CLASSROOM TECHNOLOGY INTEGRATION: A COMPARATIVE STUDY OF PARTICIPANTS AND NON-PARTICIPANTS IN THE 21ST CENTURY MODEL CLASSROOM PROGRAM

A dissertation presented to the faculty of the Graduate School of
Western Carolina University in partial fulfillment of the
requirements for the degree of Doctor of Education

By

Darrell Grady McDowell

Director: Dr. Ellen A. Sigler
Associate Professor
Department of Psychology

Committee Members:
Dr. Kathleen Topolka-Jorissen, Educational Leadership and Foundations
Dr. Robert Crow, Psychology

February 2013

ACKNOWLEDGEMENTS

I would like to thank Dr. Ellen Sigler, who provided continuous encouragement and expertise. Her support enabled me to engage in this challenge with confidence and persistence. I would also like to thank Dr. Kathleen Topolka-Jorissen for her enthusiastic motivation, high expectations, and sound judgment. Dr. Robert Crow's understanding of technology and his creative insight enhanced the writing of the proposal and this dissertation as well.

Colleagues that have helped facilitate this project include: Beth Walton, an outstanding retired educator, for her contributions with editing; Kimberly Martin, for her extensive knowledge of the school system's 21st Century Model Classroom program; and Natalie Wittich and Brandi Osborne, for their numerous contributions and their integration of technology within the classroom setting.

Finally, I would like to express my heartfelt thanks to my wife, Lisa, and our three children. They have been patient and considerate of the time and effort involved in my participation with this program.

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ABSTRACT

CLASSROOM TECHNOLOGY INTEGRATION: A COMPARATIVE STUDY OF PARTICIPANTS AND NON-PATICIPANTS IN THE 21ST CENTURY MODEL CLASSROOM PROGRAM

Darrell Grady McDowell, Ed.D.

Western Carolina University (February 2013)

Director: Dr. Ellen A. Sigler

This study provided a unique opportunity to examine how two groups of teachers experienced the integration of technology in a K-12 school system in the southeastern United States. The total number of respondents (n=338) included 21st Century Model Classroom (CMC) program teachers (n=27) and non-participants (n=311). Teachers in the 21st CMC program were given advanced technology equipment and relevant professional development. The non-participants received less training and had limited access to advanced technology equipment. Guskey's (2000) "Five Levels of Professional Development Evaluation" was combined with technological pedagogical content knowledge (TPCK) (Harris, Mishra, & Koehler, 2009) to create a survey for comparing the two groups. Cronbach's (1984) "alpha measurement" of internal consistency revealed a score of α=.911 for the questionnaire; hence, the quantitative survey was found to be highly reliable. Many similarities were found among the respondents. However, significant differences were found on nine of the forty-four quantitative survey items. Effect size measurements were also calculated for those nine items. Open-ended survey items yielded rich qualitative data. More than two-thirds of all respondents surveyed were positive about their access to professional development and technology equipment. They were equally optimistic in their overall beliefs about integrating technology in the classroom. The data and the views of the teachers provided exclusive information for improving instruction through technology integration. *Keywords: quantitative, qualitative, professional development, technology integration, collaboration, constructivism, teacher beliefs, engagement, leadership*

CHAPTER ONE: INTRODUCTION

Technology developers, school leaders, and grant providers have encouraged the rapid progression of technology integration in schools. A worldwide focus on technology integration required schools to reshape their objectives for educating students and providing effective professional development for teachers (Rodríguez, Nussbaum, López, & Sepúlveda, 2010). Allocations for funding technology initiatives have increased due to anecdotal and research-based findings that support the use of technology in the classroom (North Carolina Technology Plan, 2007-2009; Yang & Huang, 2008). Hernández-Ramos (2005) highlighted a number of new challenges facing leaders attempting to provide professional development for integrating technology. Although there has been a popular shift toward increased technology integration in schools, not all educational leaders are convinced about the value of these new tools for instructional purposes. Fullan (2011), a well-respected researcher in the field of educational change, stated “ever since the first laptop emerged almost 40 years ago technology has been winning the race over pedagogy” (p.15). He suggested that technology had its place in the classroom; however, he argued that having a laptop computer for all students would not make them more intelligent or even more knowledgeable (Fullan, 2011). Regardless of the conflicting perspectives that exist among educational leaders, technology is still a major part of today’s K-12 classrooms.

In the past, teachers provided instruction to students without concern for technology integration. They now encounter ever-changing expectations about their responsibility to enhance and increase their practices with technology integration. Guzman and Nussbaum (2009) asserted that a primary requirement for training teachers must include professional development activities that produce knowledgeable teachers skilled in technology competencies. Although expectations from stakeholders are high, key barriers often inhibit the successful integration of technology in the classroom.

Professional Development

Throughout the 1990s a strong consensus about increasing professional development for classroom teachers emerged among researchers (Darling-Hammond & McLaughlin, 1999). Stakeholders in school systems were in agreement that this additional professional development substantially increased the knowledge and skills of teachers. Among them, Elmore and Burney (1999) argued the benefits of focusing on the application of knowledge and skills, best practices, professional reflection, collaborative planning, purposeful evaluation, and feedback. Hawley and Valli (1999) noted a growing consensus about "providing collegial opportunities to learn that are linked to solving authentic problems defined by the gaps between goals for student achievement and actual student performance" (p. 127). Their findings focused on research linking school improvement to increased professional development. One of the main ideas connected to providing effective professional development included the need to set higher expectations and standards for complex problem solving and collaboration. Their findings also revealed the need for educators to consider progressive methods of teaching and learning that veered away from traditional strategies for instructing students. This view encouraged educators to have universal beliefs about promoting professional development as an effective way to ensure student success. Teachers' beliefs about integrating technology also have the potential to impact the effectiveness of professional development initiatives.

Joyce and Showers (1996) noted that collaboration among teachers to identify students' needs was important for developing content, training, and assessments. They asserted that the use of professional development should be monitored and evaluated based on the impact of the tools and strategies provided by the training. Joyce and Showers (1996) highlighted the need for professional development to focus on helping teachers redesign their work places in ways that increased student performance and ensured successful collaboration. They argued that teachers needed to be taught to use knowledge and skills that had powerful impact on student transformation. The use of research-based teaching strategies, commonly developed assessments, and peer coaching was at the forefront of their progressive views on professional development. They suggested forming peer-coaching teams on the first day of school to provide the organizational structure and support needed to facilitate a systematic approach for providing professional development. Their findings encouraged the development of structures for collaborative planning that ensured opportunities for teachers to share ideas beyond the isolation of the traditional classroom environment (Joyce & Showers, 1996).

More recently, research on professional development has focused on professional learning communities (PLCs), which are defined as collaborative teams of teachers with a student-centered focus (Dufour, Dufour, Eaker, & Many, 2006). Schmoker (2005) argued that learning communities represented the richest examples of authentic school improvement. Sparks (2005) supported the use of well-implemented professional learning communities as the most effective practice for improving learning. He indicated that PLCs provided teachers with continuous opportunities to create more meaning and accessible. Sparks (2005) also argued that teachers should be sharing information and learning from their peers while they worked in the classroom environment. He suggested teachers should be participating in professional development activities, such as classroom walkthroughs, with other staff members.

In the past, professional development for technology integration has been limited by a lack of relevant knowledge, equipment and competent trainers. MacDonald (2008) found that traditional models of professional development often consisted of one-day workshops that were inadequate for improving teacher performance because they provided no follow-up activities or continuous collaboration. Concerns about providing successful professional development have been further complicated by the rapid changes and growing expectations for teachers to seamlessly integrate technology in the classroom. Fullan (2011) maintained that effective professional development included training that focused on research-based instructional practices, provided active-learning experiences for participants, and created opportunities for teachers to adapt practices for their individual classroom environments. He stated, "No improvement effort has ever succeeded in the absence of thoughtfully planned and well-implemented professional development" (Fullan, 2011, p 497).

Guskey's views on professional development. Guskey's (2000) research has provided a useful framework for evaluating professional development. His research has widely impacted the development of evaluation instruments in a variety of business and educational environments. This framework, entitled "Guskey's Five Levels of Professional Development Evaluation" (2000) has been modified and used in diverse research studies throughout the world. Although professional development is an important aspect of teaching and teacher education, there are often problems with its implementation. Guskey (2000) explained that when budget issues arise for schools and school systems, professional development is one of the first items targeted and considered for elimination. He found that teachers and other educators frequently question the importance of professional development. Inadequate and ineffective evaluations of professional development have been traced back to a lack of confidence in professional development activities. His research revealed impediments, such as exaggerated emphasis on mere documentation, shallow results, and evaluations that were too brief because researchers were "in a rush to provide evidence of effectiveness" (Guskey, 2000, p. 9).

Guskey (2002a) emphasized that professional development should include systematic efforts to change the practices of classroom teachers. He suggested research should focus on examining attitudes and beliefs among teachers. In order to provide a degree of measurable evidence about teachers' acquisition and application of knowledge, Guskey (2002b) recommended increasing the level of new knowledge provided during professional development activities.

