digital Citizenship and Responsibility

Teachers understand local and global societal issues and responsibilities in an evolving digital culture and exhibit legal and ethical behavior in their professional practices. Teachers:

a. advocate, model, and teach safe, legal, and ethical use of digital information and technology, including respect for copyright, intellectual property, and the appropriate documentation of sources
b. address the diverse needs of all learners by using learner-centered strategies and providing equitable access to appropriate digital tools and resources
c. promote and model digital etiquette and responsible social interactions related to the use of technology and information
d. develop and model cultural understanding and global awareness by engaging with colleagues and students of other cultures using digital-age communication and collaboration tools

5. Engage in Professional Growth and Leadership

Teachers continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating the effective use of digital tools and resources. Teachers:

a. participate in local and global learning communities to explore creative applications of technology to improve student learning

b. exhibit leadership by demonstrating a vision of technology infusion, participating in shared decision making and community building, and developing the leadership and technology skills of others

c. evaluate and reflect on current research and professional practice on a regular basis to make effective use of existing and emerging digital tools and resources in support of student learning

d. contribute to the effectiveness, vitality, and self-renewal of the teaching profession and of their school and community

2008 International Society for Technology in Education (ISTE), www.iste.org.

Appendix C: Levels of Use Descriptors

Levels of Use Inventory

	Categories of Levels of Use	Descriptions of Levels of Use Categories
Non-Transfer	**0** **Non-use**	The learner has little or no knowledge of the innovation*, no involvement with the innovation, and is doing nothing to become involved.
	Decision Point	Decides to take action to learn more about the innovation.
	I **Orientation**	The learner has acquired or is acquiring information about the innovation and/or has explored or is exploring its value orientation and its demands upon learner and learner system.
	Decision Point	Decides to use the innovation by establishing a time to begin.
	II **Preparation**	The learner is preparing for first use of the innovation.
	Decision Point	Decides to go ahead with implementation with perception that personal needs/concerns have been/will be addressed.
Transfer	**III** **Mechanical Use**	The learner focuses most effort on the short-term, day-to-day use of the innovation with little time for reflection. Changes in use are made more to meet learner needs than client needs. The learner is primarily engaged in a stepwise attempt to master the tasks required to use the innovation, often resulting in disjointed and superficial use.

	Decision Point	Decides that innovation should become part of routine work practices.
	IV A Routine Use	Use of the innovation is stabilized. Few if any changes are being made in ongoing use. Little preparation or thought is being given to improving innovation use or its consequences.
	Decision Point	Decides to modify the innovation to achieve better client outcomes.
	IV B Refinement	The learner varies the use of the innovation to increase the impact on clients within immediate sphere of influence. Variations are based on knowledge of both short- and long-term consequences for clients.
	Decision Point	Decides to modify innovation based on input of and coordination with colleagues.
	V Integration	The learner is combining own efforts to use the innovation with related activities of colleagues to achieve a collective impact on clients within their common sphere of influence.
	Decision Point	Decides to explore alternatives or major modifications of the innovation to substantially elevate outcomes.
	VI Renewal	The learner reevaluates the quality of use of the innovation, seeks major modifications or alterations to present innovation to achieve increased impact on clients, examines new developments in the field, and explores new goals for self and the system.

Note: Adapted from G. E. Hall and S. F. Loucks (1977). A developmental model for determining whether the treatment is actually implemented. *American Education Research Journal,* 14 (3), 263-276.

Appendix D: Permission from School District

Application to Conduct Research

[redacted]

Reply all |

Today 11:15 AM

...

You replied on 6/14/2016 1:14 PM.

Action Items

Good Afternoon Ms. Brown,

Your application to conduct research has been approved. You may stop by the district office and pick up a copy of your approval letter at the front desk.

Sincerely,

[redacted]
Director of Testing, Research, and Evaluation
[redacted] County School System
Office: [redacted] ext. [redacted]
Fax: [redacted]

Appendix E: Permission from School A

Sample Letter of Cooperation from a Research Partner

[redacted]

June 2, 2016

Dear Ms. Annette Lobban-Huzzie,

Based on my review of your research proposal, I give permission for you to conduct the study entitled Beliefs versus Behavior: Elementary Teachers Integrating Technology in Math Instruction within the [redacted] Elementary School. As part of this study, I authorize you to recruit participants through the use of invitation letters. Permission is also granted for you to distribute consent forms, conduct surveys, and classroom observation of the teachers while they teach math lessons, as well as conduct follow-up interviews, member checking and dissemination of your findings by providing a 2-3-page summary. Individuals' participation will be voluntary and at their own discretion.

