2015

The Impact of the Role of an Instructional Technology Facilitator on Teacher Efficacy in Classroom Technology Integration in Two Rural Public Schools in Northwestern North Carolina

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A Dissertation Submitted to the
Gardner-Webb University School of Education
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Education

Gardner-Webb University
2015

Approval Page

This dissertation was submitted by Karri Campbell Adams under the direction of the persons listed below. It was submitted to the Gardner-Webb University School of Education and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Gardner-Webb University.

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Acknowledgements

The dissertation process has been a challenge and a reward. In the journey to completion, I have realized how blessed I am to have people in my life who love and encourage me.

I would like to thank Dr. Stephen C. Laws for being the chairperson of my committee. Thank you for your honesty and support and for seeing me through every step of the way. Your professionalism and expertise in education inspire me. Thank you to Dr. David Shellman for sharing with me your much appreciated knowledge during this study; and thank you to Dr. Marty Hemric for supporting me at the district level and for allowing me the opportunity to complete my research with your guidance.

I would like to thank my wonderful family—Andy, Campbell, and Haedyn—for your patience and understanding during the courses of this program. Andy, I cannot tell you how much your confidence in me carries me though. Girls, I could not have made it without your hugs and "I Love You's."

To my Daddy, thank you for always saying I could be anything I wanted to be. I believed you! Your dedication to family has and will continue to be the model for my own life.

Terry and Cindy Adams, I thank you for the time you spent accommodating my busy schedule for the last two and a half years. I always knew that if I needed anything, all I had to do was ask. You have and continue to be an integral part of our lives.

Finally, I would like to give credit for all I am and ever will be to my Heavenly Father. Thank you, God, for the prayers, answered and unanswered, that have led me to this place in my life. I owe all to You.

Dedication

for Campbell and Haedyn –

Someday, a long time from now, your own hair will glow silver in the sun. And when that day comes, love, you will remember me.

–from *Someday,* McGhee & Reynolds (2007, pp.30-32)

Abstract

The Impact of the Role of an Instructional Technology Facilitator on Teacher Efficacy in Classroom Technology Integration in Two Rural Public Schools in Northwestern North Carolina. Adams, Karri Campbell, 2015: Dissertation, Gardner-Webb University, Role of Instructional Technology Facilitator/Technology Integration/Barriers to Technology Integration/Teacher Efficacy/International Society for Technology in Education [ISTE]/Substitution, Augmentation, Modification, Redefinition [SAMR]

The purpose of this study was to contribute to a limited body of research on the impact of the role of the school-level instructional technology facilitator on teacher technology efficacy. This mixed-methods study involved the administration of a survey instrument designed to measure teacher technology efficacy, the Computer Technology Integration (CTI) survey developed by Wang, Ertmer, and Newby (2004) as well as an ITF survey measuring the direct impact of the role of the school-level instructional technology facilitator on those efficacy levels. Interviews were conducted by proxy interviewers to further clarify the ways that the instructional technology facilitator impacted teacher technology efficacy at two schools in rural, northwestern North Carolina. The Review of the Literature for this study explored theoretical frameworks in self-efficacy and technology integration. Four constructs were examined during the treatment period of this case study: Skills, Strategies, Standards, and Other Abilities. Those constructs were used to code qualitative interview data for further evidence regarding the role of the instructional technology facilitator's impact on teacher technology efficacy at the study sites.

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Chapter 1: Introduction

Statement of the Problem

A 2009 report by the Metiri Group entitled *Technology in Schools: What the Research Says* was commissioned by Cisco (2009) Systems to highlight major studies in the field of instructional technology since 2006. The report stated that "school leaders must think strategically about which technologies, tools, and programs will have the greatest impact on preparing students for the 21st Century" (Lemke, Coughlin, & Reifsneider, 2009, p. 4), yet "the real potential of technology for improving learning remains largely untapped in today's schools" (Lemke et al., 2009, p. 5). Ertmer and Ottenbreit-Leftwich (2010) found that recent studies indicate that "we have not yet achieved high levels of effective technology use, either in the United States or internationally (Kozma, 2003; Mueller, Wood, Willoughby, Ross, & Specht, 2008; Smeets, 2005; Tondeur, van Braak, & Valcke, 2007). This is problematic for our students, as technological competencies are necessary for them to compete in the workforce of the future (Warlick, 2012, p. x).

In a dissertation study of the impact of technology professional development on technology integration and student engagement, Booth (2008) cited the National Center for Educational Statistics (NCES) Report on Teachers which found that "only about half of the teachers with computers available in their classrooms use them for instructional purposes" (p. 3) and that the technology available was primarily used for administrative tasks (e.g., planning). Additional studies resulted in similar findings as summarized by Ertmer and Ottenbreit-Leftwich (2010): "If and when technology is used, it typically is not used to support the kinds of instruction (e.g., student-centered) believed to be most powerful for facilitating student learning" (p. 255). It could be concluded that a historical

tendency to focus on the hardware amidst technological innovations has resulted in an ill-preparedness of teachers in the process of integrating those technologies into instruction (Booth, 2008; Earle, 2002). Earle (2002) stated that "we cannot assume that, just because adequate resources have been obtained, integration would naturally follow" (p. 7). Research exists to suggest probable causation for this lack of integration. Farah (2012) cited that the lack of resources, time, and training and teacher self-efficacy along with certain philosophical beliefs about technology are likely culprits for its infrequent integration into instructional activities (Kellenberger & Hendricks, 2003; Littrell, Zagumny, & Zagumny, 2005; Teo, 2009; Wang, Ertmer, & Newby, 2004). Various studies that investigate the greatest challenges presented to today's teachers identify integrating technology into teaching as a prominent issue (Cennamo, Ross, & Ertmer, 2010; Clausen, 2007; Roblyer & Doering, 2010; Wang et al., 2004, as cited by Moore-Hayes, 2011, p. 1).

Abbit (2011) posited that a lack of knowledge in how and why to implement technology in education is part of the problem. Abbit stated that "the ever-changing nature of technology has made the knowledge base for technology a moving target in terms of its relationship with teachers' ability to successfully integrate technology into classroom practices" (p. 1). Abbit's work regards Technology, Pedagogy, and Content Knowledge (TPACK) as a means for bridging the gap between knowing about the technology available and integrating it into meaningful instructional opportunities. To successfully integrate technology into education, teachers need to understand the connection between the knowledge of technological practices and their own efficacy in using them (Abbit, 2011). Research shows that as teachers begin to know and understand what constitutes best practices in technology integration, they gain a higher level of

confidence in their own abilities to carry out those practices. As a result of this phenomenon, teachers become more likely to integrate instructional technologies effectively in their own classrooms (Abbit, 2011; Albion, 1999, 2002; Bandura, 1997; Bull, 2009; Kellenberger, 1996; Marcinkiewicz, 1994; Wang et al., 2004).

The Research Problem

Cakir (2012) stated that “in order to integrate technology into the school curriculum, it is necessary to identify student needs, existing resources, technology-related educational needs and technology design” (p. 273). The integration of technology in education poses meaningful implications for student learning. Using technology-integrated instructional strategies has the potential to have a “widespread, positive effect on students as various technologies offer relevant and engaging opportunities for meaningful learning experiences” (Shell et al., 2005, as cited by Farah, 2012, p. 3). Most teachers have an awareness of the technologies that are made available to them through their school and district resources; however, many are still hesitant to embrace the benefits that frequent and effective application of technology has to offer. This culture of hesitancy not only poses as a barrier to the benefits of technology integration, but it also represents a trend in education in which teachers are failing to capitalize on the gains made possible by the effective use of technology in instruction (Farah, 2012).

Kopcha (2012) completed a case study of teachers’ perceptions of barriers to technology integration which revealed five factors that inhibit teachers from utilizing technology effectively in their classrooms. Table 1 summarizes those findings.

Table 1

Kopcha's (2012) Barriers to Integrating Technology into Instruction

Barrier	Instructional Implications	Supporting Research
1. Access .	Teachers feel they lack access to technology even when it is available because it does not work properly. Teachers feel they lack access to technology because it is not useful to teaching (Norris, Sullivan, Poirot, & Soloway, 2003).	Clark (2006); Hope (1997); Lan (2000); Leggit and Persichitte (1998); Lim and Khine (2006); Lumley and Bailey (1993); Norris et al. (2003); Zhao, Pugh, Sheldon, & Byers (2002)
2. Vision	Teachers without administrators who have a strong vision for technology integration are less likely to persist in the integration of instructional technologies when they encounter setbacks.	Cafolla and Knee (1995); Cohen (1987); Cuban (1986); Ertmer (1999); Hays (2007); Hope (1997); Lumley and Bailey (1993); Park and Ertmer (2008); Sugar and Kester (2007)
3. Beliefs	Teacher beliefs about the usefulness and difficulty of technology integration influence the frequency in which they practice technology integration. Teacher beliefs may have implications on "teacher resistance, passivity, school cultures, and traditions of teaching" (Earle, 2002, pp.5-13).	Beacham (1994); Cafolla and Knee (1995); Cohen (1987); Cuban (1986); Ertmer (1999); Hope (1997); Inan and Lowther (2010); Lumley and Bailey (1993); Ottenbreit-Leftwich, Glazewski, Newby, and Ertmer (2010); Vannatta and Fordham (2004)
4. Time	Teacher reports indicate that integrating technology into instruction takes larger amounts of time than traditional instructional practices due to an increase in management of student misbehavior when using technology. Teachers have reported that learning to plan and implement technology instructionally takes a large amount of time. "Time for personal exploration, online access, and skill development" is viewed as scarce or unavailable for many teachers (Earle, 2002, pp.5-13).	Al-Senaidi, Lin, and Poirot (2009); Bauer and Kenton (2005); Clark (2006); Duffield (1997); Hope (1997); Lan (2000); Leggett and Persicheitte (1998); Lim and Khine (2006); Sheingold and Hadley (1990); Wachira and Keengwe (2010)
5. Professional Development	Inadequate professional development is a barrier to technology integration when it fails to provide teachers with authentic experience for planning and implementing instructional technologies. The professional development becomes meaningful when teachers are able to apply it directly within their instruction.	Bradshaw (2002); Cafolla and Knee (1995); Hinson, LaPrairie, and Heroman (2006); Hope (1997); Mouza (2009); Shelton and Jones (1996); Wells (2007)

Kopcha (2012) indicated that there is a "clear connection between the degree to which teachers experience these barriers and their decision to use technology for instruction" (p. 110); and that professional development, administrative support, and teacher beliefs impact teacher technology efficacy and the frequency with which they integrate technology into instructional classroom experiences. Farah (2012) correlated the lack of integration of instructional technologies to lack of teacher self-efficacy when using them. Additionally, Farah drew a similar conclusion to that of Kopcha when stating that "educators who feel uncomfortable using technology are unlikely to incorporate it because of the fear associated with using something with which they have limited experience" (p. 3). This inability to accept and cope with emerging technologies, termed Technostress, often prohibits teachers from applying appropriate instructional technologies in ways that are conducive to learning (Brod, 1984; Huwe, 2005). As aforementioned research indicates, variables known to affect teachers' likelihood to integrate technology instructionally have been identified (Farah, 2012); and while teacher technology efficacy is one of those variables, "studies indicating how that efficacy is constructed have not been conducted" (Farah, 2012, p. 3).

Purpose of the Study

Educators often fail to see the function of instructional technology due to a preoccupation with its aesthetic appeal (McLeod, Lehmann, & Sessums, 2012, p. 185). Teachers are more likely to instruct students on how to use available technologies without instilling an understanding of what those tools afford and an appreciation of what we gain and lose from using them (McLeod et al., 2012, p. 185). This research study took into consideration the findings of Gimbert and Cristol (2004), as cited by Booth (2008):

1. Teaching with technology requires an adequate support system including collegial sharing opportunities.
2. As new skills are learned and barriers are approached, teachers need time, space, and professional development opportunities to meet their needs.
3. Collaborative teaching is an authentic form of professional development that results in meaningful pedagogical shifts in the application of instructional technologies.

Booth's (2008) research focused on the impact of a professional development program on teacher efficacy relating to technology integration and student engagement. Findings from this particular study support that the treatment group of teachers receiving professional development showed a higher level of efficacy after participating in professional development.

Cakir (2012) argued that it is critical for teachers to prepare students for finding and making use of new information. Cakir also opined that "encouraging learning and securing the development of a rich learning environment in order to present opportunities for teachers and students to obtain new and correct information" (p. 247) is of paramount importance. Professional instructional technology facilitators (ITFs) are trained to be open to communication for the sake of active participation with teachers as they navigate these new problem-solving processes with technology (Cakir, 2012). This openness to communication and problem solving is a crucial characteristic as "many instructional and educational technologists make integrating technology effectively into the classroom sound so easy" (McLeod et al., 2012, p. 183). In reality, the use of these technologies throughout the instructional day is quite challenging and often takes participants, including teachers, out of their comfort zones (McLeod et al., 2012, p. 185). Therefore,

the purpose of this study was to examine how the role of a school-level ITF impacts the technology efficacy of teachers as they integrate instructional technologies into classroom practices.

Research Question

> What is the impact of the school-level ITF on teacher technology efficacy during the integration of instructional technologies at the sites chosen for this research study?

Background

This study was conducted in a rural, northwest region school system in North Carolina. This district is comprised of 13 elementary schools, four middle schools, four high schools, and an early college high school. Every elementary, middle, and traditional high school in the district is outfitted with an interactive whiteboard or television and teacher laptop. According to the North Carolina School Report Card for this district, there was a ratio of 1:1 digital devices per student in the district in the 2012-2013 school year and a ratio of 1:1 internet accessible digital devices per student. One hundred percent of the classrooms within the district have internet access (Education First, 2013). The district-wide technology planning committee is representative of various stakeholders including central office personnel, technology support staff, classroom teachers, and community members.

The participating district employs a total of 11 ITFs. Each ITF serves two schools within the district; and while there are a total of 22 schools in this district (Education First, 2013), this study focused on two specific schools—one middle and one elementary.

These two schools were chosen because both schools began the 2014-2015 school year with a different ITF from the one assigned to them in previous years. Also, the

school sites for this study were chosen due to access to the researcher.

Definition of Terms

Accessibility. Lewthwaite (2011) termed "accessibility" to "describe the degree to which a service or product gives learners the ability to access functionality, services, or materials" (p. 85). Lewthwaite also cited Seale (2006) in stating that "accessibility implies two essential aspects: (1) access by any technology, and (2) access in any environment or location" (p. 28).

Distributed leadership. Sharing leadership and decision-making roles among school staff members, therefore alleviating some of the authoritativeness of the administrator's status.

Instructional technology. Instructional technology for this study is defined in reference to Seels and Richey (1994, p. 9), as cited by Earle (2002) as "the theory and practice of design, development, utilization, management, and evaluation processes for learning with technology" (p. 7).

Instructional technology facilitator [ITF]. North Carolina Public Schools (2013) defined ITFs as individuals who offer significant insight into schools' instructional technology programs by providing tools, resources, and content that promote critical thinking, problem solving, and information and communications literacy while also making content engaging, relevant, and meaningful to students and sharing in the leadership and core mission of the school.

International Society for Technology in Education [ISTE] Standards. Standards established by ISTE to promote the enrichment of professional technology practice, provide positive models for technology implementation, and to promote excellence and support instructional transformation throughout educational organizations

(ISTE, 2008, 2009).

Mobile learning devices. Tablets, laptops, cell phones, and other portable learning devices that allow users to access learning materials.

Pedagogy. Pedagogy refers to "the strategies or styles of instruction used by teachers in the classroom" (Booth, 2008, p. 9).

Professional development. Professional development includes the instruction, mentoring, and support provided to teachers by an ITF (Booth, 2008).

Teacher efficacy. Bandura (1993) defined teacher efficacy as "teachers' beliefs in their personal efficacy to motivate and promote learning" (p. 117). This study looks at teachers' beliefs in their capacities to motivate and promote learning that integrates technology (Wang et al., 2004, p. 231).

Technology integration. The intentional design and delivery of appropriately selected technology in instructional practices.

Technology leadership. Creating, engaging, facilitating, and exhibiting a passion for the school community in a shared vision for instructional technology practices and expectations.

Technological Pedagogical Content Knowledge [TPACK] Framework. Mishra and Koehler (2008) defined the TPACK framework as a construct that

> encompasses understanding of the representative concepts of using technologies; pedagogical techniques that apply technologies in constructive ways to reach content in differentiated ways according to students' learning needs; knowledge of what makes concepts difficult or easy to learn and how technology can help redress conceptual challenges; knowledge of students' prior content-related understanding and epistemological assumptions; and knowledge of how

technologies can be used to build on existing understanding to develop new epistemologies or strengthen old ones. (p. 3)

Title I school. Schools that receive federally allotted funds due to high numbers or high percentages of low-income families to help ensure the success of all children regardless of their socioeconomic status (U.S. Department of Education, 2014).

Substitution, Augmentation, Modification, Redefinition [SAMR] Model. A practical model of technology integration that guides the introduction of technology into instruction beginning with the basic levels of substitution and augmentation (enhancement) and move upward into the modification and redefinition (transformation) levels (Puentedura, 2009).

Universal design. According to the Universal Design for Learning (UDL) Guidelines, Universal Design means a scientifically valid framework for guiding educational practice that

1. provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged; and
2. reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient (CAST, 2011).

Vision. A statement of clear expectation regarding the mission and desired outcomes in relation to school agendas.

Summary

Chapter 1 is an introduction to the study of the role of ITFs at two schools in a

rural district of northwestern North Carolina and the impact of that role on teacher efficacy in the creation and delivery of technology-integrated instructional activities. Bandura (1993) stated that “teachers’ beliefs in their personal efficacy to motivate and promote learning affect the types of learning environments they create and the level of academic progress their students achieve” (p. 117). A paradigm shift is critical if educators expect to see the potentially powerful implications of the effective use of technology in instruction (Earle, 2002). “All can agree that the core challenge is to expand the use of technology to support teaching and learning opportunities” (McLeod et al., 2012, p. 184).

Chapter 2: Literature Review

Overview

Lawless and Pellegrino (2007) stated that "technology is not one thing but many things that can be woven into the instructional environment by a teacher to assist the teaching and learning process" (p. 578), yet instructional technology integration faces many challenges due to barriers that "restrain, resist, and discourage the change efforts of teacher practices regarding technology" (Earle, 2002, p. 8). During a study by Liu (2013), teachers were given opportunities to willingly reflect upon and share with each other their experiences with technology. This study revealed that teacher input during this activity lacked depth and that some teachers felt anxiety about opening up to their colleagues (Liu, 2013, p. 52). Liu found that in classrooms where teachers focus on their traditional instruction, they experience discomfort with sharing and reflecting with other teachers regarding teaching practices, including instructional technology practices (Liu, 2013, p. 52). Discussing those practices with colleagues and administrators can provide the capacity for teacher growth when using instructional technologies (Garet, Porter, Desimone, Birman, & Yoon, 2001).

Professional development can contribute to this kind of "collective participation" and help create a school culture that fosters and sustains a "common understanding of instructional goals, methods, problems, and solutions" (Garet et al., 2001, p. 922). Ball (1996) and Garet et al. (2001) found that collective participation in a similar activity, such as best instructional practices when using technology, can "provide a forum for debate and improving understanding, which increases teachers' capacity to grow" (Garet et al., 2001, p. 13). Ultimately, technology facilitation in the classroom is a "problem of individual learning as well as organizational learning" (Knapp, 1997, as cited by Garet et

al., 2001, p. 922). Knapp (1997) established that "organizational routines and establishing a culture supportive of reform instruction can facilitate individual change efforts" (Garet et al. 2001, p. 922). Knapp (1997) noted that

> The implementation of reforms in the classroom is often piecemeal, involving discrete elements of what is called for but not a coherent whole. Understandably, teachers rely heavily on what they already know best. Thus, classroom "use" of reform-advocated practices may support of subvert reform intentions and teachers are often unaware of how much or how fundamentally their practice is changing. (p. 2)

Technology integration. ISTE established a rigorous set of national standards meant to guide teachers as they facilitate 21st century learning opportunities for students (ISTE, 2014). In addition to the North Carolina Essential Standards that explicitly detail for teachers certain information and technology skills that should be mastered by the end of each grade level by students, ISTE establishes certain performance goals that should be met by teachers. The five ISTE Standards for Teachers are

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

As teachers begin to integrate instructional technologies in their classrooms, these didactic standards facilitate that process by helping them "design, implement, and assess learning experiences to engage students and improve learning; enrich professional practice; and provide positive models for students, colleagues, and community" (ISTE,

2014, p. 1). A dependency exists, however, between the willingness of teachers to integrate the technology in their classroom and their ability to achieve the ISTE standards. There are various reasons why technology integration fails to thrive in today's classrooms (Brinkerhoff, 2006; Ertmer, 1999, 2005; Patter, 2009). An analysis of research pertaining to this quandary will persist in this section as the review of the following sources will be used to imply the need for this dissertation study.

Barriers to technology integration. "There is a general agreement among leaders in the field of educational technology that, due to a variety of barriers, teachers often fail to capitalize on the educational potential offered by technology resources" (Brinkerhoff, 2006, p. 22). Becta (2003) defined "barrier" as any factor that results in the prevention or restriction of teacher use of technology in the classroom. Brinkerhoff (2006) grouped the barriers to the integration of instructional technologies into four main categories: resources, institutional and administrative support, training and experience, and attitudinal and personality factors (p. 22). Patter's (2009) research categorized barriers and assigned attributes to each in order to deduct why teachers remain hesitant to implement instructional technology strategies in their classrooms. Based on previous research (Ertmer 1999, 2005), Patter divided the barriers into two distinct categories. First-order barriers include those which are external to the teacher and include problems over which teachers rarely are able to exert control. Second-order barriers involve the intrinsic beliefs of teachers that hinder their abilities to successfully integrate technology into their classrooms. Ertmer (1999) described first-order barriers as incremental and institutional (p. 48). Examples of first-order barriers are the lack of time, access, and support needed to effectively integrate instructional technologies (Ertmer, 1999; Patter, 2009). Additionally, Ertmer (1999) defined second-order barriers as fundamental and

personal. Examples of second-order barriers include teacher beliefs that available technologies are unreliable (Butler & Sellbom, 2002), teacher beliefs regarding their own perceptions of best instructional practices, and their willingness (or the lack thereof) to change their current pedagogical strategies (Patter, 2009). Various studies (Balanskat & Blamire, 2007; Ertmer, 1999, 2005; Patter, 2009) suggested that because first-order barriers are described in terms of resources, they are relatively easy to measure and eliminate; whereas second-order barriers are more difficult to resolve because they are less tangible than first-order barriers and are "more personal and more deeply ingrained" (Ertmer, 1999, p. 51). Second-order barriers are therefore recognized by some studies (Ertmer, 1999, 2005; Patter, 2009) as "causing more difficulties than first-order barriers" (Ertmer, 1999, p. 51) when it comes to effectively integrating instructional technologies. Ertmer (1999) stated that "although teachers today recognize the importance of integrating technology into their curricula, efforts are often limited by both external (first-order) and internal (second-order) barriers" (p. 51). Integration of instructional technologies must be seen as an ongoing innovative process designed to meet the instructional needs of teachers and the learning needs of students (Robey, 1992, as cited by Earle, 2002). Additionally, it is crucial from an instructional standpoint to remember that the integration of technology is not at all about the technology itself, but it is about the content and instructional practices that can flourish as a result of their merger with appropriate technologies (Earle, 2002).

Implications of two related studies (Guskey, 1988; Sparks, 1983) suggest that five criteria influence teacher decisions regarding the implementation of recommended practices. Table 2 describes those criteria in relation to teacher practices.