National Staff Development Council Standards. Teachers and school leaders needed guidance to provide systematic strategies for improving schools through professional development activities. The initial goal of the National Staff Development Council (NSDC) was to ensure professional development was guided by a vision for meeting high standards (National Staff Development Council, 2012). The NSDC offers school leaders and teachers resources to support educational initiatives and staff development concerns related to context, process, and content.

The NSDC addressed issues of context by supporting the use of learning communities and increased leadership opportunities to enhance professional learning. Procedures supported by the NSDC organization included the following: data driven processes, evaluation, research-based strategies, a focus on new knowledge and skills, and a framework for ensuring high levels of collaboration. The NSDC supported content related to concerns that focused on equity, teaching quality, and family involvement in the educational environment (Hirsh, 2006).

Professional development for technology integration. The rapid growth of technology innovations at the close of the 20^{th} century created concerns about the need to equip students with 21^{st} century skills. The Partnership for 21^{st} Century Skills (2003) found that “by teaching in a 21^{st} century context educators can create a balanced education that reflects both national and local needs” (p. 12). Increased technology integration forced classroom teachers to focus their attention on upgrading their knowledge, skills, and practices to keep pace with the rapidly growing 21^{st} Century expectations. According to the Partnership for 21^{st} Century Skills (2003), new knowledge should be applied to instruction in ways that urge students to think critically and comprehend information that extends beyond core subject areas. The focus on critical thinking increased the need for teachers to plan lessons that included problem-solving and project-based learning activities. Technology equipment has created the potential for teachers to extend the scope of presentations to include progressive applications that enhance the final products of students’ work (Staples, Pugach, & Himes, 2005).

One aspect of critical thinking is integrating technology across the curriculum. However, Pierson (2001) suggested definitions of technology integration differ greatly among teachers. In a qualitative study related to general teaching practice, 16 teachers were questioned about their views on technology expertise and pedagogy. Pierson (2001) found that unless a teacher views technology as an integral part of the learning process, it will remain ancillary to his or her teaching. Teacher's levels of buy-in had a direct impact on the amount and quality technology integration in the classroom. Dunleavy, Dexter, and Heinecke (2007) suggested that technology integration research was essential and the facilitation of integration should be investigated. Unfortunately, Donovan, Hartley, and Strudler (2007) found that many teachers who integrated technology in the classroom showed more concern about how technology integration affected their time, lesson planning, and instructional practice rather than how it impacted student learning. Their findings indicated that teachers concerns failed to include a clear understanding or appreciation for the many long-term benefits associated with time management, planning, and instructional practices when technology is used effectively. Their high levels of concern about fully integrating technology into their lesson plans often create shortfalls in the full benefits and student work that is accomplished in fully integrated classrooms.

Harris, Mishra, and Koehler (2009) expressed concerns about how teachers used minimal and unsophisticated levels of technology integration and instructional practice. They argued that superficial use of technology by teachers was related to how it was conceptualized and supported. Thus, they indicated professional development should provide tools to engage students in the transformative uses of educational technology. They recommended using pedagogical content knowledge (PCK) as a framework for providing a better understanding of the knowledge teachers need to effectively integrate technology.

The continued evolution of technology and the changing curricula for teachers challenges students to participate in their own learning. Palak and Walls (2009) concluded, “Unless the focus of technology integration is explicitly on student-centered pedagogy, technology integration may continue to support teacher-centered practice with inadequate, highly controlled student use in the classroom” (p.437). The increased focus on technology in the classroom created a growing level of consensus about the need to provide a systematic level of professional development for technology integration. Data collected from studies conducted to investigate teacher knowledge from successfully emerging technology integration initiatives could be used to develop positive, supportive, and successful strategies for integrating technology in the classroom. (Chen, Looi, & Chen, 2009).

Teacher beliefs. Findings in the literature suggested that teachers’ beliefs impacted technology integration. Ringstaff and Kelley (2002) found that difficulties with changing basic beliefs about teaching and learning inhibited teachers’ ability to integrate technology. Levin and Wadmany (2006) developed three major assumptions about teacher beliefs: (a) teacher beliefs come from a variety of experiences; (b) the teacher’s view on technology can present a major barrier to the use of technology in the classroom; and (c) changing the teacher’s paradigm is a complex matter. They maintained there was still much to learn about the impact of teacher beliefs on professional development and technology integration. Wang, Etmer, and Newby (2004) discovered data that revealed teachers' beliefs were useful indicators for predicting their potential knowledge and skill level with technology integration. Their findings confirmed that "teacher beliefs provide sufficient reason to undertake further investigations in this area and to consider approaches to teacher education and professional development that might be effective in increasing self-efficacy for teaching with technology" (Wang, Etmer, & Newby, p. 232).

Davis, Preston, and Sahin (2009) examined evidence related to a national initiative in England with teachers who were required to know when to use and when not to use technology integration in the classroom. These researchers confirmed the complexities involved with evaluating technology integration in schools. Davis et al. (2009) revealed that high quality professional development led to observable change in the classroom and in the school. Their findings provided evidence for the need to use a multilevel evaluation process to examine professional development programs (Davis, Preston, & Sahin, 2009).

Technological pedagogical content knowledge. Shulman (1986) was a pioneer in research related to linking professional development for teachers with the need to improve content knowledge and teaching processes. Shulman's findings on pedagogical content knowledge (PCK) were important in the emergence and development of the technological pedagogical content knowledge (TPCK) that was used to evaluate teachers in technology-rich learning environments. Prior to the use of TPCK professional development approaches were organized "according to the educational technologies being used, rather than students' learning needs relative to curriculum-based content standards" (Harris et al., 2009, p. 395).

Pierson (2001) found that effective technology integration included the need for teachers to understand content knowledge, pedagogical content knowledge, and technological pedagogical content knowledge. TPCK is used to arrange and assess technology integration by combining the different aspects of knowledge. Content knowledge (CK) is the term used to describe the content that is taught in the classroom. Pedagogical content knowledge (PCK) is used to describe how content is taught in the classroom. Finally, technological pedagogical content knowledge is used to describe how teachers integrate technology in the classroom. Technology integration with a focus on TPCK became an important aspect of teachers' professional development (Mishra & Koehler, 2006). More specifically, TPCK "was used to describe teachers' body of knowledge in terms of how they made intelligent pedagogical use of technology" (Koehler, Mishra, & Yahya, 2007, p. 741). TPCK was further defined in the following description:

> TPACK [TPCK] is different from knowledge of its individual component concepts and their intersections. It arises instead from multiple interactions among content, pedagogical, technological, and contextual knowledge. TPACK [TPCK] encompasses understanding and communicating representations of concepts using technologies; pedagogical techniques that apply technologies appropriately to teach 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, along with related technological expertise or lack thereof; and knowledge of how technologies can be used to build on existing understanding to help students develop new epistemologies or strengthen old ones. TPACK [TPCK] is a form of professional

> knowledge that technologically and pedagogically adept, curriculum-oriented teachers use when they teach. (Harris et al., 2009, p. 401)

ISTE NETS-S and NETS-T Standards. When teachers were evaluated on the integration of technology in the classroom, a uniform standard for measuring their knowledge and skills was necessary. The International Society for Technology in Education (ISTE) National Educational Technology Standards for Students (NETS-S) and Performance Indicators for Teachers (NETS-T) (2008) provided a model for teachers to integrate technology in the classroom. These standards included the following five categories: (a) facilitate and inspire student learning and creativity, (b) design and develop digital-age learning experiences and assessment, (c) model digital-age work and learning, (d) promote and model digital citizenship and responsibility, and (e) engage in professional growth and leadership (ISTE NETS, 2008). The ISTE NETS-T performance indicators were used in the development of surveys in a number of scholarly studies related to technology integration throughout the world (Hsu, 2010). The ISTE Standards (2008) support many of the essential components of TPCK, which has played an important role in the investigation of professional development aimed at integrating technology.

School systems across the nation have continued to purchase advanced equipment and to revise policies that reinforce their commitments to integrating technology in the classroom (North Carolina Technology Plan, 2007-2009). The Rhode Island Department of Education (RIDE) used the ISTE NETS-T standards to develop the following description to aid in guiding technology integration in that state:

> Technology integration is not a subject area, nor is it a curriculum: it is an

> instructional strategy. Technology is an instructional tool; using it in an integrative fashion is an instructional strategy. As such, it is not added to the curriculum; it is a tool for delivering subject matter already in place within the curriculum. It is a tool for accessing, organizing, managing, analyzing, incorporating and evaluating information. It is a tool for developing new understandings and communicating. It is the tool of the 21st century to be used by teachers and students in their teaching and learning. (RIDE, 2006, para.1)

Technology goals and objectives have become an integral part of vision statements and school improvement plans in Local Educational Agencies and school districts (North Carolina Technology Plan, 2007-2009). New expectations about training and professional development brought into question the status of teachers' knowledge, skills, and pedagogy.