We understand that our organization's responsibilities include: providing information pertaining to teacher and school related demographics and allowing the researcher to observe grades 3 -5 teachers within their normal setting as they integrate technology in their math instruction. Additionally, we will allow the researcher to utilize an available room (e.g. classroom or conference room) to conduct follow-up interviews or meetings. We reserve the right to withdraw from the study at any time if our circumstances change.

The student will be responsible for complying with the [redacted] County School District's research policies and requirements.

I confirm that I am authorized to approve research in this setting and that this plan complies with the organization's policies.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the student's supervising faculty/staff without permission from the Walden University IRB.

Sincerely,
Authorization Official

Appendix F: Introductory/ Invitation Letter

Grades 3-5 Math Teachers – Invitation Letter

Dear Sir/Madam,

My name is Annette Huzzie-Brown and I am a doctoral student at the Walden University. I am also a fourth grade teacher at [redacted]. Please be informed that I am not viewed as an authority figure or someone who can affect a teacher' career. Additionally, please be informed that the administrators at [redacted] Elementary School, as well as the directors at the [redacted] Public School System are in no way endorsing my research. Instead, they have given me permission to conduct my study within the school. As a teacher, you have valuable insights to share with regards to technology adoption. Therefore, I am inviting you to volunteer to participate in a research study that seeks to examine grades 3-5 teachers' general feelings towards their ability to use technology during math instruction. No names of teachers, administrators, schools or the system will be mentioned in the final report. The information from my study will not be shared in any way that could affect a teacher's career or reputation.

My topic is "Beliefs versus Behavior: Elementary Teachers Integrating Technology in Math." The purpose of this study can be divided into three components: (a) to explore teachers' general feelings towards their ability to use technology during math instruction, (b) to observe teachers' actual technology use during math lessons, and (c) to describe in depth the relationship between teachers' beliefs and their behavior. To achieve these goals, I am requesting that you complete a Stages of Adoption of Integration Survey which is a single item survey in which you will choose the stage that best describes your level of technology use. After completion of this survey, the data will be analyzed; participants will be stratified or placed in groups according to the categories, 1-2 low to medium technology use, 3-4 medium to high technology use and 5-6 high technology use. From this group, nine participants will be selected to complete the Computer Technology Integration Survey in order to determine feelings about integrating technology into math instruction.

Additionally, observation will be conducted in order to determine teachers' actual technology use during math lessons. I will use the ISTE Classroom Observation Tool Checklist during observation of a math lesson where these nine teachers will be required to incorporate technology in their math lessons. Lastly, face-to-face interviews will be conducted to explore the patterns between the teachers' beliefs about technology in relation to their technology integration behavior. Each interview will be about 40 minutes. The findings of this study could be useful to schools with similar student population. To protect your privacy, your name will not be used in the research report, nor will the state in which this research is being conducted be identified in reports. Pseudonyms and study codes will be utilized to ensure privacy. You will be assigned study codes and required to use them on all documents instead of your real names. Please be assured that your responses during the surveys, observations, and interviews will be held in the strictest of confidence. The observations and interviews will be set up based on a date, time, and location convenient to the participants. Your individual identity will be kept confidential in any published reports. Your participation is voluntary and you have the right to decline or discontinue participation at any time. Doing so will not negatively affect your relationship with the researcher.

If you are interested in participating in this research effort, I would appreciate your response within a week via email or phone call and you may ask any questions you may have. Upon your response, I will contact you regarding the review of the consent form. All surveys will be sent to you via the inter office mail system and can also be returned to me the same way. You may contact me via phone at [redacted] or email at [redacted] For questions regarding the rights of research participants, any complaints, or comments regarding the manner in which the study is being conducted, you may contact [redacted] who is a Walden University representative who can discuss this with you.

Respectfully,

Annette Lobban-Huzzie

Appendix G: Stages of Adoption of Technology Survey Instrument

Stages of Adoption of Technology Survey

Instructions: Please read the descriptions of each of the six stages related to adoption of technology. Circle the number of the stage that best describes where you are in the adoption of technology.

Stage 1: Awareness

I am aware that technologies exist but have not used it - perhaps I'm even avoiding it.