Table 2

Guskey's (1988) Five Contributing Factors Regarding Integration of Innovative Instructional Strategies

Criteria Influencing Teacher Practices	Implication on Probability of Teacher Use
Instrumentality	Teachers are more likely to implement new instructional strategies when the expectations of those strategies are clearly and specifically presented (Guskey, 1988, p. 63).
Congruence	Teachers are more likely to implement new instructional strategies when they are aligned with the current teaching practices and philosophies of the teachers (Guskey, 1988, p. 63).
Cost	Teachers are more likely to implement new instructional strategies when they estimate the extra time and effort exerted for the new strategy to be worth the potentially yielded benefits (Guskey, 1988, p. 63).
Importance	Teachers are more likely to implement new instructional strategies when they perceive them as important in their classrooms (Sparks, 1983).
Difficulty of Use	Teachers are more likely to implement new instructional strategies when they feel as though they can manage the level of difficulty of the new task(s) (Guskey, 1988, p. 63; Sparks, 1983).

The themes within these five contributing factors recur throughout the research examining why computers and technologies are often "oversold and underused" (Cuban, 2001) in today's classrooms.

The ever-changing nature of teaching and learning involves the implementation of "new or alternative instructional practices"; and at times, the implementation of these practices may only be slight revisions; other times, it may require a paradigm shift of pedagogical beliefs (Guskey, 1988, p. 63). "Since the decision about whether or not to

try these recommended practices is generally a conscious one made by teachers (except, of course, in those instances where implementation is mandated), it is important to understand what factors influence that decision" (Guskey, 1988, p. 63). Bandura's (1989a, 2001) human agentic perspective suggests that teachers' conscious beliefs regarding these factors are what enable them to either integrate new practices successfully or to make the decision not to. Agentic perspective recognizes that humans are "forethoughtful, generative, and reflective beings" that make decisions they believe are vital for their survival and success in their environment (Bandura, 2001, p. 4). Current research in Instructional Technology Integration supports that there are four trending facets of successful integration. Each of the areas is the focus of the following analysis. An important consideration when examining the facets of integration is that the role of the school-level ITF was established to aid in planning and implementation of the best practices that are embedded within them (Williamson & Reddish, 2009).

Facet 1: Accessibility. Accessibility has a variety of meaningful implications for instructional technology. The Universal Design Principles for Learning have been widely accepted as the guidelines for reducing barriers to technology accessibility. The U.S. Department of Education, Office of Educational Technology (2010) referenced Universally Designed Learning as "a framework that reduces barriers and maximizes learning opportunities for all students (as cited by Rappolt-Schlichtmann et al., 2013, p. 1222). The U.S. Department of Education's (2010) Educational Technology Plan supports the use of Universal Designs for Learning by referencing its validity in relation to the "most widely replicated finding in educational research: learners are highly variable in their response to instruction" (p. 10). Research supporting the framework stems from the fields of neuroscience, the learning sciences, and cognitive psychology.

Prominent researchers in these fields whose work has contributed to the establishment of the UDL framework include the works of Piaget; Vygotsky; Bruner, Ross, and Wood; and Bloom (U.S. Department of Education, 2010). Rappolt-Schlichtmann et al. (2013) found that "access to materials and tools is an important advantage that can be built into digital technologies, but Universally Designed Learning [UDL] offers another level of design advantage—access to learning" (p. 1211).

Various studies cite reasons why "accessibility" is in the center of such issues. A recent publication from the Center for Technology Innovation at Brookings (2013) claimed that technology is not just limited due to fiscal resources. As lead researcher in a review of several innovative technologies that have improved the quality of instruction and learning, West and Bleiberg (2013) found having a "finite length of instructional time" to be an issue of accessibility (p. 2). This substantive review of technology success stories details how the application of certain technologies can "add value" (West & Bleiberg, 2013, p. 2) to student learning experiences but it requires time.

The Center for Implementing Technology in Education reviewed various case studies related to technology integration. The findings from these studies indicated that "the number one obstacle teachers face in using technology at school for professional tasks is the lack of time in the school day" to practice, apply, and receive feedback on instructional strategies integrating technology (Patter, 2009, p. 33). Vannatta and Fordham (2004) confirmed that "teachers must have substantial time if they are going to acquire and, in turn, transfer to the classroom the knowledge and skills necessary to effectively and completely infuse technology into their curricular areas" (Patter, 2009, p. 33). Christensen (2002) cited Beasley and Sutton (1993) who found that "at least thirty hours of instruction and practice were required just to reduce anxiety about information

technology" and continued to say that "reducing uncertainty is just the first step to becoming confident and competent users of technology" (p. 412).

Since the United States is now placing a large emphasis on recruiting and retaining teachers with a high level of content and pedagogical skill, it is becoming more and more important for teachers to also have the ability to support and create differentiated classroom learning experiences and to use data as a driving instructional force. Lawless and Pellegrino (2007) stated that

> it seems likely that children from most, if not all, social and economic strata will ultimately come to have reasonable levels of access to communications and information technologies in their schools. The most recent U.S. Department of Education data tend to support such a conclusion. Less clear, however, is the likelihood that they will have access to teachers who know how to use that technology well to support 21st-century learning and teaching. Thus, the digital divide could actually widen over time with the increased investment of technology in schools unless urban and rural K-12 educational settings attract and maintain a teaching force equipped to use technology effectively in support of student learning. (p. 578)

Nevile (2005) proposed that even when certain technologies are made available in schools, the hardware or software components of those technologies are often limiting in that the visual, auditory, and tactile features are often unadaptable. Nevile's supposition is based on his studies indicating that instructional technologies are most effective when they are chosen in relation to their potential for accessibility according to diverse student needs. This is a shift from the paradoxical approach of choosing a technology because it is accessible in terms of availability (Nevile, 2005).

Lewthwaite (2011) cited Kelly et al. (2009) in describing the Three Models of Accessibility. Within these three models, accessibility is depicted as more than simply providing users with software or hardware resources. The first model, Accessibility 1.0, "is a technical approach to universal design characterized by web standards, guidelines, and validation tools" (Kelly et al., 2009, as cited by Lewthwaite, 2011, p. 86).

The second model, Accesibility 2.0, builds on the first model, "responding to the particular flaws of a purely technical approach" (Lewthwaite, 2011, p. 87). It is within the Accessibility 2.0 model that the authors establish that the contextual factors in which a given resource will be used should be counted as an important consideration when implementing technology into instruction (Kelly et al., 2007, as cited by Lewthwaite, 2011). Universally Designed Learning "places a premium on the use of contextual support" (CAST, 2011, as cited by Rappolt-Schlictmann et al., 2013, p. 1211). The principles of universal design are intended to develop and reinforce pedagogy as it is building into the active learning process (Rappolt-Schlictmann et al., 2013). This was proven during a study conducted in eight schools located in the southeastern United States of how the use of universal design principles and digital science notebooks improved student science learning outcomes. Results of the study indicated that students using the universal design principles integrated with their technology-enhanced science instruction outperformed their peers who had been using traditional science notebooks on the study posttest. Lewthwaite (2011) stated that "this return to pedagogic principles rather than technical properties is particularly important given the abundance of Web 2.0 tools and apps now available" and that "tools that offer some assistance to some users, but remain technically inaccessible to others" are difficult to use appropriately as instructional resources (p. 87).

Accessibility 3.0 is the final model of accessibility. Within this model, authors "build upon the aggregate of prior approaches, building to utilize the strengths of tools that have a specific value, despite lacking technical aspects of accessibility" (Lewthwaite, 2011, p. 87). Accessibility 3.0 stresses the importance of realizing how a one-size-fits-all approach is not the most effective way to provide equitable access to diverse learners and establishes that students are not homogenous, therefore our approach to teaching with technology cannot be either (Lewthwaite, 2011). When the UDL is integrated with "powerful digital technologies," customizing the curricula for all learners "becomes easier and more effective" (U.S. Department of Education, 2010, p. 9).

The U.S. Department of Education's (2010) Educational Technology Plan stated that

> advances in technology and the learning sciences have made "on-the-fly" individualization of curricula possible in practical, cost effective ways, and many of these technologies have built in supports, scaffolds, and challenges to help learners understand, navigate, and engage with the learning environment. (p. 9)

Accessibility to "technology-based" learning formats does not automatically mean better student learning opportunities. Rappolt-Schlichtmann et al. (2013) found that

> When technology is used to foster a supported learning environment in which the emphasis is on core learning activities, with strong teacher experience and embedded support for construct-irrelevant skills and strategies, technology can provide consistent gains for a variety of learners. (p. 1223)

Facet 2: Professional Development. Improving the depth and breadth of teacher qualifications and student learning are major national goals (No Child Left Behind [NCLB] Act, 2002). Recent federal legislation and funding initiatives have focused on

the provision of professional development for in-service teachers as a vehicle for changing teacher practice and improving student achievement. Professional development is critical to ensuring that teachers keep up with changes in statewide student performance standards, become familiar with new methods of teaching in the content areas, learn how to make the most effective instructional use of new technologies for teaching and learning, and adapt their teaching to shifting school environments and an increasingly diverse student population (Lawless & Pelligrino, 2007, p. 575).

In a 2006 study of the effect of long-term technology professional development, Brinkerhoff reported that "institutional barriers relating to training and experience include sufficient professional development focused specifically on technology integration" (p. 23). This report came as a result of the analysis of various data from participant surveys, interviews, and Likert-scaled items revealing that a long-term professional development "academy" did increase participant skill in integrating technology. An accepted conclusion based on the data is that teachers are more likely to integrate technology when they have attained the appropriate skillset to do so (Brinkerhoff, 2006). Butler and Sellbom (2002) conducted a study which sought to identify the major factors affecting the adoption of instructional technology. They found that "not all faculty are innovators when it comes to technology" (p. 25) and that technology staff would need to provide training to "help faculty determine if learning and using technology are really worth it" (p. 27). Lawless and Pellegrino (2007) reported that "the existing body of literature on professional development draws an important connection between student achievement and effective professional development" (p. 579). Their report indicates that high-quality professional development programs are

> longer in duration, consist of contact hours in addition to supporting follow-up

> sessions, actively engage teachers in meaningful and relevant activities for their individual contexts, promote peer collaboration and community building, and have a clearly articulated and common vision for student achievement. (Lawless & Pellegrino, 2007, p. 579)

Other research has shown that "wise use of technology takes adequate training, time, planning, support, and teacher ownership" (Viadero, 1997, p. 16, as cited by Earle, 2002, p. 7) and that the "extent to which teachers are given time and access to pertinent training to use computers to support learning plays a major role in determining whether or not technology has a positive impact on student achievement" (Valdez et al., 2000, p. 6). Technology integration requires teachers to merge the elements of content, pedagogy, and technology simultaneously (Mishra & Koehler, 2006, as cited by Skoretz & Childress, 2013, p. 462), and this takes a considerable amount of time.

Various reviews of professional development have shown that the most common form of professional development is often "one-shot workshops" that provide between an hour and a day in training per year (Parsad, Lewis, & Farris, 2001, as cited by Lawless & Pellegrino, 2007, p. 593). According to Lawless and Pellegrino (2007),

> Research (Gross, Truesdale, & Bielec, 2001; Moursund, 1989) has indicated that this type of fragmented approach to professional development does not meet the ongoing pedagogical needs of teachers and is often too far removed or disconnected from day-to-day classroom practices. The movement of the field away from quick in-and-out workshops for technology integration would support the notion that best professional development activities are spread out over time with opportunities for follow up learning and feedback. (p. 594)

A study on the expectations and uses of evolving computer-based technology and

learning (Valdez et al., 2000) found that students whose teachers had received more than 10 hours of focused technology professional development significantly outperformed the students whose teachers had five or fewer hours of focused professional development (p. 6). In reference to the TPACK framework (Mishra & Koehler, 2006), Abbit (2011) established that "the ever-changing nature of technology has made the knowledge base for technology a moving target in terms of its relationship with teachers' ability to successfully integrate technology into classroom practices" (p. 134). Mishra and Koehler (2006) developed the TPACK framework as one that

> Encompasses understanding of the representative concepts of using technologies; pedagogical techniques that apply technologies in constructive ways to reach content in differentiated ways according to students' learning needs; knowledge of what makes concepts difficult or easy to learn and how technology can help redress conceptual challenges; knowledge of students' prior content-related understanding and epistemological assumptions; and knowledge of how technologies can be used to build on existing understanding to develop new epistemologies or strengthen old ones. (p. 3)

Abbit (2011) contended that the TPACK framework was designed to support the construction of the types of essential knowledge that must be present for successful teaching with technology. Skoretz and Childress (2013) reported that "simply adding technology to Pedagogical Content Knowledge (PCK) will not suffice if teachers are to realize new strategies for 21st century teaching and learning" (p. 462) and that successful technology integration requires an intersection of knowledge from all three elements of the TPACK framework which include technology, pedagogy, and content knowledge. Similarly, Dede (2000) argued that "The important issue for the evolution of school

curriculum is not the availability and affordability of sophisticated computers and telecommunications, but the ways these devices enable powerful learning situations that aid students in extracting meaning out of complexity" (p. 299).

Skoretz and Childress (2013) acknowledged the paradigm shift in "approaching instructional design decisions from a technological pedagogical content knowledge base and implementing these lessons within the classroom" (p. 462) as yet another challenge for teachers regarding their successful integration of instructional technologies. The implementation of instructional technology must be pedagogically sound in order to be effective and must extend beyond simple information retrieval tasks to critical thinking and problem-solving experiences for students (Earle, 2002).

Puentedura's (2009) SAMR model is another framework that has the potential to transform content delivery when integrated with instructional technologies (Chou, Block, & Jesness, 2012). "At the basic levels, technology can be used to substitute print text and augment traditional face-to-face learning. At higher levels, the use of technology should aim at transforming the learning experiences through modification and redefinition" (Chou et al., 2012, p. 15). Chou et al. (2012) contended that by using the SAMR model, "learners can work with peers or experts in the field to engage in authentic learning" (p. 15) as is shown in the Figure.

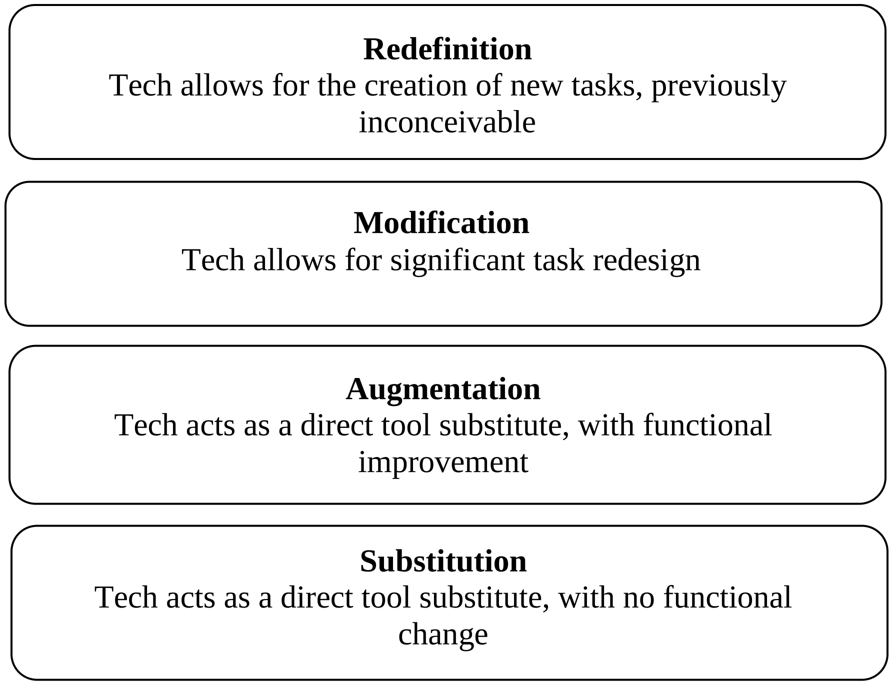

Figure. SAMR (revised from Puentedura, 2009, as cited by Chou et al., 2012).

A case study from a 4-month pilot project of one-to-one learning with iPads in four different ninth-grade geography classrooms examined what factors contributed to student learning and teacher facilitation of learning with mobile devices and what factors inhibited student learning and teacher facilitation of learning with mobile devices (Chou et al., 2012). Data were collected using teacher and student focus groups. Qualitative data indicated that professional development in the SAMR model promoted teacher implementation of student-centered learning activities as well as enhanced teaching strategies due to an increase of teacher knowledge of up-to-date technology information (Chou et al., 2012). Students reported in focus group sessions that they felt more actively engaged in their learning experiences and had more time to begin and complete class projects when they used the iPads. Teachers corroborated student responses in stating that "the students were 100% on task and engaged in classroom discussions" (Chou et al.,

2012, p. 21). Chou et al. (2012) concluded that

> although we have observed that most of the instructional activities stayed at the basic two levels of substitution and augmentation according to Puentedura's SAMR model (2009), given time and more collaboration among teachers, we are confident that we will see more instructional activities that maximize the full potential of iPads (p. 23)

using the following recommendations as guidelines.

1. Model transformative teaching practices during faculty professional development workshops: provide more examples of best practices and encourage teachers to incorporate activities that are modification or redefinition of the existing practices. Establishing a social network for teachers to share ideas and information throughout the school year can provide continuous performance support. (Chou et al., 2012, p. 23)
2. Provide training opportunities and resources for students at the early stage: Although we are working with digital natives, students would want to know why they use iPads in the classroom, how to use them properly, and when to use iPads for what purposes. Digital citizenship should be emphasized to remind students of appropriate online behaviors. Training materials can be made available in person or via the Web to deal with schools with high student turnover rate. Alternatively, identifying student tech ambassadors who are more tech savvy at each school will provide timely support for instructors during instruction. (Chou et al., 2012, p. 23)

Kay and Honey (2006) suggested that "professional development in technology integration is essential for teachers to learn how to effectively infuse 21st century

knowledge and skills into the curriculum" (as cited by Skoretz & Childress, 2013, p. 463). The U.S. Department of Education (2010) acknowledged the need for sustained, school-based professional development to fully prepare our teachers for today's classrooms (as cited by Skoretz & Childress, 2013, p. 463). Lawless and Pellegrino (2007) asserted that the purpose of "technology professional development for teachers is to provide better instruction for the 21st century learner and increase student achievement through technology-enhanced learning opportunities" (p. 598). It is in this way that teachers can be given the information they need to make their instruction motivating and enjoyable for their students (Mumtaz, 2010, p. 338) and also the confidence needed to capitalize on the opportunities to do so (Abbit, 2011; Albion, 1999). Earle (2002) stated that

> instructional technology does, indeed, hold a remarkable promise for changing the quality of teaching and learning in our schools. It is the catalyst for transformation – but this does not mean that we merely need more computers in our classrooms. Technology also involves process. (p. 15)

Teachers, instructional support staff, and administrators will have to view the effective integration of technology into teaching practices as a process and not an event if it is to be a successful and sustainable innovation in our schools (Earle, 2002; Hall & Hord, 2001). Gusky (2000, as cited by Skoretz & Childress, 2013) established that the "real challenge of any professional development is after the session ends and implementation begins" (p. 462). Christensen (2002) examined the effects of a professional development program on in-service teachers who participated in 2 days of needs-based technology integration training with a follow-up day of training every 6 weeks for a full academic year. Those results were compared with a control group of

teachers who did not receive any training. The results from this study indicated that the 2-day trainings with follow-up sessions had a positive effect on teacher efficacy when using instructional technology (Watson, 2006, p. 155). Garet et al. (2001) argued that teacher technology integration is dependent upon professional development and support that is sustained and supported over time (p. 921).

> The duration of professional development activities is expected to be important in two ways. First, longer activities are more likely to provide an opportunity for in-depth discussion of content, student conceptions and misconceptions, and pedagogical strategies. Second, activities that extend over time are more likely to allow teachers to try out new practices in the classroom and obtain feedback on their teaching. (Garet et al., 2001, p. 922)

According to Earle (2002), the curriculum being implemented in our schools should be the "vehicle for technology integration" and that technology should be "woven into the fabric of learning" (p. 12). Technology professional development is one way teachers can be taught how to make their technology fit their curriculum and not the other way around (Cuban, 1986, as cited by Earle, 2002). Effective professional development should provide teachers with the opportunities to apply and evaluate integration of available technologies into developmentally appropriate curricular experiences; analyze, reflect, and share their own digital best practices; incorporate quality software that is researched-based into rigorous curricular experiences; and develop engaging curriculum activities using technologies that pose various applications for instructional use (Shamburg, 2004, p. 229). This strategic shift in pedagogy to seamlessly integrate technology likely will be slow and gradual before finally experiencing a period of "relatively dramatic growth" or innovation in our schools (Patter, 2009, p. 27).

Eteokleous (2008, as cited by Liu, 2013) found that teachers often lack the knowledge and resources needed for successful innovation and suggested that technology professional development could remedy the issue. "Teachers need to learn ways to integrate technology into their regular lessons, activities, and assessment and see new possibilities rather than treating technology as an end in itself or an add-on" (Rand, 2001, as cited by Shamburg, 2004, pp. 228-229). Joyce and Showers (2002) maintained that technology professional development should enable teachers to develop the knowledge and skills required for tracking and modifying their classroom learning environments. Eteokleous's (2008) research also contended that technology professional development should be at the school level and not at the district or national levels. As opposed to district or national professional development, school-level training directly addresses teacher needs in collegial collaboration, provides an opportunity for training according to identifiable areas of weakness, and supports teachers in changing their traditional beliefs about technology use in their classrooms (Liu, 2013, p. 39).

Aforementioned studies indicate that technology professional development can have positive effects on teacher implementation of technology in instruction (Liu, 2013, p. 40). Harris and Hofer (2011) explored technology professional development through comparative interview data and planning products before and after teachers took part in those sessions. They found that teacher instructional plans became focused on student intellectual development and instructional needs while their selection and application of technology became more intentional and varied than before. A different study by Overbaugh and Lu (2008) investigated what impact technology professional development had on teacher self-efficacy in the integration of technology into instruction. Their findings demonstrated a positive correlation between the attendance of participants in the

professional development sessions and their confidence in implementing technology integration in their classrooms.

Lowther, Ross, Strahl, Inan, and Pollard (2005) completed a study that demonstrated the effectiveness of a technology professional development program consisting of teacher observation and replication. Teachers observed other teachers effectively implementing technology into instruction and were then encourcqaged to use modeled strategies in their own classrooms. “Classroom practices were typically student-centered when students used technology as a learning tool” (Liu, 2013, p. 40). Findings from this study argued that teacher training experiences should focus on how technology helps teachers implement student-centered learning that gives students the skills needed to be successful “in every enterprise in the twenty-first century” (Kay & Honey, 2006, p. 66). According to Liu (2013), this type of learning is characterized as student-centered, collaborative and dependent upon higher order reasoning and student independence (p. 40). Kay and Honey (2006) pointed out that driving questions for professional development that would encourage this kind of learning include “(1) How can students take ownership of developing and tracking their analytical thinking and problem-solving skills? (2) How do students become truly innovative learners? And (3) How do we most effectively teach and measure self-directed learning skills?” (p. 69). Information technology literacy gives us a great capacity for accomplishing these learning, thinking, and innovation tasks (Kay & Honey, 2006, p. 69). Effective leadership by the school-level ITF will help support the kind of teaching and learning required for the 21st Century (North Carolina Public Schools, 2013).

Ash, Sun, and Sundin (2002) developed a survey that was administered to 329 teachers from 10 schools in Alabama regarding their Level of technology integration.

The developed survey items mirrored the expectations set forth in ISTE's five standards for teacher technology integration. As a result, the survey measured quite comprehensively the degree to which the state was integrating instructional technologies. Findings illustrated that most respondents were still in the beginning stages of instructional technology integration. Given the fact that no comparable study was found which analyzed technology integration using precisely the same expectations that teachers are encouraged to teach with, it could be hypothesized that many other schools in the United States are not effectively integrating technology according to ISTE standards. One solution to a problem of this complexity might be the implementation of a highly effective technology training program for teachers that focuses directly on international technology performance standards for teachers (Ash et al., 2002).