Significance of the Study

Conflicting views on technology integration. Research identified conflicting notions of how technology integration supports learning. Some studies indicated increases in student engagement (Sandholtz, Ringstaff, & Dywer, 1994) and student achievement (Ringstaff & Kelley, 2002; Schacter, 1999) due to the inclusion of technology in the classroom. Eldakak (2012) argued that teachers who focused on using new technologies had the opportunity to provide meaningful learning experiences for students. His findings revealed that access to technology integration increased opportunities for self-directed study, which allowed students to increase independent practice and work at their own pace. Guskey (2010) suggested that these mastery-learning strategies provide teachers with a wide variety of interventions and innovations for classroom instruction.

In contrast, Lowther, Inan, Strahl, and Ross (2008) found that technology-rich learning environments revealed minimal results with student outcomes. The previous literature identified key barriers that inhibited successful technology integration efforts. Sparks, the Executive Director of the NSDC, acknowledged the increased use of technology in teacher training but voiced concerns and remained skeptical about the potential for technology to fundamentally transform professional development in schools (NSDC, 2011). A wide variety of educational, logistical, and political barriers frequently impeded opportunities to investigate professional development initiatives that involve the use of technology in schools (Hennessy, Ruthven, & Brindley, 2005).

Surprisingly, the negative findings appeared to have little influence on the proliferation of technology integration in the classroom. The implementation of new technology initiatives continued to expand despite limited empirical evidence, inconsistent narratives in the research, and mixed reviews concerning technology use in schools. The lack of concrete evidence in the findings was in contrast to the increased use of technology integration in the classroom. The irony between the positive and negative beliefs in the research provided rich prospects for a future study. Savery (2002) suggested that studies on technology integration should include specific professional development programs, a full range of instructional strategies, and a focus on how to develop better survey questions. Kleiman (2004) noted that new research on integration should assess "the educational value of technology-enhanced or technology-enabled instructional practices, in contexts that enable teachers to have the training, support, and resources to successfully implement those practices" (p. 4). MacDonald (2008) noted that only a few studies have focused on professional development programs for technology integration that are comprised of teachers who want to be a part of "communities of practice" (p. 431), and include only teachers who volunteer to participate in professional development.

Studies that included technology integration in schools have been limited due to restrictions on the amount of access made available to researchers on this topic. Full access to this type of study has been constrained by concerns that included political ramifications, impact of findings, and underlying motives associated with outside researchers (Strite & Karahanna, 2006). A unique opportunity was provided for this study to examine a system-wide K-12 technology integration program. This program supported collaboration and required interested teachers to apply for an opportunity to participate in the extensive professional development that was provided to each participant. The current study proposed a plan to assess the attitudes of teachers concerning technology and the effect of professional development programs on those attitudes. The professional development program involved in this study was the 21st Century Model Classroom program (21st CMC).

The 21st CMC program was designed to target specific teachers in the school system and provide them with specialized professional development opportunities and advanced technology equipment. The exclusive selection process for the program identified teachers who were highly motivated to integrate technology. Extensive technology equipment was uniformly provided for each individual teacher's classroom in the program. On-going professional development activities provided all teachers in the program with the chance to share new knowledge and skills among their colleagues.

Thus, the 21st CMC program attempted to eliminate existing barriers such as negative attitudes toward technology, a lack of professional development, and limited access to technology equipment. Lowther, Inan, Strahl, and Ross (2008) found these barriers could interfere with technology integration in the classroom.

Before this study, no formal evaluation process had been used to examine the 21st CMC program. However, teachers in the program were required to develop a technology-related teaching strategy based on the professional development provided by the program that demonstrated their knowledge and skills. In an annual PLC meeting, 21st CMC program teachers were then required to present their strategies to an audience of their peers and district administrators. This study provided a window of opportunity to investigate the professional development, technology integration, and beliefs of teachers in the 21st CMC program and compare the findings to non-participants in the school system.

Purpose of the Study

The purpose of this study was to compare and similarities between how participants in the 21st CMC program and non-participants acquired and applied new knowledge and skills for integrating technology in the classroom environment. This study also examined how participants described their use of professional development activities and their beliefs about integrating technology in the classroom environment.

Research questions. The research questions included

1. What are the differences and similarities between how teachers in the 21st CMC program and non-participants acquire knowledge and skills for integrating technology?

2. What are the differences and similarities between how teachers in the 21st CMC program and non-participants apply knowledge and skills for integrating technology?

3. How do teachers describe their beliefs about integrating technology in the classroom?

CHAPTER TWO: LITERATURE REVIEW

Chapter two provided the context for development of the research questions that were used for this study. Information found in previous studies outlined the evolution of professional development and the emergence of technology for instructional purposes. A description of the NSDC Standards (2012), and ISTE NETS-T and performance indicators (2008) were included in this review. Technology integration standards were highlighted as a specific set of guidelines related to effective, research-based, and ethically appropriate professional development for educational leaders and teachers. Professional learning communities (PLCs) were included in the review to examine their impact on collaboration and pedagogical practices related to professional development, teacher knowledge and technology integration. Student engagement and constructivism were reviewed and described to investigate the motivational and pedagogical aspects of professional development designed for integrating technology.

The development of the three research questions for this study were directly impacted by Guskey's Five Levels of Professional Development Evaluation (2000) and findings related to technological pedagogical content knowledge (TPCK). A review of Guskey's Five Levels of Professional Development Evaluation (2000) and TPCK revealed valid and reliable tools for measuring whether or not teachers acquired and applied knowledge provided by the 21st CMC program. The impact of teacher beliefs on the acquisition and application of knowledge for integrating technology was also included in the review of the literature. Ultimately, the literature described in this chapter provided a strong foundation of information for conducting the investigation and for understanding the results that were discovered in the study.

Professional Development

Professional development for educators is an integral part of efforts to ensure that students have a successful experience in the classroom. Concerns about ensuring successful teaching have heightened the need for effective experiences in this area. Guskey (2000) contended that there was a lack of collaboration and professional sharing among teachers unless a specific framework for collegial exchange was included in professional development activities. Guskey (2002b) stated, “Professional development programs are systematic efforts to bring about change in the classroom practices of teachers, in their attitudes and beliefs, and in the learning outcomes of students” (p. 381). He declared that the most neglected aspect of professional development was in educators’ failures to sustain change.

Teachers and administrators have struggled with the need to meet the demands of standardized testing in the classroom. Much of the recent professional development in schools has been linked to standardized objectives. The emergence of new technology has also demanded an additional level of professional development. Sparks (2002) noted that an abundance of books and studies have been published that provide ideas for improving teaching. He maintained that even with numerous opportunities that have been available for teachers to increase their knowledge, only minor improvements have been observed in the quality of the professional development in schools. He insisted that high quality professional learning should include activities that increase teachers’ content knowledge and pedagogical knowledge and provide more time for practice, access to research, and teacher reflection during the school day. He placed a great deal of importance on the need for educators to share long-range goals. Also he noted that organizational structures in schools should ensure collegiality and collaboration between teachers and create an environment that promotes a genuine level of collaboration between teachers and administrators for problem solving. Steiner (2004) suggested that there was a strong body of research related to the effectiveness of professional development activities with a focus on subject matter knowledge and on understanding how students learn particular subject matter. The NSDC was instrumental in developing standards that focused on the alignment and support for ensuring effective professional development.

Concerns about professional development are often related to the relevance and authenticity of the knowledge that is shared among participants. Joyce and Showers (2003) suggested that knowledge for professional development should be specifically related to the intended outcomes designated for each individual implementation program and its participants. They contended that professional development programs should be constructed in the context of the related goals, problems, and connected priorities, with consideration for the complex nature of the goals and the newness of the expected outcomes for the specific organization (Joyce & Showers, 2003). They argued that educational leaders should be devoted to developing ways to monitor the impact of the training, knowledge, and skills provided by professional development programs (Joyce & Showers, 2003).

Researchers attempted to analyze the impact of professional development on teacher participants. Lowden (2005) used Guskey's (2000, 2002b) findings on teacher change to evaluate the impact of professional development on student achievement in eleven public schools within two districts. Participants included 205 certified K-12 classroom teachers in a suburban area of New York State. Students were described as being identified in the low-need demographic category in regard to the district's resource capacity. Lowden's (2005) study was based on the following criteria: (a) participant satisfaction; (b) participant learning; (c) organizational support and change; (d) change in teacher knowledge, skills, and pedagogy; (e) teacher perceptions of student learning; (f) and changes in attitudes and beliefs of teachers. A jury of experts in the field of education and professional development was used to establish face and content validity (Lowden, 2005).

Effective professional development should be determined by the impact it has on student learning in the classroom. Lowden (2005) found that professional development was often evaluated based on the satisfaction of the participants or their self-reported opinions of their professional development experiences. Guskey (2000) contended that in order for professional development to have an impact on student outcomes, evaluation of professional development should focus on measuring the impact it has on the knowledge, skills, and beliefs of its teacher participants. Lowden (2005) stated, "Professional development programs that focus on changing teachers' attitudes and beliefs presume that they will result in a change of instructional practice and pedagogy leading to the improvement of student learning" (p. 2). Steiner (2004) found that strong professional development programs improve the quality of teachers.