Stage 2: Learning the process

I am currently trying to learn the basics. I am often frustrated using computers. I lack confidence when using computers.

Stage 3: Understanding and application of the process

I am beginning to understand the process of using technology and can think of specific tasks in which it might be useful.

Stage 4: Familiarity and confidence

I am gaining a sense of confidence in using the computer for specific tasks. I am starting to feel comfortable using the computer.

Stage 5: Adaptation to other contexts

I think about the computer as a tool to help me and am no longer concerned about it as technology. I can use it in many applications and as an instructional aid.

Stage 6: Creative application to new contexts

I can apply what I know about technology in the classroom. I am able to use it as an instructional tool and integrate it into the curriculum.

The stage that best describes where I am now is number _________.

From: Christensen, R. (1997). Effect of technology integration education on the attitudes of teachers and their students. Doctoral dissertation, Univ. of North Texas. Based on Russell, A. L. (1995) Stages in learning new technology. *Computers in Education, 25(4)*, 173-178.

Appendix H: Approval Letter from School B

[redacted]

September 15, 2016

Dear Ms. Annette Lobban-Huzzie,

Based on my review of your research proposal, I give permission for you to conduct the study entitled Beliefs versus Behavior: Elementary Teachers Integrating Technology in Math Instruction within the [redacted] Elementary School. As part of this study, I authorize you to recruit participants through the use of invitation letters. Permission is also granted for you to distribute consent forms, conduct surveys, and classroom observation of the teachers while they teach math lessons, as well as conduct follow-up interviews, member checking and dissemination of your findings by providing a 2-3-page summary. Individuals' participation will be voluntary and at their own discretion.

We understand that our organization's responsibilities include: providing information pertaining to teacher and school related demographics and allowing the researcher to observe grades 3 -5 teachers within their normal setting as they integrate technology in their math instruction. Additionally, we will allow the researcher to utilize an available room (e.g. classroom or conference room) to conduct follow-up interviews or meetings. We reserve the right to withdraw from the study at any time if our circumstances change.

The student will be responsible for complying with the [redacted] County School District's research policies and requirements.

I confirm that I am authorized to approve research in this setting and that this plan complies with the organization's policies.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the student's supervising faculty/staff without permission from the Walden University IRB.

Sincerely,
Authorization Official
Contact Information

Appendix I: Interview Questions

1. Describe your confidence levels with regards to integrating technology during math lessons.
2. How do you use technology during your math instruction?
3. How do you decide what you will teach in math each day?
4. How do your technology self-efficacy beliefs influence the way you incorporate technology during math instruction?
5. How does the way you rated yourself on the Stages of Adoption of Technology component of the survey measure up to the way you utilized technology during the observed lessons?
6. What are your perceptions about the patterns that existed in your technology integration behavior?

Appendix J: Permission to use Stages of Adoption of Technology Survey

April 29, 2016

Dear Annette,

You have permission to use the Stages of Adoption survey instrument under the conditions you list above.

Best of luck in your study,

Rhonda Christensen

Appendix K: Permission to use Computer Technology Integration Survey

Annette,

Yes, please feel free to use the survey in the way you described for your study.

All the best,

Ling Wang

[redacted]

Appendix L: ISTE Permission to use ICOT

International Society for Technology in Education

Connected learning. Connected world.™

April 25, 2016

Annette Brown
Teacher and PhD Candidate

Dear Ms. Brown:

Thank you for your request for permission to use the ISTE Classroom Observation Tool (ICOT) for your doctoral dissertation for Walden University.

We are pleased to grant you permission to use the ICOT under the following terms:

1. This permission allows you to use the ICOT tool as requested for your dissertation and in all copies to meet university requirements, including University Microfilms edition.

2. This permission is non-transferable. Though this permissions allows you to authorize others to use the ICOT in your data collection activities, it does not authorize others to utilize the ICOT in any projects separate from yours.

3. There will be a standard credit to our material, using the copyright notice information below. We request that you reference the tool and any supporting materials, but do not publish the tool itself as an appendix or in any way including images.

4. In lieu of a fee please have a copy of your dissertation sent to ISTE Attn: Permissions Fulfillment, 180 West 8th Ave. Suite 300 Eugene, OR 97401 (accompanied by a copy of this letter).

5. No other rights are granted with this request.

Thank you for your interest in the International Society for Technology in Education. Please don't hesitate to contact me if you have any questions.

Sincerely,