High-quality professional development is a necessity if our teachers are to master the ISTE standards and meet performance indicators of those standards. These learning opportunities for teachers should provide the support needed to integrate technology into pedagogy and content in a way that will improve teacher practice, student learning experiences, and student achievement (ISTE, 2014). The successful implementation of sustainable professional development should manifest in the creative learning opportunities modeled and facilitated by teachers with the effective integration of digital tools and resources.

Facet 3: Vision and leadership. Gilbert and Green (1997) established that "long term deep educational change must be driven by educational visions, not technological visions" (p. 38) Zhao (2010) found that "school leadership can provide teachers with a knowledge management framework and strategies needed for technology professional development" (p. 174). A multitude of research regarding the importance of a strong

administrative presence during technology integration exists. Within that research there are several common themes that arise. The themes that arise as being important charges for school leaders are reversely some of the same themes that pose as barriers for teacher technology integration (Bailey & Lumley, 1997; Brockmeier, Sermon, & Hope, 2005; Cakir, 2012; Dawson & Rakes, 2003; Fullan, 2001; Guskey, 1988; Miller, 2008; Rogers, 2003; Sparks, 1983; Yee, 2000). Instrumentality (clarity of expectations when using technology), congruence (the alignment of technology integration into previously adopted practices), cost, importance and difficulty of use were all factors that contributed to the rise or fall of effective classroom technology integration (Guskey, 1988). Table 3 represents the culmination of the themes necessary for administrators who wish to lead successful technology integration in their schools. Clearly, Guskey's (1988) themes echo within the desired characteristics of effective technology leaders.

Table 3

Studies of Administrative Technology Leadership for Effective Instructional Technology Integration

Research Study	Identifiable Themes
Bailey, G., & Lumley, D. (1997). Technology Planning: A toolkit for administrators and school board members. As cited by Cakir, R. (2012). Technology integration and technology leadership in schools as learning organizations, *The Turkish Online Journal of Educational Technology*.	Eight Important Themes for Leaders Who Want to Integrate Technology Effectively: 1. Change with developments in technology 2. Budget and planning for technology 3. Professional development of personnel involved in technology 4. Technological infrastructure 5. Technical support in the implementation of technology 6. Learning and teaching with technology 7. A curriculum in which technology is integrated 8. Individuals who consider themselves to be technology leaders
Fullan, M. (2001). *The new meaning of educational change*. New York: Teacher's College Press. As cited by Cakir, R. (2012). Technology integration and technology leadership in schools as learning organizations, *The Turkish Online Journal of Educational Technology*.	An Effective School Technology Leader: 1. Possesses positive characteristics 2. Is open to innovation 3. Is willing to encourage learning and teaching 4. Expects teachers and students to use technology 5. Embraces technology as a leader in innovation (Brockmeier, et al., 2005; Dawson and Rakes, 2003; Rogers, 2003).
Miller, M. (2008). A mixed-methods study to identify aspects of technology leadership in elementary schools.	Themes Materialized from Study of Highly Effective Leaders in Technology Integration: 1. Leadership that casts a vision. 2. Leadership that supports technology integration at the school level. 3. Leadership that models expected technology practices. 4. Leadership with a high degree of technological expectation 5. Leadership with an understanding of pedagogical implementations of technology integration 6. Leadership with strong distributed leadership practices.
Yee, D. (2000). Images of school principals' information and communications technology leadership, *Journal of Information Technology for Teacher Education*	Identifiable Themes/Characteristics of Instructional Technology Leadership: 1. Equitable Providing 2. Learning-focused Envisioning 3. Adventurous Learning (of Administrator) 4. Patient Teaching 5. Protective Enabling (for teachers and students) 6. Constant Monitoring 7. Entrepreneurial Networking (with school and community stakeholders) Careful Challenging (administrators as model innovative educators)

Byrom and Bingham (2001) stated that "leadership is probably the single most

important factor affecting the successful integration of technology into schools (p. 4, as cited by Berrett, Murphy, & Sullivan, 2012). Moreover, Berrett et al. (2012) wrote that "administrators must create and maintain an atmosphere that is conducive to open and honest communication among teachers" (p. 203), in order for technology integration to be effective. Expectations for implementing technology in the school must be clearly articulated by administrators. Shulman (1987) argued that "teaching begins with each teacher's understanding of what is to be learned and how it is to be taught" (as cited by Almas & Krumsvik, 2008, p. 105). Additional studies exist that corroborate the need for strong technology leadership at the administrative level. Serhan (2007) found that

> when school principals feel comfortable using the technology and realize its possible applications in education then they can help facilitate its incorporation into the curriculum. A positive attitude starting from the school leadership can spread to the teaching faculty in the school and hence to the classroom and the students. (p. 5)

Similarly, Miller (2008) found in her dissertation studies that

> it was obvious that the successful integration of technology in the school began with her [the principal's] leadership. The principal was instrumental in taking the lead by serving as a catalyst, gaining the support of district leaders, developing a strong technology component in the curriculum, establishing high expectations for implementation with close and frequent classroom observations, and providing teacher training. Furthermore, she provided continuous support and shared leadership responsibilities regarding the integration of computer technology into the adopted classroom curriculum. As a result, teachers felt empowered to integrate technology to optimal capacity in their respective classrooms. The

> principal provided a strong instructional leadership in the effective implementation of computer technology in the school programs. (p. 84)

Cakir (2012) found that school technology leaders have a great deal of responsibility in helping make sure that teachers integrate the technology effectively within their classrooms. Cakir also contended that “administrators are responsible for prioritizing the use of new technologies in the schools and ensuring that teachers are provided with the support they require” (p. 275). Similarly, Berrett et al. (2012) cited the work of several educational researchers (Anderson & Dexter, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Subramaniam, 2007; Winne, 2006) in declaring that “effective leadership during the implementation process is vital. One challenge for school district administrators is to adequately support teachers who are implementing technology to enhance and improve the teaching and learning process” (pp. 200-201).

As is illustrated in Table 3, it is not enough for administrators to simply encourage the use of instructional technology in their schools. “It is necessary for leaders to model the process” (Berrett et al., 2012, p. 203). “When a new pedagogical approach or tool is presented, teachers make value judgments about whether that approach or tool is relevant to their goals” (Ertmer & Ottenbreit-Leftwich, 2010, p. 263, as cited by Berrett et al., 2012, p. 203), in part by observing their administrators’ attitudes and competencies towards it.

> Administrators’ behavior needs to be consistent with the message of the school: Technology is important and there are resources available for teachers. If the school believes that technology is important to educate effectively, then the necessary resources must be provided with the full support of the leadership in the school (Byrom & Bingham, 2001; Dawson & Rakes, 2003; Hayes 2006, as cited

by Berrett et al., 2012, p. 203).

An establishment of a clear technological vision, expectation of use, and positive regards towards technology is a critical component for school technology leaders. Teachers expect information from school leaders that will guide them in the appropriate usage and application of available technologies within their classrooms (Berrett et al., 2012).

Teachers look to their administrators to set the tone for new instructional practices and adoptions including the effective use of integrated instructional technologies (Berrett et al., 2012). Coffland and Strickland (2004) examined principal attitudes towards technology as they observed their teachers using it in the classroom. The study was conducted with 52 secondary teachers and 32 principals who participated in a mail survey on their Level of technology integration and attitudes towards technology (Esposito, 2013). Study findings revealed that as "principals' attitudes go up, so do the teachers' attitudes" (Coffland & Strickland, 2004, as cited by Esposito, 2013, p. 84). Dissertation data from Esposito's (2013) study revealed that

> the dimension of school support and principal support for teacher technology efforts correlated with multiple variables in the study. Teachers who scored higher in the dimension of school support and principal support tended to demonstrate the use of technology to promote student learning, digital citizenship, collaborate with peers and colleagues using digital tools, promote global awareness, and have collaboration with parents and community. (p. 89)

In a study of the roles of professional community, trust, efficacy, and shared responsibility of the administrator on how teachers experience principal leadership, Wahlstrom and Louis (2008) stated that

> as an instructional leader in the building, the principal is expected to understand the tenets of quality instruction as well as have sufficient knowledge of the curriculum to know that appropriate content is being delivered to all students. This presumes that the principal is capable of providing constructive feedback to improve teaching or is able to design a system in which others provide this support. (p. 459)

In other words, the administrator has to be aware of the standards that have been established for the teachers they are leading, as well as for themselves, because "the individual as part of a collective group working in a school has clear sensibilities about effective leadership when it happens" (Wahlstrom & Louis, 2008, p. 459). ISTE established five administrator standards to help school leaders meet state, local, and national expectations.

The ISTE (2009) Standards for Administrators call for school leaders to

1. Exhibit visionary leadership.
2. Create, promote, and sustain a digital age learning culture within the school.
3. Promote a school environment conducive to excellence in professional practice.
4. Lead movements for systematic improvement.
5. Model and facilitate digital citizenship.

Facet 4: Teacher efficacy. An early study by Gusky (1988) investigated the relationship between the perceptions of highly effective teachers and their attitudes toward the implementation of new instructional strategies. The results of that study showed that teacher efficacy, teaching affect, and teaching self-concept had a significant correlation to the teachers' attitudes of various aspects of suggested instructional

practices. Ross (1994) conducted an analysis of 88 studies of the antecedents and consequences of teacher efficacy. Within the context of this study, Ross defined teacher efficacy as the measurement of the extent to which teachers believe their efforts will have a positive effect on student achievement. Evidence collected during Ross's research was consistent with his hypothesis that teacher efficacy had an influence on the learning of both teachers and students. Earlier work with teacher efficacy dates back to Rotter's (1966) social learning theory which contended that teacher efficacy was both internal (belief in one's self and one's ability to control teacher and student outcomes) and external (belief that the environmental factors beyond one's control overwhelm their abilities to control teacher and student outcomes). Most teacher efficacy researchers relate their studies to Bandura's (1977) theory of self-efficacy (Ross, 1994) which contradicted Rotter's earlier conceptualizations by portraying self-efficacy as the beliefs that persuade certain actions and decisions leading to the fulfillment of a goal or outcome (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). Skoretz and Childress's (2013) definition of teacher efficacy as "the judgment of one's capability to organize and execute actions to achieve instructional goals" (p. 462) is clearly aligned with the framework established by Bandura (1977). They also established that teacher efficacy is "a strong predictor of whether teachers will translate the knowledge gained from professional development into instructional practice" (Skoretz & Childress, 2013, p. 462). Bandura's psychological research in social cognitive theory resulted in the study of self-efficacy and the "actions and inactions resulting from one's sense of self-efficacy" (Bernadowski, Perry, & Del Greco, 2013, p. 71). In these original studies, Bandura established that self-efficacy is a "key behavioral mechanism underlying human behavior that serves as one of the critical factors motivating people to engage in pursuing

individual goals" (Bernadowski et al., 2013, p. 71). Bandura's research suggested that when teachers cognitively process the interrelatedness of various perceptions, an ability to control future instructional behaviors exists. Teachers with higher levels of efficacy will be able to weigh those judgments proportionately with certain influencing criteria in order to meet instructional goals (Bandura, 1986, as cited by Skoretz & Childress, 2013).

Other studies have shown that teachers who have a strong sense of teacher efficacy and positive beliefs in relation to their impact on student learning are often teachers who have an unusually positive effect on their students' growth and development (Berman, McLaughlin, Bass, Pauly, & Zellman, 1977, as cited by Guskey, 1988). Since Bandura's work in investigating self-efficacy, researchers tend to view teacher efficacy as being comprised of two types: personal efficacy and general efficacy. Personal efficacy relates to teachers' abilities to promote positive change for their students, while general efficacy relates to teachers' beliefs that outside factors beyond their control create limitations to their potential impact on students (Ross, 1994). Bernadowski et al. (2013) used Bandura's (1997) factors of influence on self-efficacy to establish similar factors of influence on teacher efficacy. The sources identified by Bandura (1997) that influence self-efficacy are applicable in the educational setting and help to reveal insight into teachers' beliefs about themselves, other school stakeholders, and their overall job satisfaction.

Table 4

Bandura's (1997) Four Influences on Self-Efficacy and Educational Applications

Type of Influence	Description of Influence	Educational Implications
Enactive Mastery Experiences	Perceived to have the most influence on self-efficacy as they provide authentic evidence of an individual's capacity for success.	Experiences with authentic teacher opportunities. Success with this has much potential in establishing a positive teacher efficacy.
Vicarious Experiences	When individuals observe others who are believed to have "comparable capabilities" (Cone, 2009, as cited by Bernadowski et al., 2013, p. 71)	Observing colleagues, model lessons, and specific teaching strategies proven to be best practice with intent of using what is learned in one's own instructional practices.
Verbal Persuasion	Feedback given to an individual by others with significant insight that is both relevant and meaningful; that might be positive or negative.	Receiving consistent feedback from administrators, support staff, and colleagues that conveys confidence in an individual improves teacher efficacy.
Physiological and Affective States	Physical and emotional responses experienced by an individual due to various stressors, fears, and/or anxieties.	Feedback received from significant others in the educational setting drive the decision making of teachers. Specific emotions that might trigger responses include stress, fear, and anxiety (Cone, 2009, p. 21).

Note. Bernadowski et al. (2013).

It is within these four influences that teachers establish a sense of teaching efficacy. Each area of influence has the potential to affect individual teachers differently, and the variance of the impact also depends on the context in which the teacher is experiencing the particular influence (Bandura, 1977).

While the degree to which individual teachers are impacted by the influences in Table 4 vary, research supports the claim that all teachers are most susceptible or "malleable" early in learning or during their preservice training or beginning teacher years (Bernadowski et al., 2013, p. 72). Bernadowski et al. (2013) cited Hoy (2004) by

stating that “the first few years of teacher development could be critical to the long-term development of teaching efficacy” (p. 72). Bernadowski et al. also cited work by Swars, Smith, Smith, and Hart (2006), whose research supported the difficulty in modifying teacher efficacy levels once they are established.

Social cognition, self-regulation, and teacher technology efficacy. The literature that exists on self-efficacy has been based largely on the theoretical framework established by Bandura (1977). In his work Social Cognitive Theory, Bandura (1989a) stated that “an accurate appraisal of one’s own capabilities is highly advantageous and often essential for effective functioning (p. 61). The contributions to psychology that were made by Bandura’s “Self-Efficacy” (1977) and Social Cognitive Theory (1989a) provide clarity for many of the developmental expectations that are set as milestones for infants, children, and adolescents. The research of the development of one’s beliefs in his or her capabilities as an individual compared to one’s personal expectations, the success and experiences of one’s respected peers, and also to those of a larger group or society during childhood (Bandura, 1989a) established the groundwork for what is known as teacher efficacy and how to help facilitate and strengthen this belief system in today’s educational setting. While Bandura’s original studies (Bandura, 1989a, 1989b) pertained mostly to early childhood developmental phenomena, his data were later applied to various studies involving teacher efficacy (Baylor & Ritchie, 2002; Bernadowski et al., 2013; Ross, 1994;Tschannen-Moran et al., 1998; Woolfolk & Hoy, 1990) and more specifically teacher technology efficacy (Ertmer & Ottenbreit-Leftwich, 2010; Holden & Rada, 2011; Maigo & Mei-yan, 2010; Varol, 2014; Watson, 2006). Social Cognitive Theory and Social Cognitive Theory of Self-Regulation establish a cycle of behaviors that indicate the level of one’s self-efficacy. This cycle of processes has a seamless

application in the field of educational technology when examining teacher technology efficacy. Bandura (1989a, 1989b) developed a cyclic model of human behaviors that both determine and depend upon one's efficacy, called the Self-Regulative Mechanism. Bandura's Self-Regulative Mechanism establishes five levels of self-regulation. The first level of self-regulation is the forethought and prediction of events and outcomes (both favorable and unfavorable). The second level of self-regulation is realistic goal setting based on the forethought and predictions occurring in level one. Judgment of goals is the third level of self-regulation and represents the time when a person decides how successfully their goals were achieved. The fourth level of self-regulation is self-reflection, and it is during this stage that that feedback gathered from observing one's own success rate in the achievement of his/her goals is analyzed and compared to the expectations he/she holds for him/herself, as well as the expectations of peers and the larger society. Reaction is the final level of self-regulation. The reaction will either result in the establishment of new goals (for a highly efficacious person) or will result in a hesitancy or failure to establish new goals based on difficult or unfavorable conditions resulting from previously established goals (Bandura, 1977, 1989a, 1989b, 1991).

Teacher technology efficacy will increase or decrease based on the experiences each individual encounters during the goal implementation process (Bandura, 1991; Christensen, 2002; Loyd & Gressard, 1986). Additionally, Christensen (2002) asserted that "the amount of confidence a teacher possesses in using computers and related information technologies may greatly influence his or her effective implementation of technology methods in the classroom" (p. 411). The level of confidence or efficacy will have an impact on how successful the cycle of teacher technology efficacy becomes in developing highly efficacious teachers. As teachers "attain the standard they have been

pursuing, those who have a strong sense of efficacy generally set a higher standard for themselves. The adoption of further challenges creates new motivating discrepancies to be mastered" (Bandura, 1991, p. 260). Bandura (1991) also refers to the work of Locke and Latham (1990) that found that explicit challenging goals enhance motivation and performance attainments (p. 260). Farah (2012) cited the work of Bandura (2001) and others (Compeau & Higgins, 1995; Kellenberger & Hendricks, 2003; Littrell et al., 2005; Teo, 2009; Wang et al., 2004) in the conjecture that "people‘s beliefs in their capacity to carry out a given task, was identified as a significant factor influencing people‘s decisions to use technology" (p. 41). In a study by Kellenberger and Hendricks (2003), self-confidence in using a computer for work was the strongest predictor of teaching use (p. 17, as cited by Farah, 2012). Farah stated that "similarly, computer self-efficacy was identified as being significantly influential on people's expectations of outcomes when they use computers as well as their emotional response to computers and their actual use of computers" (p. 41; Compeau & Higgins, 1995; Lambert, Gong, & Cuper, 2008; Palak & Walls, 2009).

Significance of Teacher Technology Efficacy

Technology integration in schools has been around for decades and so is the seemingly automatic resistance to it in the educational system. Hayes (2006) asserted that culture and change are antithetical; that change threatens the stability, predictability, and comfort of the culture (Berrett et al., 2012).

In the study by Berrett et al. (2012), conclusions yielded that teachers who reported the most discomfort with the integration of technology were the ones who reported constant struggles with it. They lacked an efficacious belief in themselves and their capacity to implement new technological practices into their classrooms.

A study by Christensen (2002) examined three hypotheses supporting the importance of increasing teacher technology efficacy. The hypotheses were

1. Needs-based technology-integration education fosters positive attitudes toward technology among elementary school classroom teachers.
2. Teacher education in needs-based technology integration, combined with significant classroom use, fosters positive student attitudes toward information technology.
3. Positive teacher attitudes toward information technology foster positive attitudes in their students.

The results of Christensen's study found that all three hypotheses were accepted due to the indications from research data. Hypothesis one predicted that "needs-based technology integration education would foster positive attitudes towards technology among elementary school classroom teachers" (Christensen, 2002, p. 416). Data from the analysis of hypothesis one indicated that

1. Teachers at the treatment and comparison sites who reported having received computer integration education tended to exhibit more positive attitudes toward information technology than their non-integration counterparts (Christensen, 2002, p. 425).
2. Teachers at the treatment site changed to a greater extent in the direction of more positive attitudes than did their comparison group peers (Christensen, 2002, p. 425).
3. The integration education delivered at the treatment site had a significant effect on perceived computer importance, while the effects of training at the comparison site were negligible (Christensen, 2002, p. 425).

Hypothesis two posited that "teacher education in needs-based technology integration, combined with significant classroom use, fosters positive student attitudes toward information technology" (Christensen, 2002, p. 417).

> Regression techniques confirmed the strong effects of the extent of teacher computer use on the attitudes of their students. A time-lag regression confirmed the existence of a probable causal path from the beginning level of teacher integration education to the ending computer importance for their students. (Christensen, 2002, p. 427).

Hypothesis three, which examined whether or not teacher efficacy had any effect on student attitude, was supported by data indicating that

1. Positive teacher perceptions of computer importance influence student perceptions of computer importance in a positive manner (Christensen, 2002, p. 428).
2. Positive teacher computer enjoyment influences student perceptions of computer importance in a positive manner (Christensen, 2002, p. 428).
3. Positive teacher enthusiasm influences student perception of computer importance in a positive manner (Christensen, 2002, p. 428).

This study particularly supports the notion that teachers with high levels of technology efficacy likely have a positive effect on the attitudes of their students towards technology. Other studies exist that support the concept of teacher efficacy as a major determinant of attitudes toward school (Caprara, Barbaranelli, Steca, & Malone, 2006).

Tschannen-Moran et al. (1998) referenced several studies by Guskey (1981, 1982, 1987, 1988) in which he found "significant positive correlations between teacher efficacy and responsibility for student success" (p. 207). Tschannen-Moran et al. cited findings

by Guskey (1982, 1988) as "showing strong intercorrelations between overall responsibility for student success and student failure" (p. 207) and that

> Teachers exhibited greater efficacy for positive results than for negative results, that is, they were more confident in their ability to influence positive outcomes than to prevent negative ones. Greater efficacy was related to more positive attitudes about teaching, as well as a high level of confidence in teaching abilities on a measure of teaching self-concept. (p. 207)

Tschannen-Moran (1998) concluded that data from Guskey's (1981, 1982, 1987, 1988) research indicated that teachers who have higher levels of efficacy are more effective in student mastery learning and that their teaching practices are more aligned with those that support student mastery and success. In these instances, highly efficacious teachers were more effective in facilitating student achievement.

In addition to promoting positive student attitudes toward instructional technologies and increasing student achievement, studies have shown that "greater efficacy leads to greater effort and persistence" (Tschannen-Moran et al., 1998, p. 234) by teachers; and that "lower efficacy leads to less effort and giving up easily, which leads to poor teaching outcomes, which then produces decreased efficacy" (Tschannen-Moran et al., 1998, p. 234). Tschannen-Moran et al. (1998) also established that

> Teaching performance that was accomplished with a level of effort and persistence influenced by the performer's sense of efficacy, when completed, becomes the past and a source of future efficacy beliefs. Over time this process stabilizes into a relatively enduring set of efficacy beliefs. (p. 207)

In a quantitative study using a demographic questionnaire of 200 special education teachers examining the relationship between "instructionally-relevant

behaviors and attitudes" (Allinder, 1994, p. 88) that were already accepted as "predeterminations of teacher effectiveness and student achievement" (Allinder, 1994, p. 88), Allinder (1994) found that teachers with a greater belief in their ability to teach were more likely to "(a) try different ways of teaching; (b) to be well organized and planful in their instruction; and (c) to be confident and enthusiastic about teaching" (p. 92). Caprara et al. (2006) cited a number of studies "pointing to the influence of teacher's self-efficacy beliefs on children's cognitive achievements and success at school" (p. 474; Moore & Esselman, 1992, 1994; Muijs & Reynolds, 2001; Ross, 1992, 1998a, 1998b). Similarly to Allinder, Caprara et al. found that "teachers with high self-efficacy beliefs are more likely than teachers with a low sense of self-efficacy to implement didactic innovations in the classroom and to use classroom management approaches and adequate teaching methods" (p. 474) when analyzing data from over 2,000 self-reporting questionnaires from teachers in 75 Italian junior high schools. Other studies (Raudenbush, Rowan, & Cheong, 1992; Ross, 1998a, 1998b, as cited by Caprara et al., 2006) suggested a "reciprocal effect between teacher's perceived self- efficacy and a student's achievement, showing that teacher's perceived self-efficacy is particularly high in schools with high-achieving and well-behaved students" (p. 474). Caprara et al. summarized those findings by stating that

> As teachers of talented and disciplined students are more likely to be successful in their activities and tasks than teachers of students who present learning or disciplinary problems, the repeated experiences of success with students may enrich their experience and contribute to their robust sense of efficacy. (p. 474)

Rakes, Fields, and Cox (2006) conducted a study of 186 fourth- and eighth-grade teachers from 11 rural schools in a southern state of the United States to analyze the

results of a 1-year professional development program on instructional technology integration (Esposito, 2013). The Level of Technology Integration (LoTi) survey was given as the measure for how effective the program had been. Results for the study indicated that “teachers beliefs concerning their personal ability to effectively use technology and their beliefs regarding the potential effect on student achievement is quite possibly a significant factor in determining what actually happens in the classroom” (Rakes et al. 2006, as cited by Esposito, 2013, p. 36). Esposito (2013) conceived that this makes sense “because the use of technology enables teachers to create learning situations in which students become more engaged and active learners” (p. 36). In conclusion, Esposito cited Rakes et al. in stating that “teacher beliefs concerning their personal ability to effectively use technology and their beliefs regarding the potential effect on student achievement is quite possibly a significant factor in determining what actually happens in the classroom” (p. 422).