Professional learning communities. Findings in the literature indicated that professional learning, student learning, and student achievement could be increased by the implementation of effective professional learning communities. Professional learning communities have been used to describe a wide variety of collaborative associations among educators. Dufour (2004) suggested that the term has been used in such a universal manner that it runs the risk of losing its original meaning. Professional learning communities emerged from the fundamental assumption that "the core mission of formal education is not simply to ensure that students are taught but to ensure that they learn" (Dufour, 2004, p. 8). PLCs are based on the idea that teachers "need to make public what has traditionally been private----goals, strategies, materials, pacing, questions, concerns, and results" (Dufour, 2004, p.10). He suggested these conversations provided opportunities for teachers to share ideas about improving the individual and collective classroom practice of teachers. He maintained that thriving professional learning communities were facilitated by a well-designed PLC framework but the ultimate success of PLCs was determined by the hard work and commitment of the individual members of the learning community.

The enthusiasm and the work ethic of the participants in learning communities influence the outcomes of professional development in schools. Stoll, Bolam, McMahon, Wallace, and Thomas (2005) supported DuFour's (2004) views on hard work. They found that many of the important elements of constructing successful PLCs included the need for continuous efforts and hard work, which ultimately determined either the success or demise of a collaborative learning environment. They agreed with Dufour's ideas on creating a vision for instruction that included a focus on PLCs, but they more specifically focused their aims and attention on issues related to sustainability (Stoll, Bolam, McMahon, Wallace, & Thomas, 2005). Stoll et al. (2005) defined a PLC as

> an inclusive group of people, motivated by a shared learning vision, who support and work with each other, finding ways, inside and outside their immediate

community, to enquire on their practice and together learn new and better approaches that will enhance all pupils' learning. (p.1)

Stoll et al. (2005) provided three ways to determine the effectiveness of PLCs. Their findings suggested that effective PLCs impact pupil learning and social development. They also suggested that effective PLCs impact staff morale and practice and thus impact the potential for developing leadership capacity. Finally, they contended that successful PLCs promote characteristics that encourage high expectations and reinforce smooth operations of schools, which determine whether or not certain attributes are "part of the way we do things" (Stoll et al., 2005, p. 2). They also suggested that organizational structures such as grade level meetings and departmental meetings could provide opportunities to help facilitate PLCs. However, these required meetings did not necessarily include the collaboration or motivated vision needed in effective PLC structures.

The objectives related to standardized testing could have a negative impact on the aims and goals of learning communities. Reeves (2005) addressed the need for establishing effective PLCs by explaining his discontent with the accountability instruments that were put in place for measuring instructional success. He maintained that End-of-Course type tests that measured performance on one final summative assessment limited the potential for teachers to take advantage of PLCs and negatively impacted the need for using continuous formative data to improve their strategies. He designated three pivotal components for ensuring the effectiveness of PLCs. These components included (a) standards, (b) assessments, and (c) accountability. Reeves emphasized the importance of on-going teacher collaboration and accountability in the following statement:

> Standards must not merely be delivered from the state department to the schoolhouse door; they must be refined and focused. Assessment must not be the subject of annual academic post-mortems, but the focus of continuous discussion by professionals throughout the year. Accountability systems must focus not only on what students achieve, but also on how the adults in the system influenced that achievement. (2005, p. 61)

Some researchers provide a less than optimistic forecast for PLCs unless there is a dramatic change in the impact of big government on the operation of schools in the United States. Giles and Hargreaves (2006) had a less promising view on the stability and importance of PLCs in schools. They argued that professional learning communities often fail to sustain success over time. Their commentary focused on the irony and difficulty of how PLCs promote the value of extensive opportunities for sharing and for exploration of creative learning, while contending with the recent pressure of standardized reforms from top-down governmental agencies, which tend to want to micromanage public school operations. After reviewing three previous cases related to the sustainability of schools that promoted the merits, ambitions, and expectations of PLCs, Giles and Hargreaves (2006) stated, “Judging by all three cases of innovative schools explored in this article, the standardized reform agenda is actively undermining the efforts and successes of those few, truly creative ‘knowledge society’ schools, and their teachers, that currently exist” (p. 152). Giles and Hargreaves (2006) suggested that the future of PLCs depended on whether or not the government could follow the lead of

England, Australia, New Zealand, Japan, and Singapore by relaxing its grip on the standardized educational reforms in North America.

The NSDC (2012) suggested educators in professional learning communities should increase their effectiveness and ensure student achievement by committing themselves to continuous improvement and collective responsibility and by aligning their objectives. Other characteristics of professional learning identified as necessary for effective PLCs by the NSDC (2012) included support and alignment of the individual, team, school, and school system goals. Their views suggested community members should meet regularly to collaborate, to improve their practice, and to ensure ideas and strategies for improving student outcomes (NSDC, 2012). The NSDC maintained that individuals in professional learning communities should be accountable for communicating specific and broad goals in an authentic, transparent, and collegial learning environment (NSDC, 2012). Schmoker (2004) stated, "A true learning community identifies, honors and provides opportunities for every successful team or teacher to share his or her methods and successes with colleagues" (p. 88).

National Staff Development Council (NSDC). The NSDC established a set of comprehensive standards for professional learners. Each of the following standards defined a set of expectations to ensure that all educators could access understandable and effective frameworks for gathering resources and information to aid in the continued development of teachers (NSDC, 2012).

- Learning Communities: Professional learning that increases educator effectiveness and results for all students occurs within learning communities committed to continuous improvement, collective responsibility, and goal alignment.

- Leadership: Professional learning that increases educator effectiveness and results for all students requires skillful leaders who develop capacity, advocate, and create support systems for professional learning.
- Resources: Professional learning that increases educator effectiveness and results for all students requires prioritizing, monitoring, and coordinating resources for educator learning.
- Data: Professional learning that increases educator effectiveness and results for all students' uses a variety of sources and types of student, educator, and system data to plan, assess, and evaluate professional learning.
- Learning Designs: Professional learning that increases educator effectiveness and results for all students integrates theories, research, and models of human learning to achieve its intended outcomes.
- Implementation: Professional learning that increases educator effectiveness and results for all students applies research on change and sustains support for implementation of professional learning for long-term change.
- Outcomes: Professional learning that increases educator effectiveness and results for all students aligns its outcomes with educator performance and student curriculum standards.

(http://www.learningforward.org/standards/index.cfm)

As increasing technology innovations impact the classroom environment, professional development initiatives will have to incorporate new technologies as an integral part of teacher improvement efforts.

Technology Integration

In the last forty years a number of studies have been conducted to evaluate the changing attributes and characteristics of technology and the professional development designed to integrate technology in the classroom. Researchers, technology developers, and educators have attempted to use electronic devices as the universal answer for solving numerous problems that exist with teaching and learning in schools (Liu & Szabo, 2009).

Bloom's impact on technology integration. Few would argue that one of the most prominent figures among educational researchers in the last fifty years was Benjamin Bloom. The progression of technology was not the main focus of his research, but his popular findings on Mastery Learning and one-to-one tutoring (Bloom, 1984) have influenced the vision of technology enthusiasts as they searched for a technology design that could recreate the successful teaching and learning provided by a one-to-one tutor.

According to Bloom (1984) the most effective configuration for learning existed when one qualified tutor was assigned to no more than three students during a given instructional session. Bloom's study entitled "The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring" (Bloom, 1984) used the standard deviation (sigma) and compared a control group (conventional) class of 30 students to a one-to-one tutoring class and found that the average tutored student scored above 98% of the students in the conventional control group. The third configuration in the study included 30 students who were taught the subject matter in a Mastery Learning environment. The Mastery Learning students, on the average, scored above 84% of the conventional control group, but even the Mastery Learning students fell short of the benefits gained by students who were instructed in the one-to-one tutoring classroom. Since Bloom's discovery of the benefits associated with the one-to-one tutor, a wide variety of experimentation has been conducted in an effort to develop instructional strategies and technology advancements to capitalize on what was learned during the "2 Sigma Problem" study (Bloom, 1984).

The need to provide more individualized instruction motivated educators, researchers, and technology developers to produce new tools and programs for tutoring students. Findings in the "2 Sigma Problem" (Bloom, 1984) study had a profound impact on the emergence of instructional technology strategies for interactive learning devices. Following Bloom's study, progressive technology was employed in an effort to capitalize on a computer simulation of a one-to-one form of tutoring described as model tracing methodology (Merrill, Reiser, Ranney, & Trafton, 1992). Some controversy with the use of the devices emerged, suggesting there were drawbacks with this technology-based approach to teaching (Merrill et al., 1992). Concerns were raised about limitations associated with the extent to which model tracing intelligent tutoring systems accurately recreated the benefits of effective human tutors, noting their potential failure to redirect the actions of the student when necessary (Merrill et al., 1992). The researchers found that unlike the model tracing methodology, one-to-one human tutors helped students solve problems, while still managing to promote a sense of challenge and provoked curiosity as they maintained the students' feeling of control (Merrill et al., 1992).

Bloom's findings (1984) continued to influence emerging ideas and on-going changes in educational research and technology progression. Fijor (2010) used Bloom's

Revised Taxonomy and Bloom's Digital Taxonomy to explain a scale related to higher order thinking skills to further define ways to measure degrees of student engagement in the technology classroom. He linked his suggestions about using Bloom's Digital Taxonomy in a description of the levels of thinking needed to evaluate student learning that included (a) remembering, (b) understanding, (c) applying, (d) analyzing, (e) evaluating, and (f) creating.

Concerns about technology integration. Teachers' vulnerabilities and lack of new knowledge about technology have been examined both inside and outside the classroom. They deal with continuous exposure to students who live in a technology driven world and parents who expect teachers to provide the latest information with content and technology equipment. Wexler (2000) examined the relationship among teachers, students, and experts involved in addressing the changing roles in power and knowledge in the evolution of technology integration in the K-12 environment. She suggested the role of the expert includes "(1) the traditional role of bringing in speakers or providing field trips to provide expertise and also the non-traditional roles of (2) students as experts of technology or content, and (3) students as experts of technology and content" (Wexler, 2000, p. 36). Wexler (2000) argued, "How this technology is introduced into various learning environments constructs a tension between those who know and those who do not know how to use the technology" (p. 33).

Teachers have been forced to reflect on their role as instructional leaders in the classroom. Much of the new knowledge that is made available to teachers about technology integration was not a part of their educational experience when they first entered teaching. But it has now become an inevitable reality for their future. Steel and

Hudson (2001) conducted a study at the University of Sheffield Hallam in the United Kingdom. Their findings suggested that there was a level of unease with the fast rate of new technology innovation. Eleven interviews of staff members were conducted to gain insight from the instructors that were responsible for integrating technology with students in the classroom. The interviews were used as a part of a larger study that focused on obtaining qualitative insight on the perceptions, values, and thoughts of the students while integrating technology. Steel and Hudson (2001) stated, “Simply placing students in front of technology and letting them ‘get on with it’ can only degrade the student experience” (p. 110). They suggested educators recognize that serious reflection needs to occur in the area of technology and teaching practices. Schwab and Foa (2001) contended “teachers must make changes of a huge magnitude to integrate new technologies in meaningful ways” (p. 621).

Frequency of use was once the main indicator for technology integration. More recently the focus of has been on more detailed aspects of integration into teaching and learning. Barron, Kemker, Harmes, and Kalaydjian (2003) surveyed one of the largest districts in the state of Florida in order to investigate teachers’ use of technology in the classroom as it related to the National Educational Technology Standards (NETS-T) guidelines for teachers. The survey was sent to all teachers in a school district that served 113,017 students. This survey collected demographic information and addressed four domains: (a) problem solving, (b) communication, (c) productivity, and (d) research. The sample included 2,156 respondents, with an overall return rate of 35%. The investigation included elementary, middle, and high school students. This study claimed to reveal greater depth of information than a simple investigation of frequency of use. Barron et al. (2003) stated, “Many teachers are implementing technology as a tool for communication, productivity, and problem solving; however, the goal of technology integration across all grade levels is yet to be reached” (p. 504).

Teachers are not always prepared to face the various changes associated with technology integration. Comfort levels are often related to differences in their fundamental knowledge and the diversity of their past experiences with technology use. Kotrlik and Redmann (2005) conducted a study on teachers in the early stages of a technology integration initiative. Their investigation was conducted to explore the extent to which teachers were integrating technology for instructional purposes in public schools. The population in the study included 311 K-12 public school teachers employed in a full-time GED program by the Louisiana Department of Education. Mailings were sent to 172 of the identified teachers with 102 respondents. Their findings revealed a wide range of experience, confidence, and anxiety among the faculty members that were studied. They found that teachers were at varying points of knowledge and skill on the continuum of technology expertise (Kotrlik & Redmann, 2005). Findings revealed teachers felt they were effective with using low-level experimentation with technology integration. Unfortunately, as teachers attempted more innovative levels of integration, they faced greater barriers, which had a negative impact on their self-perception and decreased technology integration. However, the research did reveal that when access to technology in the classroom was increased, teachers increased their integration of technology. Kotrlik and Redmann (2005) suggested more research was needed to determine whether teachers are being adequately prepared to integrate technology. Findings suggested that anxiety among teachers was increased because of a lack of preparation with using the integration of technology to deliver the content and curriculum. They also suggested that future research should include the development of a scale to measure technology anxiety (anxiety about using computers) of teachers (Kotrlik & Redmann, 2005).

Teachers are concerned about increasing levels of accountability associated with their own level of competence and their ability to provide effective learning through technology integration. Liu and Szabo (2009) conducted a cross-sectional study that applied the same research instrument during four different summer sessions with four different groups of teachers at four different points in two different graduate courses in a midwestern public university. A total of 275 in-service teachers participated in a questionnaire that addressed seven stages of concern with attitudes toward technology integration in schools. Liu and Szabo (2009) found that technology integration across the curriculum affects teachers' instructional and pedagogical practices in the classroom. They found that predominant issues among the teacher participants were related to informational, personal, and refocusing concerns (Liu & Szabo, 2009). They noted an additional concern about a special burden on teachers who are concentrated on curriculum related to standardized assessment. Overall results from this study show that technology users expect to be informed about technology implementation and its effects on curriculum; they also are concerned about the time and energy commitment (Liu & Szabo, 2009). Not all educators are convinced about the potential benefits of a growing focus on technology for educational purposes (Hashemzadeh & Wilson, 2007).

Facilitating technology integration. Regardless of the reported concerns, technology integration has continued to gain momentum as a practice for increasing student engagement. Swan, Vań Hooft, Kratcoski, and Unger (2005) stated

> Computing is starting to get a foothold in K-12 settings, as a vision of classrooms filled with many computing devices designed for differing purposes and to be used as needed in the same ways as paper and books are used now. (p.99)

Swan et al. (2005) argued that technology devices could increase student motivation and increase their level of engagement during learning, which could increase their time on task and lead to higher quality work in the classroom. Kleiman (2004) emphasized, "Research needs to consider not just the technology but rather the educational value of technology-enhanced or technology-enabled instructional practices, in contexts that enable teachers to have the training, support, and resources to successfully implement those practices" (p. 4). A study conducted by Peng, Su, Chou, and Tsai (2009) revealed encouraging results related to integrating technology by using constructivist principles to engage students in the learning environment.

Engagement. Teachers are concerned about how to be accountable for student work and classroom participation. Traditional teaching and learning included uniform expectations about instructing, grading, behavior, and provided direction for engaging in interpersonal communication between students and adults. Technology changed the scope and complexion of the appropriate classroom environment. Fijor (2010) identified difficulties and differences in determining when students are engaged in traditional classrooms as compared to students learning with technology-rich instruction. He suggested that a group of students using the iPod touch and collaborating with each other might indicate to an observer that the students were highly engaged, not unlike students using some type of math manipulative. He suggested that although students may appear to be engaged in learning, the difficulty comes with attempting to quantify the degree of engagement. Fijor (2010) noted the importance of evaluating and discriminating between the levels of engagement and the role it plays in the learning process.

Efforts have been made by researchers and educators to identify uniform processes and indicators that apply to understanding and assessing elements of technology integration. Kearsley and Shneiderman (1999) suggested that teachers needed a depth of knowledge about ways to ensure student engagement in technology-rich learning environments. Their research on student engagement included an actual theory of engagement related to technology integration.

> The fundamental idea underlying engagement theory is that students must be meaningfully engaged in learning activities through interaction with others and worthwhile tasks. While in principle such engagement could occur without the use of technology, we believe that technology can facilitate engagement in ways that are difficult to achieve otherwise. (Kearsley & Shneiderman, 1999, p. 23)

The major premise of engagement theory included idea that effective learning was more likely to occur when students were thoroughly engaged in technology integration activities (Kearsley & Shneiderman, 1999). They defined "Engagement Theory" for the integration of technology by identifying three primary means to accomplish successful student engagement, including (a) emphasis on collaborative efforts; (b) project-based assignments; and (c) a nonacademic focus for engaging students in learning that is creative, meaningful, and authentic (Kearsley & Shneiderman, 1999). Engagement theory was a conceptual framework for technology-based learning and teaching (Kearsley and Shneiderman, 1999). The basic principles for this theory encouraged a constructivist view on learning, where students are engaged and all activities involve active cognitive processes, including creating, problem solving, reasoning, decision-making, and evaluation. Kearsley and Shneiderman (1999) suggested this type of educational environment intrinsically motivates learners due to the meaningful nature of the instructional experience.

Constructivism. Constructivism is not exclusively connected to technology integration. All students have individual needs that impact their potential to learn. Peng et al. (2009) maintained that constructivism improves teaching by enabling students to internalize authentic learning. Teachers that plan lessons and instruct students with a constructivist approach increase their chances to reach a broad range of individual differences among learners (Peng, Su, Chou, & Tsai, 2009). Constructivism facilitates engaging instruction and narrows gaps in the knowledge of students and teachers who integrate technology in the classroom (Peng et al., 2009). Resnick (1989) stated, "The general sense of constructivism is that it is a theory of learning or meaning making, that individuals create their own new understandings on the basis of an interaction between what they already know and believe and ideas with which they come into contact" (p. 1624). Becker and Riel (1999) found that in a national survey of uses of computers, teachers with a constructivist orientation toward instruction were more likely to pursue technology integration in the classroom.