The purpose of this literature review is to establish the need for a mixed-methods study determining the degree to which the role of the school-level ITF impacts teacher technology efficacy. In a review of technology’s impact on student performance Pflaum (2001) stated that

> in the drive to achieve its agenda, the technology promoters have not paid attention to teachers. They’ve not understood the priorities that motivate teachers and the societal and institutional constraints that impede them. And teachers have been ignored at the technologists’ peril. The business-oriented technology supporters have focused on wires, switches, hubs, and computers when they should have focused on teachers. School transformation (as maintained by Larry Cuban in Oversold and Underused Computers in the Classroom, 2001) will start

> with teachers and the expectations of their communities, not with boxes and wires. (p. 43)

This ideology as mentioned by Pflaum (2001) and supported by Cuban (2001) supports the need to determine how the role of ITFs impacts the technology efficacy levels of classroom teachers.

Role of ITFs. Technology improves learning when it is implemented in ways that enhance instruction (Gulbahar, 2007; Kim & Hannafin, 2011; Liu, 2013); and while technology has changed drastically over the last 2 decades (Cuban, 1986), empirical research suggests that the way it is used in classrooms around the world has not (Chen, 2008; Gorder, 2008; Hermans, Tondeur, van Braak, & Valcke, 2008; Liu, 2013). Lawless and Pellegrino (2007) discovered that the teachers in their study only used computers to complete word processing tasks (Chen & Chen, 2008). Another study revealed that students perceived technology as underutilized in their classes even though teachers and administrators felt competent using it (Gulbahar, 2007). Pelgrum (2001) asserted that "a shift from the learner as passive consumer of educational offerings to an active knowledge gathering and productive participant in educational activities" (p. 50) is required and that

> it seems that the current belief is that Information and Communications Technology (ICT) is not only the backbone of the Information Society, but also an important catalyst and tool for inducing educational reforms that change our students into productive knowledge workers. (p. 63)

Teachers are not implementing technology with effectiveness and this makes the role of ITFs essential in education (Ertmer & Ottenbreit-Leftwich, 2010). Berrett et al. (2012) cited Ertmer and Ottenbreit-Leftwich (2010) to contend that "leaders are needed who,

regardless or title or school district role, can act as change agents to promote the successful implementation of technology" (p. 203). ITFs hold important technology leadership roles in our schools (North Carolina Public Schools, 2013). The North Carolina Department of Public Instruction sets forth specific expectations of the ITFs. Those expectations are depicted in Table 5.

Table 5

North Carolina Department of Public Instruction Expectations for School-Level Technology Facilitators

Expectations	Indicators
Planning and Facilitating Teaching and Learning	Collaborates with all teachers to create curricular resources and encourage interdisciplinary approaches to learning by working with other school-level support staff (e.g. Media Specialist, Instructional Specialists).
	Facilitates the use of instructional technology at the school(s) by modeling appropriate uses of those technologies.
	Implements a professional development plan that intentionally trains teachers in the use of emerging instructional technologies.
Planning and Facilitating Information Access and Delivery	Implements research based, standards based, instructional practices that promote learning.
	Collaborates with teachers and administrators to fulfil a successful integration of technology in the curriculum.
	Advocates for access, support, and sustainability of the school technology infrastructure.
	Engages various stakeholders in the school technology program.
Planning and Facilitating Program Administration	Leads in the systematic evaluation of the school-level technology plan.
	Collaborates with all school members to strengthen the technology program.

Note. North Carolina Public Schools (2013).

The expectations set forth by North Carolina Public Schools establish the guidelines by which ITFs should adhere. The role of the ITF should be to intentionally serve as a resource to classroom teachers but not to serve as the classroom teacher (Patter,

2009), since ultimately, "teachers are responsible designers of their classes' learning environments" (Almas & Krumsvik, 2008). Additionally, ISTE established eight technology facilitation standards to help identify what the role of an ITF should be. Those standards are

1. Educational technology facilitators demonstrate an in-depth understanding of technology operations and concepts.
2. Educational technology facilitators plan, design, and model effective learning environments and multiple experiences supported by technology.
3. Educational technology facilitators apply and implement curriculum plans that include methods and strategies for utilizing technology to maximize student learning.
4. Educational technology facilitators apply technology to enhance and improve personal productivity and professional practice.
5. Educational technology facilitators apply technology to enhance and improve personal productivity and professional practice.
6. Educational technology facilitators understand the social, ethical, legal, and human issues surrounding the use of technology in PK-12 schools and assist teachers in applying that understanding in their practice.
7. Educational technology facilitators promote the development and implementation of technology infrastructure, procedures, policies, plans, and budgets for PK-12 schools.
8. Educational technology facilitators will contribute to the shared vision for campus integration of technology and foster an environment and culture conducive to the realization of the vision.

Williamson and Reddish (2009) suggested the above standards as a validation for the role of technology professionals, stating that others "may not understand the full range of what technology professionals do or why technology facilitation and leadership is a critical component of school improvement" (p. 25). In North Carolina, ITFs are given a licensure endorsement to formalize their role as professionals (Williamson & Reddish, 2009). The intent for the ITF standards is to help technology professionals shape and implement technological vision in our classrooms and to help others "achieve national technology standards" (ISTE Technology Standards for Teachers, Administrators, and Students) they often do not realize exist (Williamson & Reddish, 2009, p. 22).

Patter's (2009) research suggested that the role of ITFs is to give teachers the training and support they need to use instructional technology effectively in their classrooms since oftentimes "the teachers' consciousness of what they are doing and why they are doing it may be absent and difficult to articulate" (Almas & Krumsvik, 2008, p. 105). According to the Guidance for Instructional Technology Resource Teacher and Technology Support Positions, it is "in this role they [ITFs] are also agents of change and are actively engaged in curriculum development and lesson planning" (Patter, 2009, p. 39). Early studies on the role of ITFs contended that teachers are more likely to integrate technology into their curriculum when they have knowledgeable technology support personnel who can give them instructional guidance and emotional support (Patter, 2009; Pearson, 1994; Persky, 1990). These studies indicate that "whether this person is at the site or the district, just having someone in such a role can be a valuable asset in creating, implementing, and directing a vision for integrating technology into schools" (Patter, 2009, p. 39).

In Farah's (2012) study, local school support for instructional technology was one factor identified in influencing technology self-efficacy levels (p. 69). Both insinuate a focus on the needs of teachers and students rather than hardware or software which has traditionally been the approach to technology professional development (Knapp, 1996; McCannon & Crews, 2000, as cited by Lawless & Pellegrino, 2007, p. 593). They also indicate the need for school-level technology leadership that "matches emerging technologies with evolving institutional, student, and faculty needs" (Wright, Marsh & Miller, 1999, p. 17). Wright et al. (1999) stated that

> although technology development continues to move at a rapid rate, scholars will have consistent challenges in assessing issues related to productivity, effectiveness, performance outcomes, and assessment. Technology administrators must consistently match technological advances with evolving institutional, student, and faculty needs. (p. 1)

Because school -level ITFs are leaders in the effective use of instructional technologies, the work of Wright et al. (1999) poses significant implications for them. Lawless and Pellegrino (2007) cited various recent research studies (Cole et al., 2002; Holbein & Jackson, 1999; Kariuki, Franklin, & Duran, 2001; Mulqueen, 2001; Orrill, 2001) that support the notion that ITFs are following a "new trend toward using a mentoring or coaching model to support teacher change" (p. 594). MacAurthur and Pilato (1995) maintained that the "key features of the mentoring approach are that assistance is provided in the context of a personal relationship and is focused on the individual needs of the protégé (as cited by Lawless & Pellegrino, 2007, p. 594). The evaluation of this approach to technology leadership and support "illustrated that the teachers became more comfortable with the technology and developed a greater

proficiency in their computer use as a result of their participation" as well as seeing the technologies available as tools for teaching and learning best practices (Lawless & Pellegrino, 2007, p. 594). Lawless and Pellegrino (2007) also established that this model of professional development is also beneficial to the mentor in that they learn "how to best provide collegial support over time" (p. 594).

Bandura's (2001) research on the temporal extension of human agency found that "people set goals for themselves, anticipate the likely consequences of prospective actions, and select and create courses of action likely to produce desired outcomes and avoid detrimental ones" (p. 7). Therefore, the role of the ITF should inform, engage, and motivate teachers in a way that would encourage them to integrate best practices for instructional technologies into their processes for classroom goal setting and acting effectively upon those goals.

Various research portray the relationship between ITFs and teachers as bound by the potential implications on teacher technology efficacy and positive instructional change (Allinder, 1994; Booth, 2008; Guskey, 1988). Williamson and Reddish (2009) maintained that because many educational trends are pushing for a movement away from traditional teaching strategies, the role of the ITF will not just be training teachers in technology; it will be trying to successfully "challenge teachers' long-standing beliefs about teaching and learning" and helping them feel confident in their ability to make those changes (p. 38).

Summary

The findings in the literature review support the use of ITFs in fostering higher teacher technology efficacy when using digital classroom resources. Instructional technology has the power to motivate students and teachers, add to the innovativeness

and creativity of learning experiences, and raise student achievement. Instructional technology also has the potential to intimidate teachers and pose restrictive barriers that hinder successful school-wide implementation. An analysis of relatable research suggests that sustainable professional development, strong ITF and administrator leadership, and high levels of teacher technology efficacy are all beneficial conditions for successful school technology integration. Reciprocally, as teachers become more confident and capable in the integration of technologies, their integration practices will become stronger and more consistent.

Chapter 3: Methodology

Introduction

"In repeated and ongoing analyses of classroom practice using the Level of Technology Implementation (LoTi) framework, researchers consistently find that the most common technology uses in classrooms are not aligned to research-based best practices" (Moersch, 2002, as cited by ISTE, 2009, p. 34). Studies also show that "the amount of confidence a teacher possesses in using computers and related information technology may greatly influence his or her effective implementation of technology methods in the classroom" (Christensen, 2002, p. 411). Williamson and Reddish (2009) opined that "schools today must meet the growing need for highly qualified educational technologists" so that educators can become more competent and confident users of instructional technologies (ISTE, 2009, p. 32).

This study explores the impact of the role of the school-level ITF on teacher technology efficacy in the integration of classroom instructional technology practices. Data collected from this study will add to the current body of knowledge of teacher technology efficacy and classroom technology integration. Additionally, it will offer insight into what impact services offered by the ITF have on teacher confidence when implementing technology into teaching practices.

Methodology

The research method for this study was a mixed-methods case study approach which was used to provide for a comprehensive understanding of quantitative survey data collected along with probing qualitative interview questions. For this case study, the convergence of quantitative and qualitative data resulting from a mixed-methods approach provided a stronger understanding of the research problem than either by itself

(Creswell, 2014, p. 215). The case study design allowed the researcher to gather data that provided a clearer understanding of teacher beliefs in their capacities to integrate instructional technologies into classroom practices as a result of the role of the school-level ITF.

Participants

A beginning-of-the-year survey designed to gather information regarding the level of teacher technology efficacy was presented to all certified staff at one middle school and one elementary school by the school administrators. The researcher used the data from this Likert-style survey as baseline data for this study on teacher technology efficacy. The schools participating in the study were chosen due to accessibility to the researcher, as the researcher currently serves those two locations as the school-level ITF. Approximately 60 certified staff from both schools participated in the pretreatment survey administered by the school principal. This case study examined the impact that the school-level ITF had on teacher technology efficacy during the 8-month treatment period (September-April). A posttreatment survey identical to the pretreatment survey was given to approximately the same number of certified staff in each school following the same protocol, but the response rate changed from 72% to 83% at the elementary school and from 86% to 72% at the middle school.

Interview samples were randomly chosen based on study strata. The interview participants were certified staff members from the two schools receiving the pre and posttreatment survey. The middle school administrator randomly selected two teachers from each of the following groups from the middle school: sixth grade, seventh grade, eighth grade, middle school exploratory (chorus, band, art, health, and physical education), and exceptional children. From the elementary school, the administrator

randomly selected two teachers from each of the following groups: K-2, 3-5, encore (music, art, guidance, media, and physical education), and exceptional children. Both administrators used observation data from Standard 4d of the North Carolina Teacher Evaluation Instrument as the guide for selecting teachers. Standard 4d establishes that observations of the following behaviors are indicative of an effective user of technology:

- Teachers integrate and utilize technology in their instruction.
- Teachers know when and how to use technology to maximize student learning.
- Teachers help students use technology to learn content, think critically, solve problems, discern reliability, use information, communicate, innovate, and collaborate.
- Teachers know appropriate use.

Observations throughout the course of the school year were used to sort all certified classroom, EC, Encore, and Exploratory teachers into two groups: frequent and effective users of technology and infrequent and ineffective users of technology. Each member of those groups was assigned a number. This number served as the identifiable association for data tracking of interviewed participants. All group member numbers were entered into a digital research randomizer, and the first entry from each group was chosen to represent each two-participant group in both the middle and elementary schools. When initially randomized participants declined the research study, numbers were digitally randomized again to select another participant.

Instruments

One of the surveys used for this study was the Computer Technology Integration

(CTI) Survey (Wang et al., 2004; Appendix A). This survey "determines one's confidence level with integrating technology into classroom teaching" (Farah, 2012, p. 55). Wang et al. (2004) used this survey in a similar study measuring preservice teachers' self-efficacy for technology integration (as cited by Farah, 2012, p. 55). The CTI survey consists of 21 statements using a 5-point Likert scale that ranges from 1=Strongly Disagree (SD) to 5=Strongly Agree (SA). As Farah (2012) stated, "all 21 items are positively and consistently worded with the initial stem of –I feel confident that" (Wang et al., 2004, as cited by Farah, 2012, p. 55). The CTI survey was developed by Wang et al. and was reviewed for both content and construct validity. The content validity of the instrument "was found to be convincing after a panel of experts in the area of self-efficacy reviewed the survey items" (Farah, 2012, p. 55), while "the evidence of construct validity is mainly empirical in nature (Wang et al., 2004, as cited by Farah, 2012, p. 55). Constructs measured by this survey include technology skills, technology strategies, technology standards, and other technology abilities. Permission to use this survey was obtained prior to the beginning of this study (Appendix B). Farah found that in a similar study, researchers found the CTI survey to be a valid instrument for measuring the constructs identified within the survey; and in the same study, "Cronbach alpha coefficients were calculated for both presurvey data and postsurvey data to determine the reliability of the instrument" (Wang et al., 2004, p. 236, as cited by Farah, 2012, p. 55). "The Alpha coefficients of .94 and .96, respectively, supported that the instrument was highly reliable and holds promise for its use in further research" (Wang et al., 2004, p. 236, as cited by Farah, 2012, p. 55).

The researcher developed a second survey to analyze the influence that the school-level ITF had over the change in answer frequencies from the pre and post CTI

survey data. Permission was obtained by the author of the CTI survey to modify the original in order to make instrument items similar (Appendix C). This survey was given after the post CTI survey was completed by participants.

Cluster sampling was used to identify the population for this study. Administrators from each school sorted every teacher from the following groups into two categories based on observations throughout the year: Elementary – K-2, 3-5, EC, and Encore; and Middle – 6, 7, 8, EC, and Exploratory. One group represented frequent and effective users of technology while the other represented less-frequent and less-effective users of technology. A random number was assigned to each group member, and a digital randomizer was used to select two representatives from each strata at the elementary and middle school levels. Volunteers from each of the strata answered interview questions at the school where they teach. The data room was the setting used for this process since it is routinely used for other meetings where teachers meet to discuss data with administrators and support personnel. Probing questions were asked on an individual basis to provide clarity for the researcher and were written into the interview protocol by the researcher.

Procedures

The research design was a mixed-methods case study approach involving two Likert-type quantitative survey and semi-structured, open-ended interview questions for the qualitative collection of data. The researcher contacted the district superintendent as well as the district director of technology to request permission to conduct the study (Appendix D). The researcher also contacted the principals at each of the study schools for permission to involve staff in the study. After approval from said parties, the researcher inquired of the superintendent the proper protocol for conducting research

within the school district. The superintendent served on the dissertation committee for the researcher and has access to all data and findings resulting from the study.

The CTI survey was given by principals at the beginning of the year for their professional planning purposes. Results from the presurvey results served as the baseline for this study. The presurvey was shared via Google Documents by way of teacher email. Data were collected digitally and were stored in Google Spreadsheet.

The postsurvey was administered by principals at the end of April. The survey was again presented via Google Documents by way of teacher email to maintain consistency of delivery and promote a high response rate for survey results.

A second survey was given after post CTI data were analyzed to measure the extent to which the school-level ITF impacted teacher technology efficacy during the 2014-2015 school year. The survey was presented via Google Documents as well by way of teacher email and was sent by school administrators. This survey was titled ITF survey and was used to measure the impact of the role of the ITF on teacher efficacy. Questions for the ITF survey were created to mirror the items on the CTI survey (Wang et al., 2004). Explicit permission for the modification of the CTI survey was obtained (see Appendix C).

The ITF survey was validated by experts in the field. The technology department in another school district carefully read the ITF survey items and provided the researcher with feedback indicating whether or not the Likert-scale questions elicited responses that related directly to the constructs of this study. Changes were made by the researcher according to this feedback.

A letter describing the study was shared with school administrators, and their voluntary participation in the postsurvey was requested and documented. Copies of this

letter were shared with the superintendent prior to the disbursement of the letter to principals.

A letter of consent was also given to proxy interviewers and potential interviewees. The consent form notified participants that all information collected was to be audio recorded and transcribed for accuracy. Handwritten notes in addition to multiple digital devices were used for recording to promote accuracy. The form also indicated that each participant would have the option to see a copy of his/her transcribed sessions before it was published and that his/her name would not be identified. All participant information was kept confidential and under lock and key until the researcher completed the study, and then it was destroyed.

Procedures for conducting the interviews considered the data collection via pre and postsurveys for intervention design at the sample schools. The results of said surveys were used to create interview questions to further validate survey results and to aid the researcher in understanding the research question. Twenty-six teachers were interviewed for this study. Demographic questions were also asked to assess other important variables of teacher efficacy such as the number of years of teaching experience and licensure level. The curriculum specialist from each participant site served voluntarily as a proxy interviewer because of their knowledge of both instructional and technological strategies as well as the trust relationship they had established with interviewees. An interview protocol was created that included the date, place, interviewer, interviewee, instructions for the proxy interviewer to follow to ensure consistency among various interviewees, questions to be asked (beginning with an ice-breaker), probing questions to ask as they arise in the conversations (may vary per participant), and a final thank you statement (Creswell, 2014). The use of a nonadministrative proxy for this process was

intended to reduce response bias from interview participants and to eliminate any feeling of evaluative pressure to the interviewee.

Data Analysis

This study used specific approaches for analyzing the data from the mixed-methods study. Response bias was monitored as survey results were reported. A Wave Analysis was conducted over the timespan for which each survey was open for completion (Creswell, 2014). School administrators established the timeline for completion. Each week, the researcher examined average responses on select items to see if there was significant change (Creswell, 2014). Descriptive statistics on the results of each of the constructs in the Likert-type pre and post CTI survey were analyzed to determine the overall self-efficacy of each of the study strata. This study did not proceed analysis beyond descriptive approaches since the participant sample is too small for inferential data analysis (Creswell, 2014).

The qualitative data for this study was audio recorded and transcribed. The researcher completed a content analysis of the results of the qualitative data. Individual responses to each question were studied to determine if there were any developing themes that led to information regarding the research question. Comparisons between teachers who were avid and infrequent users of technology were made using this data and were organized during the coding process.

Limitations

A limitation of this study is that only two schools were included in the data collection. Administrator support of this study may have helped ensure that participants would actively participate in the survey and that quantitative and qualitative data would enlighten the researcher to improve services to the schools. Additionally, Creswell

(2014) indicated that the interview process naturally yields potential limitations due to the fact that

> they provide indirect information filtered through the views of interviewees; they provide information in a designated place rather than in a natural setting; the presence of the researcher may bias responses; and not all people are equally articulate and perceptive. (p. 191)

The use of audio materials could have also made materials “hard to interpret” (Creswell, 2014, p. 192).

Chapter 4: Study Results

Introduction

The purpose of this case study was to examine how the role of a school-level ITF impacted the technology efficacy of teachers as they integrated instructional technologies into classroom practices in two rural, northwest region schools in North Carolina. This study focused on results from triangulated data in order to determine the level of impact of the school-level ITF on four distinct survey constructs: Skills, Strategies, Standards, and Other Abilities.

The Skills construct contained questions that evaluated teacher confidence in their basic computer capabilities, terminology, and classroom integration of technology. The Skills construct also assessed teacher confidence in evaluating and choosing appropriate classroom technologies. The Strategies questions evaluated teacher confidence in their abilities to apply classroom technologies in various ways as they were appropriate to student learning. Questions in the Standards construct were written to measure how confident teachers feel when applying integrated technologies to their curriculum standards; and the questions in Other Abilities measured teacher confidence in areas such as diverse learning, dealing with adverse attitudes towards technology, and capacity to become more capable with instructional technology over time.

At the beginning of the school year, the CTI survey (Wang et al., 2004) was given by administrators to certified staff at each school. After 8 months an identical posttreatment survey was again distributed by administrators to certified staff at each school. These surveys were used to quantify the level of teacher technology efficacy in each of the survey constructs at each point in time. Comparative data was gathered by analyzing differences in pre and posttreatment surveys. A separate survey (ITF survey)

designed to measure the impact of the role of the school-level ITF was given after the posttreatment survey in order to determine the extent that role affected changes in pre and posttreatment response frequencies. Finally, interviews were used to provide further clarity of the survey data and to more deeply explore the impact the role of the ITF had on teacher technology efficacy during the treatment period. To maintain confidentiality, participants were randomized using a digital number randomizer. Participants were identified numerically rather than by name. The researcher used proxy interviewers for the collection of the qualitative data and an independent transcriptionist for the transcribing of the interview sessions. A total of 26 interviews were conducted for this study.

Research Question

> What is the impact of the school-level ITF on teacher technology efficacy during the integration of instructional technologies at the sites chosen for this research study?

Participation Rate

Approximately 36 certified staff members were invited to participate in the pre and posttreatment CTI surveys at the elementary school involved in this study. At the middle school, there were also 36 certified staff members invited to participate. The survey link was forwarded via email to all full-time, certified teaching staff at both study sites by school administrators. Twenty-six of the 36 teachers invited to participate at the elementary school responded for a 72% response rate. The middle school response rate on the same survey was considerably higher at 86% where 31 of 36 teachers participated. The posttreatment survey link was also forwarded by administrators via email. The response rate on the posttreatment CTI survey at the elementary school was higher than

that of the pretreatment survey with 30 of 36 respondents for 83%. At the middle school, the response rate dropped from 86% to 72% with 26 of 36 participants completing the survey. The ITF survey that was forwarded via email by school administrators after the posttreatment CTI survey gained 21 of 36 responses at the elementary school for a 58% response rate and 22 of 36 responses at the middle school for a 61% response rate.

Surveys were quantified by assigning a Likert-scale point value to each possible response. Response descriptors were assigned the following values: 1=strongly disagree; 2=disagree; 3=neither agree nor disagree; 4=agree; 5=strongly agree. As completed surveys were analyzed, individual questions were coded first by survey construct in one of the following categories: Skills, Strategies, Standards, and Other Abilities; and then coded by percent agreement. Tables 6 describes the overall percent agreement for each of the survey constructs for both study sites on pretreatment CTI surveys.