Constructivism is a progressive instructional method that focuses on the need for students to participate in their own learning, which aligns effectively with using technology integration. Richardson (2003) suggested that a lack of constructivist teaching is due to lack of access and familiarity with constructivist teaching theory. The need to increase teacher knowledge about technology integration in the classroom appears to have created opportunity for further research in the area of constructivism and teaching. Richardson (2003) also stated,

> The nature of constructivism as an individual or group mean-making process renders this conversion remarkably demanding. But there are additional aspects of constructivist pedagogy, some that are of constructivist expectations for teacher knowledge that have lead [led] to issues that are as yet unexamined or certainly not solved. (p. 1623)

The role of teachers and students has changed dramatically with the onset of advancing technologies. Students have become energetic participants in a variety of technology-based learning activities. Mishra and Koehler (2006) suggested teachers should focus on "pedagogical techniques that use technologies in constructive ways to teach content" (p. 1029). Constructivism requires teachers to use nontraditional forms of instruction to engage students in the facilitation of learning and provide a clear understanding of the technology (Peng et al., 2009). Constructivist principles included the need for learners to be active and responsible during the learning process, apply self-regulatory learning strategies, articulate goals and strategies to find answers, and internalize outer experiences to help form personal inner meaning (Peng et al., 2009). They also noted that teachers who use constructivist pedagogy and technology early in the process increase their chances to make meaningful use of the hardware and software provided in the classroom (Peng et al., 2009).

Professional Development for Integrating Technology

Professional development activities that increase technology in the classroom can create the potential for increased disruptions to emerge along with the new opportunities for student learning (Fijor, 2010). Growing expectations for integrating technology in schools affect (a) teacher beliefs, (b) teacher knowledge, (c) instructional practice, and (d) student outcomes (Palak & Walls, 2009). Evidence continues to mount about the importance of the need to provide professional development based on pedagogy to ensure the greatest impact on teachers' information communication technology (ICT) use (McCarney, 2004). The guiding research question in McCarney's (2004) study asked, "What is the teachers' view of the most effective type of staff development in ICT in terms of impact on teachers?" (p. 67). McCarney (2004) used a positivist approach to collect quantitative data with forms of staff development as factors, impact on teachers as the outcome, and teachers that had experienced professional development in ICT as the population.

Statistical tests were carried out on Statistical Packages for the Social Sciences (SPSS) software in the following categories: "experience and qualifications of the teachers; their perception of effective models of staff development; the skills and knowledge developed in the staff development undertaken" (McCarney, 2004, p.68). The survey asked teachers to classify the skills and knowledge that were used in the professional development activity in relation to technical, academic, and pedagogical knowledge and then asked which type had the most positive effect on their approach to using technology in the classroom. Pedagogical knowledge (47%) was rated higher than technical (12%) and academic (14%) in the highly effective category. McCarney's (2004) study indicated that teacher's still valued professional development that provided direct contact with tutors. He suggested that professional development needed to be offered in a way that was meaningful to what teachers perceived as valuable for their own learning.

Teacher independence appears to be at the center of training related to technology integration. Initially, teachers tend to go through level of discomfort with technology use. However, making teachers a full partner in the design and development of the processes for planning instructional activities may help ensure their success in the classroom. Lavonen, Lattu, Juuti, and Meisalo (2006) conducted a two-year study in Helsinky, Finland. Their study focused on ICT competence through a cooperative professional development project sponsored by the Finland Department of Teacher Education. This ICT study analyzed strategies for developing ICT competence by providing contextuality as a property of professional development programs for teachers by creating a situational context during learning experiences that mirrored real-life problem solving (Lavonen, Lattu, Juuti, & Meisalo, 2006). Their study categorized ICT teaching and learning with ICT as tool applications. They viewed ICT as a collection of accessible tools for helping teachers and students to reach educational goals and objectives with more efficiency. Self-evaluation data was collected on how teachers used ICT in teaching and learning. Teachers participated in suggesting courses for the professional development activities. Properties of the courses suggested by staff members included (a) co-operative work, (b) reflective work, (c) situated or (d) contextual work, (d) development of technology, (e) availability of ICT tools and pedagogy, and (f) formal courses with advisory help (Lavonen et al., 2006).

Lavonen et al. (2006) gathered data from 505 participants that completed the courses that were developed for increasing ICT competence. They found that during the professional development project, ICT competence increased. The data in their study showed that when teachers became more aware of the potential strategies that existed for teaching and learning with ICT, they became more versatile in the use of their tools. Other findings revealed that the development of web-based infrastructure decreased the constraints in the versatile use of technology and that developed courses, which were cooperative, reflective, and contextual, were beneficial for ensuring effective ICT use. Finally, Lavonen et al. 2006 suggested that teachers should have the ability manage technology in the classroom and maximize its use for student achievement without interrupting other important forms of higher level teaching and learning.

Professional development has become an integral part of implementing technology integration programs. Stein, Ginns, and MacDonald (2007) conducted a study on four primary teachers that addressed internationally recognized concerns with understanding technology for instructional purposes. The investigation focused on the professional development experienced by participants that was aimed at assisting teachers in developing an understanding of technology and technology integration. The researchers intended to "investigate how a professional development experience enabled a small group of primary teachers to extend their personal constructs of technology and technology education, including their pedagogical knowledge and their technology field/discipline knowledge" (Stein**,** Ginns, & MacDonald, 2007, p. 183).

An interpretive methodology was used to investigate and analyze the thoughts and actions of the participants (Stein et al., 2007). The researchers used a hermeneutic dialogue process based on criteria related to trustworthiness and authenticity (Stein et al., 2007). Since the investigators were interested in how teachers were making sense of the phenomena they encountered during the professional development experience, they were able to come to agreement about the participants' thoughts and views (Stein et al., 2007). Data sources used in the study included (a) teacher interviews, (b) video recordings of teacher activities, (c) teacher-made models, and (d) information extracted from personal reflections noted in the teachers' journals (Stein et al., 2007). Researchers identified the participants as four teachers at a suburban primary school in Brisbane, Australia, with little prior experience related to technology integration (Stein et al., 2007). They found that further research was needed for framing professional development around rich learning environments, so they suggested the model described in their study may provide a useful way of "conceptualizing and improving the professional development experiences in technology and technology education for many primary school teachers" (Stein et al., 2007, p. 194).

Teaching has moved the isolated pursuit of professional objectives and goals to a more collaborative experience. MacDonald (2008) stated, "Traditional models of professional development, such as one-day workshops, often remain the norm even though they are inadequate, since they do not provide for on-going collegial interaction" (p. 430). Therefore, he suggested research about the adoption of technology innovations had to take into account strategies for addressing ICT planning and implementation. He also hypothesized that ICT might be too complicated for some beginning teachers; that staff do not easily cooperate or network with each other or with experts; that they feel that they do not have enough time for experimenting; that they might have negative attitudes towards innovation; and that if there was no support available, natural human resistance to new ideas and innovations could interfere with ICT use. MacDonald (2008) discussed the use of a design-based research methodology, which allowed for emphasizing a focus on the feedback of participants in ICT professional development. He suggested that a collaborative and responsive professional development structure or community of practice (CoP) could create an effective combination for ensuring success with technology integration activities. MacDonald (2008) contended that this type of needs-based approach to sharing information and using technology provided the potential to create a synergistic environment for ensuring success with ICT integration practices.

The frameworks and systems that are constructed to ensure the overall operations and management of schools often create difficulties with PLCs. MacDonald (2008) questioned whether difficulties related to the diffusion and adoption of technology innovations would create negative attitudes toward ICT professional development. According to MacDonald (2008) “Design-based research fits very well with a CoP as both are designed to respond to the ever-changing reality of messy educational settings” (p. 433). He suggested some teachers might be resistant to new ideas or innovations that could interfere with ICT professional development and use. MacDonald (2008) investigated how a group of teacher educators diffused and adopted innovation with technology integration. He stated, “The common reasons for sparse use of resources were difficulties in integrating ICT into classroom instruction, problems in allocating computer time for classes, and a lack of ICT skills and knowledge” (MacDonald, 2008, p. 245).

Knowledge for integrating technology. The addition of technology integration in professional development, combined with the limited experience of most teachers, sparked fears, confusion, and frustration about the changing nature of the 21st Century classroom (Kotrlik & Redman, 2005). Growing quantities of technology equipment and increased expectations about technology use in schools led to the need for a framework for implementing technology successfully (Ertmer & Ottenbreit-Leftwich, 2010). Educators and technology developers in search of ways to better facilitate successful technology integration began to recognize the need to address issues of pedagogy in addition to concerns with technology and content (Harris, et al., 2009).

Technology has been used as a tool for enhancing teaching and learning. Some researchers suggest that technology could be viewed as an area of content in, and of itself. However, most educators use a blended approach to integrate technology in their lessons. Chen, Looi, and Chen (2009) analyzed teachers' personal experiences with using technology in the classroom. They mapped teachers' developmental trajectories by using a Coherency diagram that included the complex interplay of teachers' knowledge (K), goals (G), and beliefs (B), or (KGB), to investigate the technology levels of teachers in the classroom. This study identified content pedagogical knowledge as an important aspect of technology integration in the examination of data. The authors suggested that certain technology was more suitable for certain tasks. Chen et al. (2009) asserted, "Technology cannot be treated as a knowledge base unrelated from knowledge about teaching tasks and contents" (p. 473). Two researchers observed each class, and each session was also videotaped to provide further evidences associated with rating the teacher behaviors. A multifaceted research approach collected different perspectives including uptake analysis, surveys, interviews, and performance tests. A coherency diagram that combined KGB and the affordances of technology as a representation was used to describe "the extent to which technology is leveraged in teaching" (Chen, et al., 2009, p. 473). Where KGB and the affordances intersect denoted the extent of the technology that was used. Chen et al. (2009) claimed their findings presented the "main key in leveraging technology successfully" (p. 486).

Technological pedagogical content knowledge (TPCK). Pedagogical content knowledge (PCK) provided a helpful foundation for understanding the importance of using the TPCK framework for the integration of technology (Harris et al., 2009). Shulman (1986) suggested that teachers' professional development should be focused on a blend of both content aspects and teaching processes. Shulman highlighted the following questions on the subject: "What are sources of teacher knowledge? What does a teacher know and when did he or she come to know it? How is knowledge retrieved and both combined to form a new knowledge base?" (Shulman, 1986, p.8). Shulman (1986) increased expectations related to PCK and challenged teachers to make instruction comprehensible to their students. He referred to degrees of teachablility related to content knowledge to emphasize the importance of pedagogical knowledge. Because teachers and students bring differing characteristics to bear on the learning environment, any preconceptions and/or misconceptions during teaching and learning highlighted Shulman's explanation of the need to include PCK in professional development activities (Shulman, 1986). Schools were in great need of a universal structure to provide the knowledge and guide the facilitation of technology integration. Harris et al. (2009) described the significance of recognizing pedagogy as an integral part of technology integration:

> Understanding that introducing new educational technologies into the learning process changes more than the tools used—and that this has deep implications for

> the nature of content-area learning, as well as the pedagogical approaches among which teachers can select—is an important and often overlooked aspect of many technology integration approaches used to date. (p. 395)

The basis for developing the TPCK framework was built on "Shulman's construct of Pedagogical Content Knowledge (PCK) to include technology knowledge as situated within content and pedagogical knowledge" (Schmidt et al., 2009, pp. 123-124). The technological pedagogical content knowledge (TPCK) model provided a framework for evaluating the professional development experienced by teachers. The TPCK framework was introduced into the research field to provide a greater understanding of the knowledge required for teachers to effectively integrate technology in the classroom (Schmidt et al., 2009). The TPCK framework has become widely used in the assessment of teachers' understanding of the integrated use of technology, pedagogy, and content knowledge for effective technology integration (Thompson & Mishra, 2007). TPCK "was used to describe teachers' body of knowledge in terms of how they made intelligent pedagogical use of technology" (Koehler, et al., 2007, p. 741).

Schmidt et al. (2009) defined TPCK as a term that "describes what teachers need to know to effectively integrate technology into their teaching practices" (p. 123). The TPCK framework covered essential areas of knowledge and practice related to addressing intended outcomes and expectations with integrating technology. Mishra and Koehler (2006) provided an in-depth definition of TPCK.

> Technological pedagogical content knowledge (TPCK) is an emergent form of knowledge that goes beyond all three components (content, pedagogy, and technology). This knowledge is different from knowledge of a

> disciplinary or technology expert and also from the general pedagogical knowledge shared by teachers across disciplines. TPCK is the basis of good teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones. (Mishra & Koehler, 2006, p. 1028)

TPCK provides a body of knowledge and a logical framework for engaging students in technology innovations, while addressing the increasing concerns about public schools and overall student learning.

Pierson and Borthwick (2010) focused on the merits of the TPCK framework in coordination with organizational learning and participant research initiated through inquiry-based learning. They suggested that professional development needed to move past the practice of measuring the self-reported satisfaction of the participants. They referred to what was described as educational technology professional development (ETPD), which supports the need for a planned evaluation strategy that could be beneficial for "understanding the extent to which ETPD is effective, rigorous, and systematic" (Pierson & Borthwick, 2010, p. 126). From the research on technology integration, TPCK was consistently acknowledged as a renowned framework for setting the terminology, context, and uniform expectations for integrating technology. Pierson and Borthwick (2010) stated,

> Layering any examination of ETPD findings with the [TPACK] model provides a helpful lens through which to view the process in light of current pedagogical thinking for 21st century learners and teachers. The fields of educational technology and teacher education have come to agreement around the concept of [TPACK] to describe the meaningful use of technology in teaching and learning. (p.127).

Changes in Practice

Ultimately, the success of technology integration will depend on classroom teachers and their ability to use the knowledge and skills gained through professional development to ensure success. Steiner (2004) stated, “Most of this research rates professional development as ‘effective’ when it leads to desirable changes in teaching practices” (p.2). Joyce and Showers (2003) maintained that understanding how teachers use and acquire knowledge and skills was essential to creating effective professional development activities that incorporate research-based evidence in the learning process. Pierson and Borthwick (2010) suggested professional development should focus on the growth of the organization and the individual knowledge of the participants. They insisted that professional learning must include the context in which the development was occurring. They contended that changing pedagogical practice was the ultimate goal and recommended using familiar assessment instruments, such as surveys, interviews, texts, and videos, to collect data for evaluating measurable teacher and student outcomes (Pierson & Borthwick, 2010). They stated, “The potential power of educational technology professional development (ETPD) to enhance teacher knowledge and skills, and thus improve student learning, means it is worth our time to understand what works and in what contexts" (Pierson & Borthwick, 2010, p. 130).

Technological pedagogical content knowledge has evolved as an integral element of the technology integration process. Hennessy, Ruthven, and Brindley (2005) examined 18 focus-group interviews of teachers in core subject areas in England. Teacher participants were involved in an initiative to enhance learning through the integration of technology. Their interviews indicated increased understanding of pedagogical content knowledge that allowed classroom practices to be advanced and extended through the use of technology. Teachers acknowledged concerns about a level of interruptions associated with technology advancements, and obstructions were addressed by focusing student attention on essential goals and objectives (Hennessy et al., 2005).

Technology integration has advanced more rapidly in business and industry because they were better equipped to handle large-scale change than schools and educational organizations. Hennessy et al. (2005) investigated how digital technology was used to initiate "already familiar activities more quickly, reliably, broadly, productively, interactively, and how such use may be re-shaping activities" (pp. 155-156). They suggested that the overall structure in the schools had limited the pace of progress with technology. They insisted the government simultaneously encouraged and constrained teachers (Hennessey, Ruthven, & Brindley, 2005). Teachers' efforts to change their practices were affected by the complexities associated with school communities that existed in the educational environment. They contended, "Innovation and adaptation are costly in terms of the time needed to develop and establish new practices" (Hennessey et al., 2005, p.162).

Difficulties with integrating technology in the classroom are not limited to the United States. Researchers in England were also interested in the impact of technology integration on schools. Hennessy et al. (2005) focused on identifying how teachers perceived the use of technology as contributing to successful practice in schools. The second phase of the study was used to investigate promising practices in greater depth. All schools in the study were located within fifty miles of Cambridge University and were relatively socially and academically advantaged. Focus groups lasted from 45-70 minutes, and a project team leader from the university or other schools facilitated sessions. The examination focused on teachers' perceptions of the contribution that was made by using information communication technology and its impact on subject pedagogies and on classroom practices.

Concerns that were investigated in England indicated the need to understand and discriminate between curriculum change and pedagogical change. The main findings in the interview data included the desirability of building a coherent and supportive community of practice associated with the integration of technology (Hennessey et al., 2005). Other findings supported providing opportunities to build teacher confidence with technology by addressing the broad differences in the experiences between departments and individuals. The researchers stated, "Above all, the rationale underlying technology initiatives needs to be made clear, and the intricate relationship between ensuing curriculum change and pedagogical change recognized" (Hennessy et al., 2005, p. 187). They suggested that as current barriers and obstacles diminished in the classroom, technology integration would play an integral role in reshaping the future of instruction (Hennessey et al., 2005).

A clear understanding of technological pedagogical content knowledge improves teachers' chances of having a positive impact on student learning. Fox-Turnbull (2006) used a task assessment study to develop a professional development program for integrating technology in primary schools. The initial study included asking students to complete tasks and utilized the findings to develop strategies to construct relevant technological practice. The National Education Monitoring Project (NEMP) in New Zealand used this method. In grades four and eight (8-9 and 11-13 years of age), students were assessed in all curricula over a four-year cycle. The assessment spanned the years from 1996 to 2000 and measured the "Aspects of Technology" (Fox-Turnbull, 2006). The task results were used to develop a program that reflected authentic technological practice. Six classroom teachers and the researcher cooperatively constructed a program that was based on developing procedural, conceptual, societal, and technical knowledge of the relevant technological practice (Fox-Turnbull, 2006). When students were assessed on in-context tasks that were developed with the use of teachers' knowledge, they showed higher measurements than when assessed on out-of-context tasks. The results of the study revealed that when teachers have a deep understanding of the knowledge needed for technological practices, they are better prepared to provide authentic learning experiences. Fox-Turnbull (2006) declared, "The children's achievement in the in-context task was enhanced by the practice that preceded it" (p. 70).