Table 6

Overall Percent Agreement for Pretreatment CTI Survey Constructs

	Survey Constructs	N=	Percent Agreement 4=agree and 5=strongly agree N (%)
Elementary School	Skills	156	113 (72)
	Strategies	130	96 (74)
	Standards	130	79 (61)
	Other Abilities	130	99 (76)
Middle School	Skills	180	152 (84)
	Strategies	150	130 (87)
	Standards	150	119 (79)
	Other Abilities	150	136 (91)

Table 7 describes the overall percent agreement for each of the survey strata for both study sites on posttreatment CTI surveys.

Table 7

Overall Percent Agreement for Posttreatment CTI Survey Constructs

	Survey Strata	N=	Percent Agreement 4=agree and 5=strongly agree N (%)
Elementary School	Skills	180	149 (83)
	Strategies	150	122 (81)
	Standards	150	99 (66)
	Other Abilities	150	119 (79)
Middle School	Skills	156	130 (83)
	Strategies	130	104 (80)
	Standards	130	101 (78)
	Other Abilities	130	111 (85)

Table 8 describes the overall percent agreement for each of the survey constructs from both study sites on the ITF survey which was used to analyze the influence that the school-level ITF had over the change in answer frequencies from the pre and post CTI survey data.

Table 8

Overall Percent Agreement for ITF Survey Constructs

	Survey Constructs	N=	Percent Agreement 4=agree and 5=strongly agree N (%)
Elementary School	Skills	126	91 (72)
	Strategies	105	76 (72)
	Standards	105	64 (61)
	Other Abilities	105	77 (73)
Middle School	Skills	132	115 (87)
	Strategies	110	97 (88)
	Standards	110	88 (80)
	Other Abilities	110	95 (86)

While the response rates varied at each school and with each of the three quantitative measures, a considerable amount of data was collected by the total number of completed surveys. A total of 57 pretreatment surveys, 56 posttreatment surveys, and 40 teacher efficacy surveys were completed. From the participants completing those surveys, 26 interview candidates were secured for a 1:1 session with a proxy interviewer.

Survey Constructs

The CTI survey (Wang et al., 2004) contains 21 questions measuring teacher perception of their individual levels of confidence in various aspects of classroom technology integration. The survey questions are grouped into four constructs: Skills,

Strategies, Standards, and Other Abilities. Each subset of questions directly related to the overall construct and provided deeper understanding of teacher responses using Likert-scale values to quantify responses. As each category was analyzed, comparative data were collected by examining percent change from the pre and posttreatment CTI surveys. Supporting quantitative data were collected from the percent agreement per question on the ITF survey which was also quantified with Likert values.

Additional information was provided by participant interview data that were coded according to the four thematic survey constructs. Table 9 depicts the frequency counts of those themes as they were coded from each participant's interview. Beneath the numerical participant identifier are the years of teaching experience. Survey statements were coded as either positive (+) or negative (-) depending on the nature of the response. If participant responses exhibited significant confidence or ability in a particular construct, they were coded as +. Responses exhibiting significant discomfort or desire for further training in a particular construct were coded as -. Responses that were not demonstrably positive or negative were not coded. The + symbol indicated a statement of confidence or ability in one of the constructs. The - symbol indicated a statement of discomfort or desire to learn more in one of the constructs. Often, multiple codes were assigned for individual responses; for example, in the following statement, two Skill strengths and one Strategy strength were coded.

> Well, I'm comfortable with the basic stuff that we've talked about. I'm comfortable with going to the sources and resources that I have been using. I'm comfortable with the Smart Board (Skill Statement 1). I'm comfortable with the PowerPoint presentations (Strategy Statement 1). In PE, I'm comfortable with using the pedometers when we use them, and the audio and the technology that

> we have in the gym (Skill Statement 2). (Middle School Participant 1)

Skill Statement 1 was coded because it is a reflection of the teacher's confidence in using computer technologies in his classroom. Skill Statement 2 was coded because it is in reference to a second kind of technology that the teacher integrated into instruction. Strategy statement 1 was coded because the statement not only indicated that the teacher used PowerPoint software, but that he/she used it for presentation purposes in his/her classroom. Alternatively, the following response contained multiple (-) codes:

> Again, I would like to do some more projects, particularly in the health classroom (Skills Need Statement 1). I mean Phys. Ed, yes we can use them to do some research, but you know, we're also required to get so much physical activity time, so we don't want to take up a lot of time with it, especially in the health classroom setting, I think some projects that we can utilize the laptops a lot would be helpful (Strategy Need Statement 1). (Middle School Participant 1)

Skills need statement 1 was coded because "I would like to do some more projects, particularly in the health classroom" alluded to a teacher desire to learn more content specific technology integration. Strategy need statement 1 was coded because "especially in the health classroom setting, I think some projects that we can utilize the laptops a lot would be helpful" expressed the teacher need for ideas on how to utilize laptops for project-based learning in the health classroom. Additionally, within the table, bold type indicated that the participant represented the frequent and effective users of the technology group.

Table 9

Frequency Counts of Survey Themes by Participant

	Skills		Strategies		Standards		Other Abilities	
	+	-	+	-	+	-	+	-
P1 18 Years	4	5	7	0	2	0	0	0
P2 15 Years	3	2	5	0	2	0	2	0
P3 22 Years	1	1	1	0	1	0	0	0
P4 30 Years	2	0	7	0	1	0	3	0
P5 38 Years	3	1	1	1	0	0	0	0
P6 24 Years	4	1	5	0	1	0	2	1
P7 20 Years	3	1	5	2	5	0	3	0
P8 13 Years	2	3	5	0	3	0	1	0
P9 24 Years	4	1	4	1	2	0	2	0
P10 7 Years	6	4	7	3	2	0	0	0
P11 24 Years	6	0	4	0	2	0	0	1
P12 13 Years	1	1	6	0	2	0	2	0
P13 20 Years	1	1	5	1	0	0	3	0

(continued)

	Skills		Strategies		Standards		Other Abilities	
	+	-	+	-	+	-	+	-
P14 5 Years	1	1	6	0	1	0	4	0
P15 3.5 Years	0	1	7	0	0	0	2	0
P16 3 Years	2	1	6	0	1	0	2	0
P17 25 Years	0	1	9	0	0	0	3	2
P18 28.5 Years	0	1	11	0	0	0	0	0
P19 9.5 Years	2	0	7	1	1	0	1	0
P20 9 Years	3	0	5	0	1	0	1	0
P21 6 Years	5	2	5	0	2	0	2	0
P22 17 Years	3	3	3	0	0	0	0	0
P23 10 Years	1	2	4	0	0	0	3	0
P24 2 Years	2	0	7	0	1	0	5	0
P25 8 Years	3	0	9	0	1	0	3	0
P26 8 Years	3	0	6	0	0	0	4	0
Totals	67	33	147	9	31	0	75	4

The process of sorting into groups according to administrators' perceptions of technology effectiveness was based solely on observation data tied to North Carolina

Professional Teaching Standard 4d.

Skills

The Skills construct of the CTI (Wang et al., 2004) and ITF surveys contained questions specifically related to teacher confidence when selecting and using instructional software and hardware (Appendix A). The Skills construct contained six questions on both the CTI (Wang et al., 2004) and ITF surveys.

Table 10 displays comparative data from the pre and posttreatment CTI (Wang et al., 2004) survey Skills questions for the schools that participated in this study. M represents middle school responses, while E represents elementary school responses.

Table 10

Percent Change in Skills Questions from Pre and Post CTI Survey Responses

Elementary School	Pretreatment Percentage Agreement N=26 (%)	Posttreatment Percentage Agreement N=30 (%)	Change in Percent Agreement (%)
1. I feel confident that I understand computer capabilities well enough to maximize them in my classroom.	20 (77)	26 (87)	(10)
2. I feel confident that I have the skills necessary to use computers for instruction.	14 (54)	28 (93)	(39)
3. I feel confident that I can successfully teach relevant subject content with appropriate use of technology.	19 (73)	26 (87)	(14)
4. I feel confident in my ability to evaluate software for teaching and learning.	21 (81)	21 (70)	(-11)
5. I feel confident that I can use correct computer terminology when directing students' computer use.	19 (73)	22 (73)	(0)
6. I feel confident I can help students when they have difficulty using computers.	20 (77)	26 (86)	(9)
Totals	113 (72)	149 (83)	(11)
Middle School			
1. I feel confident that I understand computer capabilities well enough to maximize them in my classroom.	28 (93)	22 (85)	(-8)
2. I feel confident that I have the skills necessary to use computers for instruction.	29 (97)	20 (77)	(-20)
3. I feel confident that I can successfully teach relevant subject content with appropriate use of technology.	24 (80)	22 (85)	(5)
4. I feel confident in my ability to evaluate software for teaching and learning.	20 (67)	22 (85)	(18)

(continued)

Middle School	Pretreatment Percentage Agreement N=26 (%)	Posttreatment Percentage Agreement N=30 (%)	Change in Percent Agreement (%)
5. I feel confident that I can use correct computer terminology when directing students' computer use.	26 (87)	23 (88)	(1)
6. I feel confident I can help students when they have difficulty using computers.	25 (83)	21 (81)	(-2)
Totals	152 (84)	130 (83)	(-1)

Teachers feeling confident in the Skills construct responded with agreement on the Likert-scale questions regarding their understanding of computer capabilities, skill acquisition for computer-related tasks, ability to teach relevant subject matter with technology, ability to evaluate appropriate software and hardware for instruction, ability to use correct terminology when implementing technology in their classroom, and ability to help students experiencing technological difficulty. Table 11 displays comparative data from the ITF survey Skills questions from the middle (M) and elementary (E) schools.

Table 11

Percent Differences on ITF Survey

	Percentage Agreement M N=22 (%)	Difference in Percentage Agreement N (%) < less than or >greater than	Percentage Agreement E N=21 (%)
1. My school-level instructional technology facilitator helps me better understand computer capabilities well enough to maximize them in my classroom.	20 (91)	10 >	17 (81)
2. My school-level instructional technology facilitator has coached me in acquiring additional skills necessary to use computers for instruction.	21 (95)	14 >	17 (81)
3. My school-level instructional technology facilitator has provided training that has increased my confidence in teaching relevant subject content with appropriate uses of technology.	20 (91)	15 >	16 (76)
4. I feel more confident in my ability to evaluate software for teaching and learning as a result of the support given by my school-level instructional technology facilitator.	15 (68)	1 >	14 (67)
5. In working with my school-level instructional technology facilitator, I have obtained increased confidence and ability to use correct computer terminology when directing students' computer use.	20 (91)	29 >	13 (62)
6. The professional development opportunities offered by my school-level instructional technology facilitator have helped me feel more confident that I can help students when they have difficulty using computers.	19 (86)	19 >	14 (67)
Totals	115 (87)	15 >	91 (72)

On the initial pretreatment CTI survey, the middle school participants scored higher in agreement on all of the Skills questions with the exception of their ability to evaluate appropriate software and hardware for instructional use. Change in percent

agreement from pre and posttreatment CTI surveys indicate that middle school participants experienced the most growth in this area over the course of the case study, with an 18% increase in agreement in their confidence in their ability to evaluate and choose technological resources. Statements from qualitative analysis supported this leap. When asked which technology training had been most helpful at the middle school during the treatment period, Participant 1 responded with, "I think just the different ideas and maybe the use of some resources that we could go to, and get to utilize" was most helpful. Participant 4 from the middle school stated,

> Well, I've had help with Google Documents, help you know to make sure that I'm using that properly, because it's changed. Tagxedo (word cloud software) has been a big thing, and Plickers (online polling software) has been something I've used, and received help on.

Middle School Participant 7 indicated that "Looking at different sources online that we can use with students has been very helpful" and exhibited a confidence in this area when stating the following,

> As I've said before, we use it [technology] in multiple ways. There are certain areas of technology that you may think are more appropriate for someone. For example tools that I used in the elementary school, I may not necessarily be using in the middle school realm, but I as a teacher have to first of all test out that tool, and make sure it's going to be appropriate for classroom use. Try it out with the students. They're going to be very vocal about whether they like it or not. You're going to know immediately if it's a good tool to use, and how can you adapt that tool and use it to meet the goals you have for your instruction. I think as a professional you have to make that decision yourself.

This area was the weakest according to elementary school participant responses to the CTI surveys. From the beginning of the treatment to the end, their percent agreement decreased by 11%. Qualitative data clarifying the decrease in this question were identified in participant interviews. Participant 12 from the elementary school stated,

> I would like to be able to keep up with newer things that are coming out. Even with a degree in computer science, technology is constantly changing, and I think if opportunities or I guess professional development was offered for the newest things out, that would be helpful.

Additionally, when Elementary School Participant 14 was asked about what support he/she felt he/she needed to be able to select technology tools for projects in his/her classroom, he/she responded, "Just information about the different ways to use different types of technology for my specific grade level." Elementary School Participant 15 suggested that he/she would benefit from "knowledge of more kid-friendly websites"; and Participant 16 from the elementary school specifically noted that he/she would be "more confident if I had a little more training in some of the areas, like Google Drive, or some of the newer web-based tools."

In both schools, qualitative data themes were discovered to support the quantitative survey results. Interview respondents at the middle school level had an overall greater Skills presence embedded within the interviews transcribed there, while the elementary school respondents consistently mentioned that they would benefit from software or hardware specific training in their areas.

The greatest increase in percent change for the elementary school was for question 2 which stated, "I feel confident that I have the skills necessary to use computers for instruction." The posttreatment CTI survey indicated a 39% increase in agreement

from the pretreatment survey. Interviews indicated a particular confidence when using available hardware to integrate instructional technology into participant classrooms. Elementary School Participant 23 was asked to describe technology integration in his/her classroom and replied,

> I currently have two iPads, and we use them a lot during out math sessions. We have built stations that they are integrated into, and also during their reading zones, we have one zone set up with iPads that they do a type of graphic organizer on them.

Participant 24 from the elementary school also identified having a strong ability to evaluate and integrate educational software and hardware when asked about integrating technology into his/her classroom.

> Well, we try to use some sort of technology every day, whether it's the Smart Board, Document Camera, or we recently have been using iPads a lot. I use them in small groups. I use them to do projects for writing. I use the Smart Board to do Technology Retell, or to practice reading skills. We integrate it that way. We use whole group activities such as Plickers (online polling software).

At the middle school, participants responded with 97% agreement of their confidence in their ability to use computers for instruction on the pretreatment CTI survey and responded with 77% agreement after the case study treatment had been completed. Change for this specific skill represents a 20% decrease.

Both study sites responded with an 83% agreement overall in the Skills construct of the CTI survey. The 83% represented a 1% decrease at the middle school but an 11% increase at the elementary school. A total of three questions experienced a decrease in percent agreement from pre and posttreatment CTI surveys at the middle school, while

only one question experienced a decrease in percent agreement at the elementary school level. Of the 21 elementary school teachers who took the ITF survey at the elementary level, there was an average of 72% agreement on Skills construct questions that the school-level ITF had an impact on their confidence in this area. At the middle school level, 22 teachers took the ITF survey. There was an average of 87% agreement among Skills construct questions regarding the impact of the school-level ITF in this area.

Strategies

The strategies construct of the CTI (Wang et al., 2004) and ITF surveys contained questions specifically related to teacher confidence when applying selected instructional technologies in their classrooms (Appendix A). The Strategies construct contained five questions on both the CTI (Wang et al., 2004) and ITF surveys. Table 12 displays comparative data from the pre and posttreatment CTI (Wang et al., 2004) survey Strategies questions for the schools that participated in this study.

Table 12

Percent Change in Strategies Questions from Pre and Post CTI Survey Responses

Elementary School	Pretreatment Percentage Agreement N=26 (%)	Posttreatment Percentage Agreement N=30 (%)	Change in Percent Agreement (%)
1. I feel confident I can effectively monitor students' computer use for project development in my classroom.	21 (81)	21 (70)	(-11)
2. I feel confident that I can motivate my students to participate in technology-based projects.	22 (85)	23 (77)	(-8)
3. I feel confident I can mentor students in appropriate uses of technology.	13 (50)	28 (93)	(43)
4. I feel confident I can consistently use educational technology in effective ways.	18 (69)	27 (90)	(21)
5. I feel confident I can provide individual feedback to students during technology use.	22 (85)	23 (77)	(-8)
Totals	96 (74)	122 (81)	(7)
Middle School			
1. I feel confident that I understand computer capabilities well enough to maximize them in my classroom.	25 (83)	19 (73)	(-10)
2. I feel confident that I have the skills necessary to use computers for instruction.	28 (93)	23 (88)	(-5)
3. I feel confident that I can successfully teach relevant subject content with appropriate use of technology.	26 (87)	22 (85)	(-2)
4. I feel confident in my ability to evaluate software for teaching and learning.	25 (83)	19 (73)	(-10)
5. I feel confident that I can use correct computer terminology when directing students' computer use.	26 (87)	21 (81)	(-6)
Totals	130 (87)	104 (80)	(-7)

Teachers feeling confident in the Strategies construct responded with agreement on the Likert-scale questions regarding their confidence in the application of instructional technologies. Responses measured teacher confidence in effective monitoring of students during technology integrated projects, ability to motivate students in the use of technology for classroom projects, mentoring students in the appropriate uses of technology, ability to consistently and effectively integrate technology into instruction, and offering feedback during technology use (or with integrated technologies). Table 13 displays comparative data from the ITF survey Strategies questions from the middle (M) and elementary (E) schools.

Table 13

Percent Differences on ITF Survey

	Percentage Agreement M N=22 (%)	Difference in Percentage Agreement (%) < less than or >greater than	Percentage Agreement E N=21 (%)
1. As a result of working with my school-level instructional technology facilitator I feel more confident that I can effectively monitor students' computer use for project development in my classroom.	18 (82)	15 >	14 (67)
2. As a result of working with my school-level instructional technology facilitator I feel more confident that I can motivate my students to participate in technology-based projects.	20 (91)	15 >	16 (76)
3. As a result of working with my school-level instructional technology facilitator I feel more confident that I can mentor students in appropriate uses of technology.	20 (91)	20 >	15 (71)
4. As a result of working with my school-level instructional technology facilitator I feel more confident that I can consistently use educational technology in effective ways.	20 (91)	10 >	17 (81)
5. As a result of working with my school-level instructional technology facilitator I feel more confident that I can provide individual feedback to students during technology use.	19 (86)	19 >	14 (67)
Totals	97 (88)	16 >	76 (72)

On the pretreatment CTI survey, the middle school participants scored higher in agreement on all five strategies questions. Change in percent agreement from pre and posttreatment CTI surveys indicated that elementary school participants experienced the most growth in this area over the course of the case study, with an overall 7% increase in agreement in their confidence in their ability to apply and manage instructional technologies in their classrooms. Middle school participants responded with a 7%

decrease in agreement in the Strategies construct on the posttreatment CTI survey. Statements from qualitative analysis provide additional support of the quantitative results. Evidence of teacher confidence in the strategies section of the survey are found in participant data such as, “We have check-in points when they’re doing a project they check in with us at certain points within their project to make sure they’re following the rubric, and they are addressing all the standards they have to cover” (Elementary School Participant 25). When asked what kinds of technology-integrated activities seemed to motivate students most, Elementary School Participant 25 responded, “Projects. When they’re using the iPads or the laptops themselves to create something on their own . . . they ask to do it!” Participant 24 elaborated further on an application of technology that motivated student learning:

> I’m just going to keep trying to find new ways to do that [enrich student learning for students with a strong ability to use technology]. Like I just recently discovered a writing app that I can use for their writing. My kids have hated writing until this writing assignment, because we integrated this really fun technology.

This elementary school participant supported his/her claims by stating that “the apps that are on the iPad” motivated students most because “they really liked those.” Participant 23 from the elementary school responded with a confidence in gathering student data and providing feedback through the use of integrated classroom technologies. When asked how he/she had used technology to collect and analyze student data, he/she responded, “We use questioning games, and then it saves the data, so then you can see who’s getting it right then, or who is still struggling and needs help.” Motivational strategies were also mentioned by Participant 21 of the middle school:

> Activities [that motivate students] that are able to use Kahoot, which is a program of course that you can easily assess or formatively assess your students; activities such as New Path Learning, that provides individual lessons, where you can go in and of course set each individual student through their own achievement level, and they are able to follow different games and different learning activities to master the objective at hand; IXL.com and Mobymax.com are also fun math programs that give a change in the classroom that make math a little more up and moving and energetic where it eliminates the stereotype of the famous Ferris Bueller movie where you see the teacher with a monotone voice taking attendance, saying, "Bueller, Bueller?" And to me that is something that I never ever want to see myself as. I want to continue to grow, and I feel like with this generation, that these children are technologically driven, and they are going to continue to be.

Confidence in ability to offer student feedback through the use of technology was also a component of the Strategies construct that was identified in participant interviews. When asked how feedback was offered to students when they used technology in the classroom, Middle School Participant 20 stated,

> Monitoring, constantly monitoring and with the interactive programs it automatically does feedback, the two I mentioned previously [Kahoot and Edmodo], will tell them immediately. They know if they got it right or wrong. I used Google Docs a lot this year as well. They shared their documents with me, and I can put individual comments to them and they can reply back to me, and that worked well. They like being able to email me too.

Similarly to the Skills questions, qualitative data themes were discovered to

support the quantitative survey results. Interview respondents at the middle school had a greater "strategies" presence embedded within the interviews transcribed even though their post CTI score was 1% lower than the elementary respondents. The greatest increase in percent change for the elementary school was for question 3 which states, "I feel confident I can mentor students in the appropriate uses of technology." The posttreatment CTI survey indicated a 43% increase in agreement from the pretreatment survey. One example of mentorship was mentioned by Elementary School Participant 18:

> And if it's the student who is having difficulty, then we just talk with them, and see if it's just that they don't understand the question or the activity or directions that they're supposed to use, or if it's something that they just don't know, and then we would have to group them and reteach them.

Participant 24 from the elementary school also provided a response indicating mentorship during the integration of classroom technologies:

> We discuss you know, especially like if it's a new thing that we're doing, we'll just, you know, I'll go through the process, and we'll do practice rounds, and then we usually just try to discuss any questions that they might have. Was there something uncomfortable? Did they not understand how we answer questions? That kind of thing.

At the middle school, all five Strategies questions experienced a decrease in percentage but still maintained a higher percent agreement on questions 1, 2, and 5 than the elementary school.

The level of confidence expressed by participants in the Strategies construct of the CTI survey at the elementary and middle school were fairly close in percentage, with an

80% agreement at the middle school and an 81% agreement at the elementary school. Of the 21 elementary school teachers taking the ITF survey at the elementary level, there was a 72% agreement on Strategies construct questions that the school-level ITF had an impact on their confidence in this area. At the middle school level, 22 teachers took the ITF survey. There was an 88% agreement among Strategies construct questions regarding the impact of the school-level ITF in this area. When asked, "what training was most helpful," Middle School Participant 8 responded,

> I think the individual assistance that I have received beyond the workshops that was available, so that we were introduced to the material and discussed within the workshops as a group, but that our ITF was available to help us beyond that workshop, and actually implement some of the ideas for integration within the classroom.

Elementary School Participant 24 also mentioned that because of "working one-to-one with my technology person," he/she had gained the appropriate skills needed for the application of instructional technologies. Qualitative data exist to support ITF survey percentages; and while both middle and elementary examples were found, they were more frequent in middle school interviews.

Standards

The third construct of the CTI (Wang et al., 2004) and ITF survey was Standards. The Standards questions specifically measured teacher confidence when applying instructional technologies to their classroom curriculum standards. The Standards construct contained five questions on both the CTI (Wang et al., 2004) and ITF surveys. Table 14 displays comparative data from the pre and posttreatment CTI (Wang et al., 2004) survey Standards questions for the schools that participated in this study.

Table 14

Percent Change in Standards Questions from Pre and Post CTI Survey Responses

Elementary School	Pretreatment Percentage Agreement N=26 (%)	Posttreatment Percentage Agreement N=30 (%)	Change in Percent Agreement (%)
1. I feel confident I can regularly incorporate technology into my lessons, when appropriate to student learning.	19 (73)	27 (90)	(17)
2. I feel confident about selecting appropriate technology for instruction based on curriculum standards.	21 (81)	26 (87)	(6)
3. I feel confident about assigning and grading technology-based projects.	7 (27)	11 (37)	(10)
4. I feel confident about keeping curricular goals and technology uses in mind when selecting an ideal way to assess student learning.	17 (65)	20 (67)	(2)
5. I feel confident about using technology resources (such as spreadsheets, electronic portfolios, etc.) to collect and analyze data from student tests and products to improve instructional practices.	15 (58)	15 (50)	(-8)
Totals	79 (61)	99 (66)	(5)
Middle School			
1. I feel confident I can regularly incorporate technology into my lessons, when appropriate to student learning.	28 (93)	23 (88)	(-5)
2. I feel confident about selecting appropriate technology for instruction based on curriculum standards.	26 (87)	22 (85)	(-2)
3. I feel confident about assigning and grading technology-based projects.	20 (67)	16 (62)	(-5)
4. I feel confident about keeping curricular goals and technology uses in mind when selecting an ideal way to assess student learning.	24 (80)	23 (88)	(8)
5. I feel confident about using technology resources (such as spreadsheets, electronic portfolios, etc.) to collect and analyze data from student tests and products to improve instructional practices.	21 (70)	17 (65)	(-5)
Totals	119 (79)	101 (78)	(-1)

Confidence in the Standards construct was exhibited by responses of agreement on survey questions regarding the process of choosing appropriate technology to cater to classroom curriculum standards. Responses measured teacher confidence in using technologies appropriate to student learning, the selection of appropriate technologies based on curriculum standards, assigning and grading technology-based projects, using technology to assess students, and collecting and analyzing student data via technology tools. Table 15 displays comparative data from the ITF survey Standards questions from the middle (M) and elementary (E) schools.

Table 15

Percent Differences on ITF Survey

	Percentage Agreement M N=22 (%)	Difference in Percentage Agreement (%) < less than or >greater than	Percentage Agreement E N=21 (%)
1. The coaching that I have received from my school-level instructional technology facilitator has increased my level of confidence in regularly incorporating technology into my lessons when it is appropriate to student learning.	20 (91)	20 >	15 (71)
2. The coaching that I have received from my school-level instructional technology facilitator has increased my level of confidence in selecting appropriate technology for instruction based on curriculum standards.	19 (86)	19 >	14 (67)
3. The coaching that I have received from my school-level instructional technology facilitator has increased my level of confidence in assigning and grading technology-based projects.	16 (73)	16 >	12 (57)
4. The coaching that I have received from my school-level instructional technology facilitator has increased my level of confidence in keeping curricular goals and technology uses in mind when selecting an ideal way to assess student learning.	18 (82)	25 >	12 (57)
5. The coaching that I have received from my school-level instructional technology facilitator has increased my level of confidence in using technology resources (such as spreadsheets, electronic portfolios, etc.) to collect and analyze data from student tests and products to improve instructional practices.	15 (68)	16 >	11 (52)
Totals	88 (80)	16 >	64 (61)

Initial CTI surveys showed that middle school participants scored with higher percentages of agreement on all standards strata questions; but on the posttreatment CTI survey, the elementary school participants scored with higher percentages of agreement

on question 1 and question 2 which evaluate confidence in regularly incorporating appropriate technology into lessons when it is appropriate for student learning and confidence in selecting technology based on curriculum standards. Middle school respondents continued to answer more confidently on questions 3, 4, and 5 which evaluated participant confidence in assigning and grading technology-based projects, using curriculum standards to drive technological development in the classroom, and using technology to collect and analyze student data.

Change in percent agreement from pre and posttreatment CTI surveys indicated that elementary school participants experienced the most growth in this area over the course of the case study, with only one question experiencing a decrease—question 5, which regards the confidence of the teacher in using technology to collect and analyze student data.

Qualitative themes for the Standards construct were identified during the coding of interviews; however, Standards themes were coded less frequently than all other survey strata including skills and strategies. Most participants whose responses were coded in the Standards category alluded to the approach they followed when planning to use technology in their classrooms in ways that are appropriate to student learning. Several of the responses also described how accommodations to learning needs were met. The following statements from Middle School Participants 6 and 9 depict some of those approaches and accommodations.

> Well, everything that I will present on a daily basis is related to curriculum in one way or the other. It's not curriculum related, where I use textbooks as a tool or the computers as a tool. It's all going to be related to standards and Common Core, and again, anytime you can find the technology connection for the kids, the

> happier and more motivated they are to do it. (Middle School Participant 6)
>
> I make sure that all the lessons are aligned to the Common Core. There're no lessons taught that aren't. I make sure they're grade-level appropriate. Sometimes you have to go below grade level with certain students. You have to individualize and differentiate for them, and sometimes you have to go above grade level for students. For example, I teach 7th grade, but in IXL this year, I've assigned 7th-grade lessons, 8th-grade lessons, geometry lessons, and even some algebra I lessons that are actually a 9th-grade level, but that's what's in the 7th-grade curriculum. So it's just being very familiar with your curriculum will assure that your technology matches what you're teaching. (Middle School Participant 9)

When asked how they selected technology tools for projects in their classrooms, Middle School Participant 11 and Elementary School Participant 25 made it clear that they began with their curriculum.

> Actually I start with the curriculum and then I try to find pieces that integrate with whatever it is that I'm teaching so they will have a better understanding and a better grip on what it is I'm trying to get across to them. (Middle School Participant 11)

"Oh, whatever standard we're working on in our lesson, we try to incorporate that standard into the project that they're creating or that could be they're doing on the Smart Board" (Elementary School Participant 25). Middle School Participant 21 expressed how using technology with one aspect of his/her curriculum had changed the instruction of math by making it more "fun and interactive":

> With the help of my technology specialist (ITF). She is a lady that is very easy to

> approach. She is very fun filled, very, very intelligent as far as integration of technology into the classroom, or the individual disciplines themselves. When I came to (ITF) and spoke to her about how slope is one of the biggest topics of the 8th-grade math curriculum, we were immediately able to sit down and write out a course of the I Can statements that are needed to master that objective, and come up with ideas of course that are fun-filled and interactive for students in their integration of mastery of slope using technology.

Other Standards-based themes that arose included confidence in assigning and grading technology-based projects. Middle School Participant 10 gave an account of the kinds of research projects assigned in his/her classroom:

> We did a research project . . . and they were using their laptops, and they had parameters, but yet they didn't, in that I didn't say, "These are the only three things you can use," because everybody has a different subject. It has to be science or social studies for their research project, and then they had to have an outline and notes, and students were able to, instead of just looking for what I gave them, they found things that were of interest to them, and their papers have turned out so good compared to when I had them summarize an article in News-ELA, and they have cited their sources, and so I can go back and find . . . oh yeah, they didn't use Wikipedia. I had certain parameters, but they found good websites on their own. And to me it just showed an impact and that they are maturing. They're starting to be able to look for their own research, find their own websites, and I can think of one student for sure who has been struggling all year with computer issues and writing in general, and he had a really good paper and he did good. So I think giving them that little bit of freedom helped a little

bit.

The area least represented in this construct was question 5 regarding the collection and analysis of student data using technology. Most responses in this area reflected on the use of purchased software packages that give immediate scores and archive student data for teacher retrieval at later dates such as M-Class Reading 3D, which measures student reading ability at the elementary level; and IXL, which offers online content area lessons and assessments at the middle school level.

The question in the Standards construct that gained most percentage agreement at the elementary school was question 1: "I feel confident I can regularly incorporate technology into my lessons, when appropriate to student learning." There was a 17% increase in agreement on this question. At the middle school, question 4 gained the most percentage agreement with 8%. Question 4 states, "I feel confident that I can keep curricular goals and technology uses in mind when selecting an ideal way to assess student learning." On pretreatment surveys, the elementary school participants responded with 61% agreement to the Standards questions and the middle school participants responded with 79% agreement. Posttreatment CTI survey data showed that while the percent agreement per question had varied at the middle school, their overall percentage agreement remained higher at 78%. At the elementary school, percentage agreement on the posttreatment survey increased to 66%.

The questions within the Standards construct with the lowest posttreatment percentage agreement at the middle school were questions 3 and 5 with 62% on 3 and 65% on 5. Those questions measured how confidently teachers could assign and grade technology-based projects and use technology to collect and analyze student data. For the elementary school, question 3 regarding the assignment and grading of technology-

based projects held the lowest percent agreement with 27%. The low level of confidence in question 5 at both schools was exhibited throughout both quantitative and qualitative data for both schools. There were few frequencies coded in this area.

The average percent agreement on the ITF survey at the middle school was 80% for the Standards construct of the survey. Elementary respondents reported a 61% agreement. The Standards construct yielded a 19% discrepancy between percentage agreements of the two study sites. This is higher than the 15% discrepancy existing between study sites on the Skills construct and the 16% discrepancy on the strategies construct of the survey.

Other Abilities

Other Abilities was the final construct of the CTI (Wang et al., 2004) and ITF surveys. Comparative data from pre and posttreatment CTI (Wang et al., 2004) surveys is displayed in Table 16.

Table 16

Percent Change in Other Abilities Questions from Pre and Post CTI Survey Responses

Elementary School	Pretreatment Percentage Agreement N=26 (%)	Posttreatment Percentage Agreement N=30 (%)	Change in Percent Agreement (%)
1. I feel confident that I will be comfortable with using technology in my teaching.	23 (88)	27 (90)	(2)
2. I feel confident I can be responsive to students' needs during computer use.	21 (81)	25 (83)	(2)
3. I feel confident that, as time goes by, my ability to address my students' technology needs will continue to improve.	23 (88)	27 (90)	(6)
4. I feel confident that I can develop creative ways to cope with system constraints (such as budget cuts on technology facilities) and continue to teach effectively with technology.	16 (62)	19 (63)	(1)
5. I feel confident that I can carry out technology-based projects even when I am opposed by skeptical colleagues.	16 (62)	21 (70)	(8)
Totals	99 (76)	119 (79)	(3)
Middle School			
1. I feel confident that I will be comfortable with using technology in my teaching.	29 (97)	24 (92)	(-5)
2. I feel confident I can be responsive to students' needs during computer use.	28 (93)	22 (85)	(-8)
3. I feel confident that, as time goes by, my ability to address my students' technology needs will continue to improve.	30 (100)	24 (92)	(-8)
4. I feel confident that I can develop creative ways to cope with system constraints (such as budget cuts on technology facilities) and continue to teach effectively with technology.	21 (70)	18 (69)	(-1)

(continued)

Middle School	Pretreatment Percentage Agreement N=26 (%)	Posttreatment Percentage Agreement N=30 (%)	Change in Percent Agreement (%)
5. I feel confident that I can carry out technology-based projects even when I am opposed by skeptical colleagues.	28 (93)	23 (88)	(-5)
Totals	136 (91)	111 (85)	(-6)

Teachers responding in agreement in the Other Abilities section of the survey felt confident in their overall comfort when using technology, being responsive to students needs when using technology, ability to become more effective in using technology with experience, coping with budget constraints creatively in order to teach effectively with technology, and to overcome skeptical colleagues who are hesitant toward technology by continuing to carry out technology-based projects. In Table 17, comparative data from the ITF survey are displayed for the Other Abilities construct.

Table 17

Percent Differences on ITF Survey

	Percentage Agreement M N=22 (%)	Difference in Percentage Agreement (%) < less than or >greater than	Percentage Agreement E N=21 (%)
1. The support from my school-level instructional technology facilitator has helped me to become more comfortable with using technology in my teaching.	20 (91)	20 >	18 (86)
2. The support from my school-level instructional technology facilitator has helped me to become more confident in my ability to be responsive to students' needs during computer use.	20 (91)	19 >	15 (71)
3. As a result of the support given by my school-level instructional technology facilitator, I feel confident that as time goes by, my ability to address my students' technology needs will continue to improve.	21 (95)	16 >	18 (86)
4. The support from my school-level instructional technology facilitator has helped me to become more confident that I can develop creative ways to cope with system constraints (such as budget cuts on technology facilities) and continue to teach effectively with technology.	15 (68)	25 >	11 (52)
5. The support from my school-level instructional technology facilitator has helped me to become more confident that I can carry out technology-based projects even when I am opposed by skeptical colleagues.	19 (86)	16 >	15 (71)
Totals	95 (86)	13 >	77 (73)

Middle school survey responses indicated a higher level of agreement than those at the elementary school on the pretreatment CTI survey that was administered in September. The item with the largest discrepancy between study sites on the pretreatment survey was question 5 with a 31% difference. Question 5 measured teacher

ability to carry out technology-based projects even when opposed by skeptical colleagues. Results from the posttreatment CTI survey given in April yielded improvements in every question from the elementary school, and a decrease in all five questions for the middle school. The greatest improvement for the elementary school participants was for question 5 which ranked equally with question 4 for the area of lowest agreement in the pretreatment survey. According to posttreatment CTI survey results, middle school participants went from 93% to 85% agreement on question 1 (feeling comfortable when using technology in teaching) and from 100% to 92% on question 3 (addressing student technology needs more effectively over time), both indicating a decrease of 8%. Change in percent agreement from pre and posttreatment CTI surveys indicate that elementary school participants, once again, experienced the most growth in this area over the course of the case study. Middle school participants still retained a higher percentage agreement on both the pre and posttreatment surveys.

Responses indicative of Other Abilities were coded in participant interviews. The most common occurrence of the Other Abilities construct were statements describing responsiveness to student needs during the use of instructional technologies. Middle School Participant 19 described how technology helped him/her respond to students in her classroom:

> Like I said, in a self-contained classroom I've got students who are all over the map needs-wise, and technology really helps me to pinpoint having access to resources. I can really individualize totally made instruction for each kid, and it really helps me meet their needs no matter the subject.

Participant 4 from the middle school recalled a time when technology "really made an impact on a child":

> Well, I've got a special needs person in my room, and with him being able to turn in assignments via the computer, I believe I've had more success with him. It's made it easier for him, because writing things down, the task of that, is just more than he can do.

Middle School Participant 7 also described individualizing instruction with technology as a means of responsiveness to student needs but for enrichment as well as intervention:

> Well, as I mentioned before, we do independent studies with students who have mastered curriculum to allow them to extend their studies a bit further, and it also helps with students who may be struggling in certain areas. I can find review games. I can find activities online or that other teachers may have recommended to me that will help those students master the concepts they still need to master.

Participant 25 from the elementary school described how he/she was responsive to technological needs during instruction by stating, "We usually talk them through what they're doing or what steps they're at, and just reason through whatever their struggle is." Elementary School Participant 23 agreed that being responsive during the use of technology was effective if they "sat one-on-one with them (students)" and "worked through it."

Some participants mentioned system constraints that were usually monetary in some way as barriers to their integration of technology. Middle School Participant 11 stated that they "just didn't have the time" to "look up all these wonderful things, and websites, and programs that we've been shown with our teaching schedule." Elementary School Participant 17 responded with a similar response:

> Um, one of the reasons why I think teachers don't get to workshops is because we just don't have time. A lot of them are offered at the end of a day, and our days

> have to be very long in the school system, and I think it's really hard to pick ourselves up and learn a brand new thing like that at the end of a day, so I'm not sure how to fix that. But I think that's one of the reasons why we don't attack more.

Other issues related to lack of hardware. Elementary School Participant 13 stated,

> I feel that we have a good source of technology here at Elementary School. The only things I think is I would like to have more iPads. That's a problem. I only have one, and it's a lot easier to use the iPads than it is to use the Minis, and so sometimes there is a struggle with the Minis, getting them to operate correctly.

Elementary School Participant 18 responded similarly:

> I do not have a data projector or whatever. I don't have anything like that, but I do have other resources as far as technology, the computers in the classroom, and I do have access to laptops that I can check out for the kids, or iPads that I can check out for the kids to use, and we do that occasionally for activities that we do in the classroom. The other technology with the little iPads that the kids check out, I wish we could have more of those, and have them available, and probably, hopefully, we'll have that at some point.

Finally, the other coded theme found for this area was overall confidence for using classroom technologies. When asked how comfortable he/she was using technology in his/her teaching, Middle School Participant 8 responded that

> I'd say this year I'm really comfortable with using technology. I've always felt some gaps, and this year I think just by immersing myself in it and finding out more programs that I could use, Apps, attending workshops, working closely with the ITF, and also having the opportunity to present products that I was able to

> formulate or create that made for a really good experience, and I feel a lot more comfortable with it.

Middle School Participant 2 also identified with a high level of confidence when using technology in the classroom:

> I'm sure that there's always things that I can learn to do better, but I am very confident in my ability to use what's available to me now. There's not anything that I shy away from because I'm worried I can't do.

Middle School Participant 9 stated that over time, he/she felt he/she had become even more effective in the use of appropriate classroom technologies:

> Um, I think the more I use it, the more comfortable I'll get with it. It's to me personally, there's so much to pick from, I'm not sure where to start, but I know if I could ever find something that really works, and really draws students in, and promotes learning at the same time, I would really go with that.

Aside from the comment from Elementary School Participant 24 that "Yes, some like it and some don't" with regard to teachers who do and do not care for technology in their classrooms, there were no other responses that provided further insight into question 5 and the coping mechanisms teachers have developed to carry out technology-based projects among "skeptical colleagues."

Summary

The research findings from this case study were described in Chapter 4. The quantitative surveys along with the qualitative interviews provided a framework that allowed the researcher to analyze the research question. The Likert-scale survey responses and participant interview responses gave the researcher information regarding the impact of the role of the school-level ITF on teacher technology efficacy at two rural

northwestern North Carolina schools. In all, there were a total of four survey constructs that were later used for coding interviews thematically. The constructs were Skills, Strategies, Standards, and Other Abilities. Participant responses during interview sessions provided further clarity of both CTI and ITF survey results. A summary of those findings, conclusions, limitations of the case study, and recommendations by the researcher for further study are detailed in Chapter 5.

Chapter 5: Summary, Conclusions, and Recommendations

The purpose of this study was to assess the impact that the school-level ITF had on teacher technology efficacy in two public schools in northwestern North Carolina. Administrators at one elementary school and one middle school digitally shared the CTI Survey developed by Wang et al. (2004) to teachers at the beginning of the treatment period (September) and again at the end of the case study (April). The survey used Likert-scale results to quantitatively analyze teacher technology efficacy in four constructs: Skills, Strategies, Standards, and Other Abilities. Administrators also shared the ITF survey which was created using the same items from the CTI instrument and was rephrased to capture the effect of the ITF's impact on each question. Approximately 26 certified staff from each school were invited to participate in the surveys; and from that sampling, 26 interviews were conducted. This chapter provides an overview of supporting theory, interpretation of the findings, discussion of the limitations, implications for practice, current strengths and suggestions for the district instructional technology program, and recommendations for future studies.

Summary and Supporting Theory

Research by Guskey (1988) indicated that because teaching and learning is in an expeditious state of change, "new or alternative instructional practices" are required (p. 63). Often, "the decision about whether or not to try these recommended practices is generally a conscious one made by teachers, and it is important to understand what factors influence that decision" (Guskey, 1988, p. 63). Current research in instructional technology integration supports that there are four trending facets of successful technology integration: accessibility, professional development, vision and leadership, and teacher efficacy. According to Skoretz and Childress (2013), and founded on the

framework of efficacy built by Bandura (1977), teacher efficacy is “a strong predictor of whether teachers will translate the knowledge gained from professional development into instructional practice” (p. 462).

The intention of this study was to explore the technology efficacy of teachers in the four constructs (Skills, Strategies, Standards, Other Abilities) represented in the CTI and ITF surveys and then make connections about the impact that the school-level ITF had on teacher confidence in those areas. Bernadowski et al.’s (2013) educational applications of Bandura’s (1997) four influences on self-efficacy were integral practices at the sites participating in this study. Recent frameworks in efficacy were used as a lens for the research question in this study, as it is within these influences that teachers establish a sense of teaching efficacy. The implications of enactive mastery experiences include experiences with authentic teacher opportunities. Success in this area has much potential in establishing a positive teacher efficacy (Bernadowski et al., 2013). Vicarious experiences include observing colleagues, model lessons, and specific teaching strategies proven to be best practice with intent of using what is learned in one’s own instructional practice (Bernadowski et al., 2013). Receiving consistent feedback from administrators, support staff, and colleagues conveys confidence in individuals and improves teacher efficacy, therefore providing verbal persuasion (Bernadowski et al., 2013). Finally, physiological and affective states influence self-efficacy as feedback received from significant others in the educational setting drive teacher decision making and may trigger emotional responses (Bernadowski et al., 2013). These implications and others play a part in the technology efficacy developed by teachers.

The findings from this study were analyzed as critical components in understanding the research question, “What is the impact of the school-level ITF on

teacher technology efficacy during the integration of instructional technologies at the sites chosen for this research study?"

Interviews with the 26 participants of the study yielded information that allowed for an investigation of the level of technology efficacy of the teachers at participating schools. More specifically, it provided the opportunity to explore which practices of the school-level ITF provided the most desirable outcomes for teachers. The research question guided the study of teacher perception of their own confidence in their abilities with technology in the Skills, Strategies, Standards, and Other Abilities constructs of the CTI (Wang et al., 2004) and ITF surveys. It also served as the focal point during the analysis of participant interviews. Participant responses were explored, and the four constructs of the surveys were used as indicators of possible answers to the research question. The four constructs of the survey served as the thematic codes for the qualitative data.

1. Skills: computer capabilities, skillset acquisition for instruction with technology, using technology in content appropriate ways, evaluating software and hardware for its appropriateness to instruction, using correct terminology when using instructional technologies, and helping students to implement instructional technologies.
2. Strategies: monitoring students effectively during technology embedded project development in the classroom, motivating students to participate in technology-integrated projects, mentoring students on the appropriate uses of technology, consistently using instructional technology effectively, and providing individual feedback to students while they use classroom technologies.

3. Standards: regularly incorporating technology into lessons in ways that are appropriate to student learning, selecting technology based on curriculum standards, assigning and grading technology-based projects, keeping curricular goals and technology uses in mind when selecting an ideal way to integrate technology for student learning, and using technology to collect and analyze student data to improve instruction.
4. Other Abilities: comfortably using technology in teaching, responding to students' needs during technology use, continually addressing students' needs more effectively when using technology with time, creatively coping with system constraints that might limit technology use, and implementing technology-based projects in the midst of skeptical colleagues.

Within the responses coded in those thematic constructs, clues representing the effectiveness of the current practices of the ITF arose.

Interpretation of Findings

Research findings were discussed in the order in which constructs are presented on the CTI (Wang et al., 2004) and ITF surveys. The analysis of the research showed areas of strength and need in the current level of teacher technology efficacy at both study sites. Areas of strength and need were also identified in the current practices of the ITF, and connections were made between the efficacy of teachers and those practices. An additional analysis outside of the survey constructs was also made. Once the construct frequencies were coded, connections were made between responses and years of teaching experience among participants.

- Years of teaching experience varied greatly among participants identified as frequent and effective users of classroom technologies.

- Survey responses do not provide evidence that years of teaching experience determine how confidently participants responded in each category.
- Strategies was the most commonly found theme among interview data for both frequent and effective and less frequent and less effective users of classroom technologies.

It should also be noted that administrators did not use years of teaching experience as a criterion for gauging effective use of classroom technologies when teachers were sorted for interview selections.

Skills. Qualities most often shared by participants who felt efficacious in the Skills construct included pursuing skills needed to teach effectively with technology on their own based on self-interests, collegiality among team members that allowed for collaboration in planning for technology-based projects, and successfully implementing technology into specific content areas. Research supports that a higher level of teacher technology efficacy is crucial in fostering positive attitudes toward technology among classroom teachers, toward information technology in general, and in fostering positive attitudes toward technology in their students (Christensen, 2002).

The theoretical components of self-efficacy established in the literature review are the foundation of understanding the survey and interview responses collected by participants. Feeling confident in the capacity for choosing and implementing basic information technologies is important for teachers who feel comfortable using them. Often, teachers who are most uncomfortable with integrating technology in their classrooms are those who constantly struggle with it (Berrett et al., 2012). Teachers who do not believe they have the ability to implement technology practices are less likely to

try and do so.

When asked to describe ways that the school-level ITF could assist in the development of “skills” traits, interviewees often requested more 1:1 training of basic computer skills. Approximately half of the responses by participants regarding technology training mentioned that 1:1 training had had a positive impact on their confidence and ability to use technology or felt that if they had more 1:1 training, they would become more confident and capable users of technology. The most efficacious responses from interviewees implied that they would also like to maintain a 1:1 approach with the support coming from the ITF and for trainings to be based specifically on their individual need and at their own discretion as to when the support is given. Participants were asked, “What kind of technology training is best for you?” and “What has been the most helpful training for you this year?” Some of the responses supported a 1:1 professional development model. One teacher pointed out how large group professional development made her feel as though she was distracted by the pace of others around her.

> I like it one on one, although it is . . . one-on-one helps me because I get distracted by all the people around me, because we’re not at the same place, and you know we always have people in training that know and then they go on. (Middle School Participant 4)

Another teacher reflected on a situation where the school ITF provided 1:1 assistance and made an impact: “The Google Chrome help that the ITF gave me individually was most helpful, when I needed help with my computer doing IEPs” (Middle School Participant 5). The importance of content specificity was named as the highest priority in professional development for this participant:

> I would like to have it customized or personalized to what I teach, which would

> be math and somebody could show me specifically, "These are direct examples of how to embed technology into your lesson to maximize learning in your classroom." (Middle School Participant 21)

Participants who received 1:1 training this year from the school-level ITF also provided positive feedback regarding the sessions. One interview response was,

> Well, the ITF has worked with me more so in learning Google Doc stuff, because I've done some surveys, and she's helped me analyze the data and learn how to look at that, and how to get certain information from the surveys that I've given. Being able to see it and then use it where she's standing right behind me, watching me, and just building my confidence until I know what I'm doing has been most helpful to me this year. (Middle School Participant 3)

An English language arts teacher was asked about her 1:1 training experience with the ITF and responded that

> I think the individual assistance that I have received beyond the workshops that was made available to all of us has been helpful. We were introduced to the material and discussed within the workshops as a group and our ITF was available to help us beyond that workshop, and actually implement some of the ideas for integration within the classroom. That has helped me most. (Middle School Participant 8)

None of the interview responses indicated that "one-shot workshops" increased their abilities or confidence in the skills construct. Various reviews of professional development show that while this is often the most prominent form of training, it is far from the most effective (Gross, Truesdale, & Bielec, 2001; Lawless & Pellegrino, 2007; Moursund, 1989; Parsad et al., 2001). Some of the interviewees desired more follow-up

to individual training sessions, "pop-in" visits from the school-level ITF, and a greater overall presence of the technology facilitator in their classroom. One of the interviewees admitted that when trainings lacked follow up, it lowered the probably of his/her follow through with the instructional strategies that had been taught:

> When there is something that I feel like goes over my head I need somebody to be sure that I'm comfortable with the technology and check in to see what I am doing in my classroom, because if this is something that I'm not comfortable with and nobody ever follows up on it, I'm likely to let it fall by the wayside. (Middle School Participant 6)

One of the participants who teaches an exploratory STEM lab felt as though help would be more relevant to him/her if the ITF would spend more time learning about the unique aspects of the class:

> I think someone taking the time to research other programs, such as the function Edmodo was serving for me. Finding that and putting it out there for me to look at to see if it does the task, or maybe even someone in my room, seeing what I'm doing, and giving me some feedback while I'm doing it so I can make changes with the help. (Middle School Participant 2)

Studies have shown that students whose teachers receive focused, prolonged technology training significantly outperform students whose teachers have shorter, less frequent professional development opportunities (Valdez et al., 2000). Twenty participants responded positively with regard to the ongoing technology professional development that occurred at the study sites for the duration of the case study. In these 20 interviews, participants specifically stated some aspect of the professional development program that had made a positive impact on their practice or the student learning in their classroom.

This finding was especially important to the research question since studies show that the "extent to which teachers are given time and access to pertinent training to use computers to support learning plays a major role in determining whether or not technology has a positive impact on student achievement" (Valdez et al., 2000, p. 6).

Teachers responding with an apparent low level of technology efficacy in the Skills construct commented that "there was much more to be learned" or that they would like "more basic computer training." One of the participants identifying with a low level of efficacy stated,

> On a scale of 1 to 5, 1 being the least comfortable, 5 being the most comfortable, I'm probably about a 2.8 because I'm not as technologically savvy as I ought to be, but it's not by preference. It's just that sometimes I don't latch onto the technology. (Middle School Participant 6)

Another commented on the fact that he/she needed to learn more about technology but lacked the confidence to do it on his/her own:

> I think there's a lot more I could do, but I'm not confident enough to do it. I mean most of the time the teacher operates the Smart Board, and she does the PowerPoints for me in terms of moving it and doing this, that, and the other. So I don't do that part of it. (Middle School Participant 3)

Feeling inadequate in the use of instructional technologies has shown a direct correlation to a lack of using them (Farah, 2012). In other words, feeling unable to manage or face the challenges that often remove teachers from their instructional comfort zones increases the probability that teachers will choose not to implement available technologies throughout the day (Guskey, 1988; McLeod et al., 2012). Those with low efficacy also appeared to undervalue the use of instructional technologies in their

classrooms by referring to how they would use it at times when “it was easy” for them or when they felt they would be monetarily rewarded for attending training sessions. The likelihood of implementation decreases when teachers do not find value in the extra time and effort needed to successfully integrate new instructional technology strategies (Guskey, 1988). Few teachers identified with a low level of technology efficacy directly; however, some of the interviews alluded to a low skillset and capacity to use technology effectively in the classroom; and because research shows that the ability to use technology effectively is so closely connected to one’s confidence in doing so, it was concluded that those teachers were not very efficacious users of technology.

Finally, there were consistent responses from elementary school participants regarding a lack of hardware availability in their school. Some interviewees indicated that the available hardware had problems prohibiting effective use, while others cited that there were not enough devices. One teacher stated, “I do wish that we had more computers available to share amongst the grade level, so I could do more things with computers” (Elementary School Participant 15). Another elementary teacher replied that

> I would like to have more iPads. That’s a problem. I only have one, and it’s a lot easier to use the iPads than it is to use the minis, and so sometimes there is a struggle with the minis, getting them to operate correctly. (Elementary School Participant 13)

A similar response corroborated the issues with the “minis”: “I’m pleased with the laptops we have. Unfortunately they’re broken a lot, which limits the amount of whole group activities that we can do with those. And I would love to have more of those than I’ve had” (Elementary School Participant 12).

Budget constraints that restrict the amount of technology brought into the district

are viewed as a type of barrier that keeps teachers from "capitalizing on the educational potential offered by technology resources" (Brinkerhoff, 2006, p. 22). First-order barriers such as lack of hardware, which teachers have little or no control over, often cause teachers to be reluctant to implement new technology in their classrooms (Ertmer, 1999; Patter, 2009). While this particular barrier had a direct impact on the level of integration of the Skills construct, it is also directly related to the Other Abilities construct which measures how effectively teachers can cope with system constraints in order to overcome fiscal or facility shortcomings.

Strategies. One of the most prominent themes emerging from within the Strategies construct was with regard to the teachers' abilities to motivate students with the use of instructional technologies. Eight participants from both the elementary and middle school specifically mentioned that the "game-like" aspect of much of their available technologies (iPad Apps, Web 2.0 Tools, Smart Board applications) increased student motivation in their classrooms. When describing the excitement offered by the technologies used in their classroom, one participant described "games" as what motivated their students:

> Something that they can be interactive with, especially with the games that are created, they get excited, and a little overly excited at times, doing that. And they do like the things that I pull up, especially from Discovery Ed, and YouTube and you know, whatever is going along with what we're studying. They like that. (Middle School Participant 11)

In another study, student accounts of their use of iPads for instruction reported higher levels of active engagement in the classroom (Chou et al., 2012). Teacher accounts supported those student claims and asserted that there was "100% on task" behavior

during those learning experiences (Chou et al., 2012, p. 21). A response from an elementary school participant of this study found that the students engaging with iPads instructionally often asked, “is it iPad time yet?” and that they were “most motivated” by that particular form of technology (Elementary School Participant 17). The student-centered climate of learning offered by technology allows students to take ownership of their work and to exhibit innovative strategies when accomplishing learning tasks (Kay & Honey, 2006; Liu, 2013).

Another common theme regarding student motivation mentioned by interviewees was that the provision of choice offered by instructional technologies motivated students to participate in class and improved their overall experience with the learning. One response specifically stated that students are more excited and more motivated when they have a choice in what they are doing:

> When students have the opportunities to explore their interests they seem motivated. When they can create based on their interests. For example, a writing activity on animals where they were doing a PowerPoint and they could choose photos and they could make it look however they wanted. Instead of it being very laid out and teacher directed, it was more student choice. (Elementary School Participant 12)

Helping students to navigate their own learning and building positive attitudes around the use of technology is a skill exhibited by teachers with high levels of technology efficacy (Christensen, 2002). One teacher response specifically stated a discomfort with the student independence yielded by technology:

> Sometimes, I am going to be very honest, my trust level with my students to go on to a Weebly (web hosting service) and do exactly what they should isn’t there yet.

> I'm a little anxious sometimes that I will give an assignment, and they may or may not be where they need to be to do it. And that's a real fear that I have that I can't watch every screen at every time. And just to be honest with you, that scares me a little bit sometimes. (Middle School Participant 9)

The interview with this teacher revealed a hesitancy to try new innovations in his/her classroom for fear that students would digress from classroom expectations. Once again, the importance of teacher efficacy in the ability to apply new instructional strategies was demonstrated throughout the interview process. More often than not, teachers participating in interviews for this study seemed to share an appreciation for the potential effects of technology on student achievement and made attempts to capitalize on those effects.

The most common student monitoring strategy used by teachers during the integration of instructional technologies was informal observation. When asked how teachers monitored for student understanding, interviewees consistently responded that they walked around the room and watched the progress of their students. Specifically, teachers looked for "confused looks" on students' faces and to see "who was just sitting there doing nothing." Effective classroom management and organization when using technology is a trait exhibited by teachers with high levels of technology efficacy; and in classrooms where students are well behaved and engaged in an organized environment, student success is a more likely outcome (Allinder, 1994; Caprara et al., 2006; Raudenbush et al., 1992; Ross, 1998a, 1998b). The most common responses indicating mentorship for those students who struggle during technology use involved sitting down with the teacher or teacher assistant for 1:1 instruction or grouping students needing extra help with students who seemed to have a better understanding of the technology being

used.

Individual student feedback was represented in various ways in interview data. More efficacious users of classroom technologies used digital forums for student feedback such as blogging, student email, and online document sharing. For the teachers responding that they used those forms of technology for student feedback, it was an integral and ongoing part of their classroom practice. None of the teachers exhibiting low levels of technology efficacy reported using these digital communications for feedback in their classrooms. Perhaps the most unique aspect of individual feedback that arose as part of this construct was from one of the teachers identifying him/herself as highly efficacious in the use of technology. This participant used student email accounts made available by the district to provide feedback to students because students had expressed gratitude for the confidential nature of that form of communication:

> Well with Google Docs, I can insert comments, and they receive those immediately. I email students if they've emailed a piece of technology to me. I'll respond to them by email. On the blogs, I will respond to their blog, so it's always immediate feedback. I try to monitor that daily and allow the students . . . well, first of all it allows me to see whether or not they've mastered those concepts that I've set forth for them, but address any questions that they may have that they may be sending to me privately. (Middle School Participant 7)

Specifically, the teacher noted that technology had greatly encouraged collaboration in her classroom, not only between students but between instructor and students.

Being able to communicate with students "safely" without fear or embarrassment from peers made a big difference in the feedback occurring in this classroom:

> I like that they can actually send me an email sometimes when they're concerned.

> If they're worried about something and they don't want to say it out in front of class, they will type you a little email. I know of course that it could be seen by everybody, but they like being able to ask questions by email is safe. They will sometimes say to me, "Could you just email my mom? I don't want you to call her on the phone." So they feel a sense of security knowing that they can ask you questions by email. (Middle School Participant 10)

Technology-enabled feedback was most effectively given by teachers demonstrating high levels of technology efficacy in their classroom. Studies consistently connect teacher beliefs about their own abilities to use technology effectively in their classrooms and to potentially impact student achievement with what actually occurs (Rakes et al., 2006).

Finally, the Strategies construct measured teacher ability to consistently use technology effectively in the classroom. Once again, teachers more efficacious in the use of technology consistently reflected upon more innovative and effective technology integration strategies in their classrooms. The interview responses from efficacious participants were rich and included multi-faceted explanations of technology-based projects and rationales for use founded upon student need and instructional appropriateness. While only six teachers identified themselves as having a very high level of efficacy and only five identified themselves as having a very low level of efficacy, the researcher identified six additional teachers as having high technology efficacy based on the content of their interviews. Additionally, the researcher was able to identify seven other teachers whose interview transcriptions reflected mid- to low-level confidence when using technology in their classrooms by looking for terminology such as, "I am fairly confident" or "Out of a 10, I would say I am a 6 or 7" (Middle School Participant 11). Two interviewees were categorized as having unidentifiable levels of

efficacy due to a lack of substantial interview evidence.

Of the six teachers ranking themselves as “highly confident” or “very comfortable” when integrating instructional technology in their classroom, five responded that the training, coaching, and professional development offered by the school-level ITF had been “helpful” and “very beneficial” to their practice. One of the interviewees stated that

> the person [ITF] had observed my room, saw something that they thought would fit some of my curriculum, and some things that I had talked about with my kids, and was looking to help me get that. So that’s the kind of thing [training] that I think really works. It’s almost like, “Yeah, that’s great. I wish I’d thought of that.” (Middle School Participant 2)

The interviewee who did not specifically name the ITF as an important factor in establishing his/her confidence was licensed in a special area; and due to scheduling conflicts, there were limited training sessions made available to this participant throughout the year. Studies confirm the importance of the role of the ITF in establishing “active knowledge gathering and productive participants” of technology integration in the classroom (Pelgrum, 2001). The perception of the highly efficacious interviewees on the role of the school-level ITF appeared to be that the position was “integral and important” to their daily practices (Elementary School Participant 24). In addition, in the interviews these participants contended that the role of the ITF initiated positive instructional changes within their classrooms, which is a crucial leadership aspect of the position (North Carolina Public Schools, 2013).

Standards. For this construct, appropriateness to student learning refers to teacher confidence when connecting instructional technology to the curriculum designed

for the specific grade level or content area being taught. This skill as well as the ability to consider curriculum while weighing appropriate technology integration are inextricable to the connection of curriculum and instructional technology. Evidence that teachers are able to comfortably connect technology to student learning by beginning with a careful review of the curriculum insinuates efficacy in this construct. All of the teachers interviewed discussed the importance of connecting the technology to the curriculum. Every interview contained some kind of example of how technology was being utilized within the content or subject area being taught in participant classrooms.

The integration of the TPACK model was evident in the majority of interviews as the merger of technology, pedagogy, and content knowledge was described (Mishra & Koehler, 2006). Dede (2000) argued that the most important component of the technical evolution of curriculum is the way we use technology to "aid students in extracting meaning out of complexity" (p. 299). Teachers who exhibited high levels of confidence in the Standards construct mentioned how they cited their classroom curriculum to design authentic learning experiences for the students in their classroom:

> Well you have to know your curriculum first and foremost. And you have to know what is expected of those students, and then you as a professional have to decide which of these technology tools, if any, are going to best suit the needs of this specific standard, of this goal in my curriculum. And then you just have to make those decisions as each lesson presents itself. What works for one will not necessarily work for another. (Middle School Participant 7)

Many of these experiences were project-based and involved a myriad of technology-integrated activities. Teachers exhibiting lower levels of confidence still incorporated technology into their curriculum but preferred prealigned materials suggesting how the

integration of technology and curriculum should occur. Five participants explicitly named experiences in which they used technology for student authorship and creation of learning products. Other instances of student authorship might be assumed from some of the other responses dealing with “presentations” created by students but were not specifically named. One teacher specifically mentioned how technology had benefited his/her writing curriculum by engaging students in a content area in which they had previously found very little interest. Another reflected on how he/she had placed a great emphasis on the use of technology in his/her language arts classroom and had been able to offer real-world connections to classic texts that might otherwise have little meaning to students. One middle school participant referred to a lesson on blues music:

> I was doing a unit on Blues Music as a nonfiction and textural feature, learning experience, and we went beyond that with a global article on musical artists, and the monetary aspect of it is that they’re not making much money at all. So the kids used the Weebly to interact with that article and put their opinion onto a blog that was embedded into the Weebly. And that gave them a form of discussion, and they could discuss back and forth, and then we came back together in the whole class and discussed the issues of the music field and why or why not they would go into that field. Some of the problems, solutions, and conflicts within the field were discussed. (Middle School Participant 10)

The assignment and grading of technology-based projects is also a part of the Standards construct that was represented throughout participant interviews. Six interviewees described specific project-based activities facilitated in their classrooms that integrated instructional technology. Most of those projects involved the process of (1) student as researcher, (2) student as creator, and (3) student as presenter or teacher of

mastered content.

> Students enjoy creating, they enjoy presenting information in a format they would like to, whether it's a PowerPoint, or Prezi, or slideshow—it's whatever they enjoy being creative in, particularly in math. Math is so cut and dried, and it's either right or wrong, and the chance to be creative in math doesn't come along as it does so easily in other subjects. (Middle School Participant 9)

Research has shown that teachers with higher levels of efficacy are more effective in teaching for student mastery learning and they are more capable of facilitating student achievement (Guskey, 1981, 1982, 1987, 1988; Tschannen-Moran et al., 1998). This process is evidence of teacher advocacy for authentic learning opportunities in their classrooms. Teachers who cited these kinds of learning experiences in their classrooms were highly efficacious in this construct and felt confident in their ability to manage and implement those opportunities in ways that would excite and motivate their students. One participant specifically noted his/her belief that his/her confidence in implementing the technology creatively "spills over" and creates higher levels of student confidence when using technology, which is also a concept supported by Christensen's (2002) study on the importance of increased teacher efficacy. The third accepted hypothesis that resulted from Christensen's study is that positive teacher attitudes towards information technology foster positive attitudes in their students. The experiences described by teachers with high levels of efficacy in the Standards construct illustrate that they are functioning at the higher levels of the SAMR model (Puentedura, 2009). Operation in the lower levels of the taxonomy was common for teachers who felt low levels of technology efficacy, as they tended to linger in the substitution phase of the model. One participant specifically stated that they used their interactive white board as a means of display with

an overhead projector. Simply substituting one form of technology for another did not show high levels of instructional confidence or effectiveness when integrating technology and it does not elicit student-centered learning (Chou et al., 2012).

When asked about the collection and analysis of student data, most elementary school participants referred to the use of software purchased by the district. Reading 3D, which is software for measuring reading ability, was the most prominent example given in the elementary school interviews; while IXL.com, which provides online content lessons and assessments, was the most common example given in the middle school interviews. Technology applications that could save and archive student data appealed to the majority of interviewees.

Other Abilities. The dominating theme arising from the Other Abilities construct was teacher ability to address student needs with and during the use of technology in the classroom. The use of technology as a means of differentiation to meet student learning needs was coded in 12 interviews. Universal Design Principles for Learning is a framework supporting students with diversities (Rappolt-Schlichtmann et al., 2013). Being able to provide access to hardware was mentioned as a barrier for some elementary teachers in this study, but none of the participants found learning diversity as a barrier for integrating instructional technology; they found the integration of technology to be "a prescriptive approach" to meeting the needs of students in their classrooms (Middle School Participant 9). Rappolt-Schlichtmann et al. (2013) found "access to materials and tools" to be an important advantage of digital technologies but contended that Universally Designed Learning offered another level of advantage—access to learning for all students (p. 1211). Lawless and Pellegrino (2007) maintained that sustaining a teaching force equipped to use technology effectively to support student learning would be more

difficult than providing the hardware for 21st century learning. While the literature review established that hardware and software components of some technologies are limiting in visual, auditory, and tactile appeals (Nevile, 2005), the interviewee responses for this study found that available technologies addressed a variety of these modalities very well. One teacher reflected on an experience of a child in her second-grade classroom who engaged in voice recording to learn the life cycles of frogs. Being able to "record it and hear it back" really helped the student learn the concepts (Elementary School Participant 17). Another teacher mentioned that doing podcasting with the students in his/her classroom was an effective strategy because students could "just hear themselves" (Middle School Participant 7). An interview from a participant at the elementary school reflected on how technology had made a "true impact" on a student with a learning disability in his/her classroom:

> Well, I have had a student before with autism, and he really engaged with the iPad we had in the classroom, and when he had a hard time focusing on other things we were doing in the classroom, he really engaged with the iPad and used that as his academic support to grow his skills. (Elementary School Participant 14)

A middle school participant also described a time when being able to collect student work digitally made the student more successful because the task of keeping an agenda and handwriting all of his assignments was too difficult for him. The consensus of the teachers participating in this study is that technology was making a positive impact on student learning in their classrooms; more specifically, on addressing learning differences that might otherwise contribute to a widening achievement gap. According to the Universal Design Model, the approach taken by these teachers to increase student achievement with innovative strategies develops and reinforces pedagogy as it is building

into the active learning process (Rappolt-Schlictmann et al., 2013). Studies indicate that students whose needs are accommodated using the Universal Design Principles are more successful than their peers (Lewthwaite, 2011). Additional support in favor of the practices evidenced in participant interviews came from Rappolt-Schlictmann et al.'s (2013) study finding that

> When technology is used to foster a supported learning environment in which the emphasis is on core learning activities, with strong teacher experience and embedded support for construct-irrelevant skills and strategies, technology can provide consistent gains for a variety of learners. (p. 1223).

Conclusions

Four constructs (Skills, Strategies, Standards, and Other Abilities) were investigated in determining the degree of impact of the role of the ITF on teacher technology efficacy. Elementary teachers who participated in the CTI (Wang et al., 2004) survey maintained a higher percentage agreement in the Skills construct than in the other three survey constructs. Middle school teachers held a higher percentage of agreement in the Other Abilities construct. The elementary school participants consistently scored with lower percentages of agreement than the middle school but showed the most growth from pre to posttreatment CTI surveys. While the middle school participants tended to score higher percentages than the elementary school participants, they experienced less growth over the treatment period of the case study. In two of the four constructs (strategies and other abilities), the middle school participants actually reported with decreased percentage agreement for every question.

The ITF survey percentages were consistently higher in the middle school where the ITF met during the school day with all certified teachers every other Wednesday for

technology professional development. At the elementary school, ITF survey percentages were lower and training sessions were not consistently scheduled into the school day. Optional after-school sessions were offered every other Thursday. Additionally, the ITF was scheduled to work at the middle school 3 days a week and 2 days a week at the elementary school.

Implications for Practice

If teachers are to obtain higher levels of technology efficacy, they need specific, learner-centered support from the school-level ITF. While limited research exists on the impact that the role of the ITF has on teacher efficacy, conclusions can be drawn from the theoretical framework of Bandura (1977) regarding self-efficacy. Other works such as those from Bernadowski et al. (2013) which connect Bandura's (1977) framework to its implications on innovative classroom practices should be used to ensure effective teacher support.

Professional development opportunities encouraging the effective use of instructional technologies should be offered in various configurations based on the needs of the adult learners involved. ITFs should design their professional development to accommodate the desired training experiences of the teachers they serve. Beginning- and end-of-year surveys offer helpful data in establishing what kinds of services would benefit the teachers in the school and then assessing the impact of those services. In establishing the professional development model for the school, it could be beneficial to the rigor of the sessions for scheduling to accommodate a substantial and consistent amount of time dedicated to the trainings. In instances where scheduling accommodations cannot be met, it is crucial for the ITF to maintain a positive rapport with classroom teachers and to be seen as available when assistance is needed. Some

participant responses indicated that they experienced higher levels of confidence in integrating classroom technologies when they knew they had the full support of the school-level ITF.

Providing relevant, current, and content-specific examples of classroom technology integration is also beneficial in building greater teacher technology efficacy. This study found that teachers were more likely to attempt suggested practices in their classrooms when new concepts could be implemented immediately. Having an exact idea of where and how to use instructional technologies boosted the confidence of some participants according to their interview responses. Districts could support this need by developing initiatives encouraging the collaboration between the curriculum specialists and ITFs. The merger of curriculum and technology would provide the kinds of pertinent and engaging instructional ideas required for developing more efficacious teachers.

While most hardware issues were reported by elementary school participants, it is important to recognize that the lack of appropriate hardware poses a barrier for technology integration, therefore hindering instructional opportunities that might increase teacher technology efficacy (Ertmer, 1999, 2005; Patter, 2009). Another first-order barrier to technology integration is the lack of time teachers feel they have in order to prepare for innovative classroom practices (Ertmer, 1999, 2005; Patter 2009). For example, one participant in this study responded that because the school day was extended at the study site, they felt as though they did not have time to attend after-school professional development opportunities. The response indicated that scheduled technology professional development built into the school day would be beneficial in eliminating that barrier.

Regarding teacher technology efficacy, results of this study inferred that each

teacher had his/her own specific expectations of the role of the ITF and how it could most benefit their practice. Those needs should be pursued by the ITF if he/she wishes to build positive relationships with teachers that foster a collaborative culture of learning and risk-taking in the classroom. Establishing this relationship could encourage the confidence needed for teachers to implement more innovative and technology-integrated strategies.

Findings of this study were consistent with the research on technology integration.

1. Teachers are more likely to implement new instructional strategies when the expectations of those strategies are clearly and specifically presented (Guskey, 1988, p. 63).
2. Teachers are more likely to implement new instructional strategies when they are aligned with the current teaching practices and philosophies of the teachers (Guskey, 1988, p. 63).
3. Teachers are more likely to implement new instructional strategies when they estimate the extra time and effort exerted for the new strategy to be worth the potentially yielded benefits (Gusky, 1988, p. 63).
4. Teachers are more likely to implement new instructional strategies when they perceive them as important in their classrooms (Sparks, 1983).
5. Teachers are more likely to implement new instructional strategies when they feel as though they can manage the level of difficulty of the new task(s) (Guskey, 1988, p. 63; Sparks, 1983).

The qualitative data are consistent with this research, as the same barriers to implementation and teacher confidence arose throughout the interviews in all four survey constructs. More specific recommendations for the school-level ITF are to individualize training for each teacher to the extent possible, provide relevant and content specific

examples of how proposed technology strategies can be implemented immediately in classrooms, and be available for the follow-up support and coaching in technology-integrated instructional practices.

In summary, teacher technology efficacy is most effectively built by the school-level ITF when teachers feel that their individual, specific needs have been accommodated during professional development. As much as possible, districts employing ITFs should develop a plan to ensure that the professional development programs in technology are consistent with the research on self-efficacy and the implications of efficacy on technology integration. It would benefit districts for ITFs to use pre and postsurvey data to inform them of exact teacher needs and assess the impact of services on teacher efficacy. Practices that do not produce positive outcomes should be reevaluated, redesigned, or changed altogether. The increased focus on teacher technology efficacy will likely produce more efficacious teachers who are more willing to implement innovative and authentic instructional strategies in their classrooms.

Limitations

This study was designed to identify the impact of the role of the ITF on two rural northwestern North Carolina schools—one middle and one elementary. A limitation of this study would be whether or not the findings are consistent in other environments such as urban settings or high schools. Another limitation of this study is that the sample size only included two schools due to the assignment of the researcher. Had the study been more inclusive of schools within the district, more in-depth conclusions may have been drawn. Additionally, because the practices of only one ITF were implemented during the treatment period, comparisons cannot be made on various impacts to teacher technology efficacy.

The results are limited to the self-reported measures of technology efficacy of teachers and may have produced findings different from what actually occurs in classrooms. Due to a small sample size of interview participants, interviewees may have been concerned that their identity was not concealed from the researcher even though various efforts were made to protect their confidentiality. The services of two proxy interviewers and a licensed transcriptionist helped to ensure participant anonymity, but some reflections in interview responses yielded identifiable information. Finally, because the researcher was also the ITF for the schools participating in this study and a proxy had to be used, the depth of responses may have been limited.

Strengths of the Program and Recommendations for Improvement

From study results, certain strengths in the current ITF program were identified by interview participants. These critical practices employed by the district and exhibited by the ITF made notable positive impacts on teacher technology efficacy.

1. The 1:1 support that was offered by the ITF during professional training sessions gave teachers more confidence to implement innovative instructional practices integrating technology.
2. Teachers viewed the ITF as a person who could provide current and engaging ideas for instructional technology use in their classrooms.
3. Creating, modeling, and implementing instructional technologies effectively for teachers gave them the confidence to do so themselves in the future.
4. Technologies that are made available at the study sites motivate students to engage in learning experiences and empower students to take the lead in their learning.

Multiple teacher responses from both study sites indicated a higher level of

success with the integration and effective use of available technologies when the professional development was delivered in a 1:1 setting that was tailored specifically to the needs of a single teacher. Teachers who received the specific support offered during these sessions reported a positive impact on their confidence and teaching abilities. When Elementary School Participant 24 was asked, "What kind of staff development or professional training has given you the skills to make instructional decisions when using technology in your classroom," he/she responded, "Working one-on-one with my technology person." Middle School Participant 21 was asked, "How do you plan to grow in your use of technology in your classroom next year?" and responded by goal setting based on the 1:1 technology training he/she had received:

> I am going to focus more on my Weebly (web hosting service), and create pages for the 8th grade math curriculum, such as systems of equations, coordinate pairs of graphs, and volume. The Weebly page that I have that the ITF helped me create is much easier to upload course documents to than my original wiki page. It has a much more inviting background. It has a much more inviting climate too, as opposed to the wiki, which is just a front page and class notes. The Weebly goes farther than that.

Wright et al. (1999) alluded to the importance of meeting teacher needs when stating that

> Although technology development continues to move at a rapid rate, scholars will have consistent challenges in assessing issues related to productivity, effectiveness, performance outcomes, and assessment. Technology administrators must consistently match technological advances with evolving institutional, student, and faculty needs. (p. 1)

During the interview process of this study, elementary and middle school

participants noted their confidence in the technological and pedagogical guidance offered by the ITF. Patter's (2009) research suggested that the role of the ITF is to give teachers the support they need in order to use instructional technologies effectively. Almas and Krumsvik (2008) found that oftentimes what teachers are doing and why they are doing it may be absent or difficult to articulate, therefore the school-level ITF should help teachers establish that rationale. Elementary School Participant 18 reflected on new practices he/she has been able to put into place as a result of that guidance:

> We used to use Turning Points Clickers. We don't really use the Clickers much anymore, but we do the new activity that our ITF showed us. The ITF showed us new technology that we could use with the Smart Board, Plickers (online polling software). I've also used the QR Reader that was shared with us by the ITF, and selected some activities that the children could use the iPads to go around and scan those. That made it really fun for the children to be able to do that. So I've integrated those two activities this year. The QR codes are really, really effective, and they give variety to change it up a little bit. The training on these activities has been beneficial, because without the training we wouldn't have had a clue as to how to get them started. I am pleased with the activities that the ITF has provided for us to learn new aspects of instruction. The ITF has kept us up-to-date on new technology as it has become available for us. The ITF is really good to help us troubleshoot problems that we have with those technologies as well.

Middle School Participant 8 also reflected on new instructional strategies he/she had put into place as a result of the support from the ITF:

> Technology integration in my classroom this year has been very successful. I decided to switch from using a wiki interface in my classroom to a Weebly, and

> the ITF has been beneficial to me in helping me to start that process, and offering some suggestions with the layout. That Weebly is used for instructional purposes, to create resources for students, to look beyond assignments and also to engage them with forums, such as Tri-Ciders (online polling software) and other opinion collecting software to get them interested in the classroom.

Another strength identified of the instructional technology program at the study sites was the creation, modeling, and implementation of effective technological and pedagogical practices in the classroom by the ITF. ISTE established that ITFs should "plan, design, and model effective learning environments and multiple experiences supported by technology" (Williamson & Reddish, 2009). Middle School Participant 4 reflected on his/her experience with the ITF:

> It was more of a one on one thing, because I would find out about things, and then I would go and ask and I would get the ITF to help and he/she would help me do it, integrate it into my class or implement it in my class.

Similarly, Middle School Participant 5 reflected on another time when the ITF modeled the effective implementation of technology: "The ITF went into a class and did some technology with the whole group. It was called TedEd. The ITF helped them with research and that was wonderful!"

The final notable strength of the instructional technology program at the study sites was that the majority of participants from the elementary and middle school felt as though technology motivated and inspired the students in their classrooms to learn. Middle School Participant 8 was asked to explain how technology helped him/her respond to student needs in the classroom and responded,

> Well going back to different styles of learning, I think it provides the opportunity

> to meet kinesthetic and auditory learning challenges. Students seem to be more engaged. They have a natural inquisitive nature to research, and if they have that tool that they're interacting with in the classroom, which is something very socially norm for them at this age, then I think that helps to meet some learning gaps within the classroom.

Elementary School Participant 18 described the kinds of technology-integrated activities that seemed to motivate his/her students most:

> Anytime that they can use that Smart Board, they love it! It engages them, and I have other students who are waiting for their turn, I have those children who sit and watch because their turn is coming up soon.

Study results also yielded specific recommendations for the district ITF program based on needs and weaknesses mentioned by participants during interview sessions. If fulfilled, the recommendations could assist school-level ITFs in meeting the expectations of the North Carolina Department of Public Instruction's expectations of the school-level ITF which include (1) planning and facilitating teaching and learning, (2) planning and facilitating information access and delivery, and (3) planning and facilitating program administration. Those recommendations are as follows:

1. ITF schedules should be designed to accommodate the daily schedules of teachers so that more 1:1 professional development can occur with consistent follow up.
2. Consideration should be given for more equitable distribution of instructional technologies.
3. A cohesive instructional design is needed for technology trainings so that professional development is content relevant to teachers.

While many responses indicating a positive experience in 1:1 training with the technology facilitator were found in interview data, some responses indicated a need for more of this kind of professional interaction. The reason for this need appeared to be the result of scheduling incompatibilities between the classroom teachers and the school ITF. At the middle school, the ITF met with classroom teachers every other Wednesday during common planning times. Exploratory (art, band, chorus, health/PE, STEM, and technology) teachers had a split planning shared with their lunch period; therefore their professional development sessions on Wednesdays were often cut short or cancelled altogether. At the elementary school, the ITF was only available 2 days a week and could only be part of the grade-level meetings that were scheduled on those 2 days. Other grade levels were unable to share a single common planning time with the ITF all year. Participant accounts from the elementary and middle school attribute the lack of adequate planning with the ITF to a lack of time. When asked what the "perfect technology training would be for him/her," Middle School Participant 22 responded,

> The facilitator coming into my classroom and seeing, because music is slightly different than the classroom teachers' use of technology. Coming into my classroom and observing my class and maybe offering ideas of how I could better integrate technology with my curriculum to help engage the students would be best.

Middle School Participant 2 stated that he/she would like training sessions when he/she "had more time to think about it, and didn't have the pressures of everything else" because he/she "would probably do a better job." When asked if there was anything the participant would like the researcher to know regarding his/her classroom technology practices, Elementary School Participant 17 responded with regard to a lack of time for

attending professional development sessions:

> Um, one of the reasons why I don't think teachers get to workshops is because we just don't have time. A lot of them are offered at the end of a day, and our days have to be very long in the school system, and I think it's really hard to pick ourselves up and learn a brand new thing like that at the end of a day, so I'm not sure how to fix that. But I think that's one of the reasons why we don't attack more.

Middle School Participant 10 reflected on being new to the district and discussed what he/she felt was needed in order to help increase technology effectiveness in his/her classroom:

> I want somebody right beside me to hold my hand. Because it just gives you the confidence, when somebody else has already done it, and then you don't feel so bad about it, so it's probably what I need the most . . . just having spent my first year in the district . . . being able to have time to sit down one-on-one and say, "Here's what I need." I think that would have helped me a lot this year.

In addition, Middle School Participant 11 mentioned the overall lack of time as a barrier for technology integration in his/her classroom:

> I would like more time in order to look up all of the wonderful things we are introduced to in training. The websites and programs that we've been shown. You know, with our teaching schedule we just don't have the time.

Perhaps additional time with the ITF would allow the extra time needed to help this teacher feel more capable of harnessing the benefits that newly introduced technologies have to offer. The individualized professional development sessions were prioritized as one of the most needed aspects of the technology program at the study sites. Research

supports that finding. Studies indicate that teachers are more likely to integrate technology into their curriculum when they have knowledgeable technology support personnel who can give them instructional guidance and emotional support (Patter, 2009; Pearson, 1994; Persky, 1990). It would be of benefit to the instructional technology program for administrators and district technology program leaders to advocate for scheduling that more equitably places ITFs in schools so they are accessible to more teachers more often. Scheduling that allows for the curriculum specialist and ITF to have some common planning with every teacher at various times throughout the school year would increase the quality of the technological and pedagogical soundness of the professional development being offered. One possible scheduling solution might be a rotating rather than fixed schedule for the ITF.

Another need mentioned in participant interviews from the elementary level was the lack of student devices needed for integrating the kinds of innovative strategies being explored during professional development sessions. When referring to iPad use in the classroom, elementary school participants expressed that students got “excited” when they were able to incorporate the tablets into their learning. Only having one or two iPads per class poses a major barrier to the implementation of more of those exciting learning opportunities. While five iPads were mentioned as being available for check-out through the media center, the participants desired having more devices per student in their own classrooms. At the middle school level, participant reflections were much more detailed when describing the way that technology allowed students to become creators of their own learning experiences. A 1:1 model of student laptops helps middle school teachers provide those kinds of opportunities for students. Middle School Participant 19 specifically mentioned how the 1:1 initiative at the school impacted daily

learning in his/her classroom:

> Well, of course at our school each student has their own laptop, and I also have a teacher laptop with a Smart Board, and it's something that I've grown so accustomed to now, it's just part of everyday life. We use the Smart Board for almost every lesson, and of course their laptops, they're constantly doing research, word processing, presentations, and things like that.

While elementary teachers noted the availability of grade-level carts of mini computers that could be used at assigned times throughout the day, their preference remained with the tablets. The U.S. Department of Education's Educational Technology Plan (2010) agreed that providing the appropriate student devices is a key for improving classroom learning:

> Advances in technology and the learning sciences have made "on-the-fly" individualization of the curricula possible in practical, cost effective ways, and many of these technologies have built in supports, scaffolds, and challenges to help learners understand, navigate, and engage with the learning environment. (p. 9)

Without availability to the right hardware, those "on-the-fly" experiences will fail to thrive.

The third and final recommendation for the instructional technology program is for district and school administrators to establish a vision of technology professional development that is instructionally sound and strongly rooted in classroom content. ITFs and curriculum specialists could collaborate to provide those professional development sessions for teachers. According to Earle (2002), the curriculum being implemented in our schools should be the "vehicle for technology integration" (p. 12) and that technology

should be "woven into the fabric of learning" (p. 12). Cuban (1986) established that technology professional development should be the way teachers are taught how to make technology fit their curriculum and not the other way around. This study's findings also found that teachers desire to be taught technological strategies that have clear implications for their curriculum goals. Participants of this study expressed a need for technology professional development to offer ideas that could be immediately implemented in the classroom. Middle School Participant 21 expressed his concerns in this area:

> To me a perfect example for technology training would be (1) you go into the training session and when you leave you know exactly what the objective of the professional development was; (2) You have examples you are able to use in your classroom, and you of course have been fully trained and not partially trained on the objective or subject matter at hand; (3) You have of course, an instructional technology facilitator that is very interactive with teachers as far as helpfulness, answering questions about Weebly's, wiki pages, document cameras, etc. They also show you the new and fun filled interactions that of course are the most innovative ways to bring that into your curriculum; (4) You are able to take what you learned at the professional development and apply it into your curriculum very easily. It is not a matter at hand that I'm looking for where I am going to integrate this. Where is it going to slide in easily? To me a very, very awesome professional development session in technology ends with you knowing where you're going to be able to implement the things you were taught, and how easy it is going to be for you to do so.

This participant and others desired for technology professional development to have clear

connections to their classroom curriculum. Rand (2001) stated that "teachers need to learn ways to integrate technology into their regular lessons, activities, and assessments and see new possibilities rather than treating technology as an end in itself or an add-on" (p. __). In order for this to happen, administrators need to lead the vision of technology integration in their schools. When administrators "create and maintain an atmosphere that is conducive to open and honest communication among teachers technology integration will be more effective" (Berrett et al., 2012, p. 203). Administrators should prioritize these kinds of training experiences for teachers so that they are ensured the kind of support they require to confidently and effectively teach with technology (Cakir, 2012, p. 275).

These strengths and needs were evidenced in the responses of participants who interviewed for this study. The current instructional technology program has some definite strengths that already contribute to an increase in teacher technology efficacy and effective implementation of instructional technologies. The recommendations, however, if followed, could yield much more positive results for the program by increasing teacher technology efficacy even more and encouraging an even greater effectiveness during integration.

Suggestions for Future Research

The methods of this study analyzed the impact of the role of the school-level ITF in two schools. There is a need to examine teacher technology efficacy in various schools within districts so comparisons of teacher efficacy in teachers with different ITFs can be made. Districts should also attempt to measure teacher efficacy at the beginning and end of the school year to gauge the continued effectiveness of the services of the ITF. Additionally, this study only evaluated the results of the impact of a single ITF's services

over the course of the treatment period. It did not take into consideration past ITFs or previous technology professional development sessions that might have been a contributing factor to increased levels of technology efficacy.

Teacher technology efficacy was self-reported through the CTI (Wang et al., 2004) survey. Valuable comparisons could be made between teachers' self-reported levels of technology efficacy and perceptions of school administrators on teachers' levels of technology efficacy. It would also be beneficial to evaluate the extent to which teachers' perceptions of their own levels of technology efficacy is consistent with other indicators of technology efficacy such as student motivation and success during technology-based projects and frequent and effective use of innovative technology practices in their classrooms.

The role of school administration in fostering the development of teacher technology efficacy was not addressed by this study, but research indicates that strong administrative vision of technology integration in schools is the "single most important factor affecting the successful integration of technology" (Bryom & Bingham, 2001, p. 4). Therefore, in order to assess the impact of the school administrator on teacher technology efficacy, a similar study could be conducted to gain additional perspectives in efficacy.

Additionally, there is a need to replicate this study in other environments such as urban area schools or rural high schools in order to gain a wider perspective of the findings. Finally, a study comparing schools with a 1:1 initiative to schools where technology is less common might also show variations in the effect of the ITFs as their roles would differ according to the hardware available in the schools. Comparisons could be made between the findings of this study and those of different environments.

Conclusions based on additional findings could provide further evidence for the necessary practices of the school-level ITF.

Summary Statement

School technology leaders such as the ITF have a great deal of responsibility in helping make sure that teachers integrate technology effectively within their classrooms (Cakir, 2012). Studies like this and others (Gulbahar, 2007; Kim & Hannafin, 2011; Liu, 2013) have found that technology improves student learning when it is implemented in ways that enhance instruction. For this reason, it is important for school-level technology facilitators to act as change agents to promote the successful implementation of technology. According to the North Carolina Public Schools (2013), it is the role of the ITF to intentionally serve as a resource to classroom teachers (Patter, 2009). This study was intended to contribute to a limited body of research regarding the impact the role of the school-level ITF had on teacher technology efficacy and is important since others "may not understand the full range of what technology professionals do or why technology facilitation and leadership is a critical component of school improvement" (Williamson & Reddish, 2009, p. 25).

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Appendix A

CTI Teacher Survey

Appendix A

Computer Technology Integration Survey

Direction:

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

Below is a definition of technology integration with accompanying examples:

Technology integration:

Using computers to support students as they construct their own knowledge through the completion of authentic, meaningful tasks.

Examples:

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

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

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

1.	I feel confident that I understand computer capabilities well enough to maximize them in my classroom.	SD	D	NA/ND	A	SA
2.	I feel confident that I have the skills necessary to use the computer for instruction.	SD	D	NA/ND	A	SA
3.	I feel confident that I can successfully teach relevant subject content with appropriate use of technology.	SD	D	NA/ND	A	SA
4.	I feel confident in my ability to evaluate software for teaching and learning.	SD	D	NA/ND	A	SA
5.	I feel confident that I can use correct computer terminology when directing students' computer use.	SD	D	NA/ND	A	SA
6.	I feel confident I can help students when they have difficulty with the computer.	SD	D	NA/ND	A	SA
7.	I feel confident I can effectively monitor students' computer use for project development in my classroom.	SD	D	NA/ND	A	SA
8.	I feel confident that I can motivate my students to participate in technology-based projects.	SD	D	NA/ND	A	SA
9.	I feel confident I can mentor students in appropriate uses of technology.	SD	D	NA/ND	A	SA
10.	I feel confident I can consistently use educational technology in effective ways.	SD	D	NA/ND	A	SA
11.	I feel confident I can provide individual feedback to students during technology use.	SD	D	NA/ND	A	SA

12.	I feel confident I can regularly incorporate technology into my lessons, when appropriate to student learning.	SD	D	NA/ND	A	SA
13.	I feel confident about selecting appropriate technology for instruction based on curriculum standards.	SD	D	NA/ND	A	SA
14.	I feel confident about assigning and grading technology-based projects.	SD	D	NA/ND	A	SA
15.	I feel confident about keeping curricular goals and technology uses in mind when selecting an ideal way to assess student learning.	SD	D	NA/ND	A	SA
16.	I feel confident about using technology resources (such as spreadsheets, electronic portfolios, etc.) to collect and analyze data from student tests and products to improve instructional practices.	SD	D	NA/ND	A	SA
17.	I feel confident that I will be comfortable using technology in my teaching.	SD	D	NA/ND	A	SA
18.	I feel confident I can be responsive to students' needs during computer use.	SD	D	NA/ND	A	SA
19.	I feel confident that, as time goes by, my ability to address my students' technology needs will continue to improve.	SD	D	NA/ND	A	SA
20.	I feel confident that I can develop creative ways to cope with system constraints (such as budget cuts on technology facilities) and continue to teach effectively with technology.	SD	D	NA/ND	A	SA
21.	I feel confident that I can carry out technology-based projects even when I am opposed by skeptical colleagues.	SD	D	NA/ND	A	SA

Appendix B

CTI Survey Usage Permission

From: Ling Wang <XXXXXXXXXXXXXX>
Sent: Sunday, August 17, 2014 12:10 PM
To: Karri Adams
Subject: RE: CTI Survey Permission

Dear Karri,

Please feel free to use the survey in your study.

Best of luck!

Ling

Ling Wang, Ph.D.

Professor of Graduate School of Computer and Information Sciences

Nova Southeastern University

XXXXXXXXXXX

Appendix C

CTI Survey Modification Permission

Ling Wang <xxxxxxxxxxxx>
Mon 2/9/2015 12:21 PM
To:
Karri Adams;
You forwarded this message on 2/10/2015 8:17 AM.
Karri,

Yes, it is ok to modify the survey so it better serves the purpose of your study.

Good luck!

Ling

Appendix D

LEA Agreement for Research

Jan 20

Marty Hemric

to me

Hello Mrs. Adams

I have an understanding of your research topic/intent and hereby grant approval for your research to be conducted in the XXXX County Schools.

Good luck!

Marty T. Hemric