A lack of understanding about nontraditional forms of teaching and learning could lead to a skewed view of teachers' own capacity with integrating technology. Kopcha and Sullivan (2007) surveyed 50 teachers in one middle school to determine whether self-presentation bias influenced teachers' self-reports of their practices with and attitudes toward the use of educational technology. Findings suggested that such self-report surveys of teacher practices and attitudes related to technology in the classroom may yield data that were inaccurate because they indicated exaggerated accounts of teacher use of these practices. "None of the teachers had been enrolled in an educational technology program or had any formal training in the field except for a few who had taken a computers in education course" (Kopcha & Sullivan, 2007, p. 632).

Continuous access to training and equipment could have a positive impact on teachers' views and beliefs about how much they know about technology integration. However, bias about what they think they know could have negative impact on their responses to survey items. The school under investigation in this study had a total of 700 students. Teachers had access to two computer labs containing 24 computers per lab. Each teacher's individual classroom had two computers. The teacher used one, and all the students in the classroom used the other one. Teachers participating in this study indicated their experience with technology integration would have been more extensive with greater access to computer equipment. Kopcha and Sullivan (2007) suggested research conducted with teachers who had recently completed a technology program could help to determine the degree of self-presentation bias. They contended, "Training in a program of this type could conceivably increase the trainees' perceptions of the importance and social desirability of computer use, and consequently increase their self-presentation bias on surveys related to it" (Kopcha & Sullivan, 2007, p. 643). In addition, they suggested that when accurate data are viewed as important to the investigator or to a funding agency, self-presented data might need to be supplemented with additional measures.

Concerns about bias and other potential misunderstandings must be considered as an important aspect of implementing technology programs. Kopcha and Sullivan (2007) suggested that future studies on technology needed to collect and analyze alternative sources of data in addition to the self-reported findings. Future research could include (a) the examination of student projects related to technology-integration initiatives, (b) performance measures based on teacher lesson plans, and (c) observations conducted by the investigator. According to Kopcha and Sullivan (2007), “The use of such additional measures, accompanied by the evaluation of their usability and efficacy should provide a more complete and accurate assessment of teachers’ use of technology-related practices in the classroom” (p. 643). They suggested future studies related to technology integration should be concerned with minimizing inaccuracies related to self-presentation bias.

Teacher Beliefs

Teacher beliefs can have an immediate impact on the level of enthusiasm and persistence needed to integrate of technology in the classroom. The nontraditional aspects of teaching with technology force teachers to make a determination about the need to embrace or deny the importance of these new instructional tools. Hirsh (2005) suggested the most powerful professional development approaches are successful at changing teachers at the belief level. She was a proponent of open and respectful conversations that allowed for the surfacing of assumptions and changing of beliefs. She stated,

> A significant challenge to schools is selecting the staff development approach that aligns most clearly with the assumptions and beliefs of staff members and produces the results desired for students. When beliefs are in alignment, change in behavior accelerates; when beliefs underlying a new staff development program contradict long-held beliefs of participants change can come much slower or not at all. To expedite the change process and successfully close the achievement gap, educators might begin the process by ensuring a thorough understanding of the assumptions and beliefs underlying staff development programs. (Hirsh, 2005, p.39)

Much of he success enjoyed by teachers who integrate technology is connected to how their feelings about using new knowledge and skills. Confidence enhances the likelihood that they will use and successfully teach students with technology integration. Wang, et al. (2004) designed a study "to explore how vicarious learning experiences and goal setting influence pre-service teachers' self-efficacy for integrating technology into the classroom" (p.231). They used a Likert-style survey to measure teachers' perceptions of self-efficacy beliefs for technology integration. The final survey included items that asked participants to rate their levels of agreement (1- strongly disagree to 5 - strongly agree) on their confidence with technology use. Content and construct validity were reviewed for items on the survey. A panel of experts was assembled to individually review the instruments and discuss the adequacy of the conceptual definition used for the study (Wang et al., 2004). They used expert opinions to provide ratings and revisions to ensure the content validity of the instruments. Following the collection of data for the survey, a factor analysis was conducted on presurvey data and postsurvey data to determine if the instrument measured meaningful constructs in the analysis of the relationship of the items to the factors identified in the study (Wang et al., 2004).

An understanding of the knowledge and a level of comfort with the equipment are essential for integrating technology. Wang et al. (2004) found that differences in mean scores and standard deviations on presurvey scores were not significant. However, their post survey data indicated that the group of participants who had knowledge of vicarious experiences and goal setting had the highest mean score related to self-efficacy for technology integration. Participants who had no vicarious experiences and no goal setting directions had the lowest mean scores on post surveys of the four experimental groups that were used in the study (Wang et al., 2004).

A two-way ANOVA for post survey scores indicated significant effects, which indicated vicarious learning experiences and goal setting significantly increased the self-efficacy of the participants in the study (Wang et al., 2004). The researchers stated,

> Teacher educators might consider using both strategies when helping preservice teachers learn about technology integration. For example, instructors might anticipate increases in students' self-efficacy for technology integration when exemplary uses of technology in K-12 classrooms are presented and students explore these uses according to specific goals. (Wang et al., 2004, p.241)

This study could have implications for addressing previous concerns about anxiety and technology integration that were noted in the study conducted by Kotrlik and Redmann (2005).

Changing teacher beliefs is a difficult task under almost any circumstances. The literature frequently discusses what children already know when it comes to identifying their learning needs and styles. This same approach cold be used to address teachers fears, concerns and beliefs about technology integration. Levin and Wadmany (2006) conducted a longitudinal study that analyzed teachers' beliefs related to "learning, teaching, and technology, and their instructional practices, the context of integrating technology-based classrooms" (p. 157). This three-year study examined whether, how, and why information-rich tasks (IRT) influenced teacher's instructional views, knowledge and practice (Levin & Wadmany, 2006). They suggested there was still much to learn about the relationship between teacher beliefs about learning and teachers' actual practices in the classroom. Their study was developed on three major assumptions: (a) teacher beliefs come from a variety of experiences; (b) the teacher's view on technology can present a major barrier to the use of technology in the classroom; and (c) changing the teacher's paradigm was a complex matter (Levin & Wadmany, 2006). Their assumptions included the need for using a constructivist approach to investigating technology in the learning environment.

The integration of technology demands access to equipment; time to learn the technology, and effective professional development. Levin and Wadmany (2006) conducted their study in collaboration with the local municipality education department and the Israeli Ministry of Education. Their three-year longitudinal study was conducted between the years of 1997–2000 in a school located in a city in central Israel. A large portion of the investigation included a qualitative case study. An exploratory case study was actually combined with a collective study since they attempted to examine processes that affected teachers' beliefs and those that affected classroom practice in a technology-based learning environment (Levin & Wadmany, 2006). Findings suggested that, "spending three years in a technology-rich learning environment produces substantive change in teachers' beliefs and classroom practices" (Levin & Wadmany, 2006, p. 172). They that teacher beliefs ranged on a continuum from positivist, or transmissionist, to constructivist-based views on teaching and learning.

Fortunately, teacher beliefs are not always static or one-dimensional. Some teachers changed their beliefs even though they remained in a specific belief paradigm, while others shifted completely from a behaviorist to a constructivist paradigm (Levin & Wadmany, 2006). They stated, "In the context of thinking about their own experiences in rich technology-based classrooms, they acquired both conscious and unconscious insights into the meaning of teaching, learning and technology through powerful and rich actions and through reflections on these actions" (Levin & Wadmany, 2006, p. 173). The notion that teachers were able to demonstrate that they could "hold compound beliefs concerning learning and teaching has important implications for teachers' professional growth, technology integration and instructional flexibility" (Levin & Wadmany, 2006, p. 173).

It has been difficult for some teachers to align technology with their embedded patterns and beliefs about classroom instruction. According to Palak and Walls (2009), teachers with student-centered beliefs continued to use technology to support teacher-centered practices. Palak and Walls (2009) surveyed 113 PK-12 teachers, including 9 males and 104 females with teaching experience ranging from 2 to 39 years and computer experience from 2 to 20 years, averaging 9.8 years. Sixty percent taught PK-sixth grade, and forty percent taught grades 7-12. The purpose of their study was to investigate whether teachers who frequently used technology in technology-rich classroom environments changed their beliefs and practices toward a student-centered paradigm (Palak & Walls, 2009).

The full use of technology integration as an authentic alternative to traditional classroom instruction may depend on the need for teachers to make students a full partner in their learning. The quantitative results showed that the shift in teacher practice did not occur for the participants in this particular study even though they had "(a) technology availability at their schools, (b) had positive attitudes toward technology, (c) had adequate technical and general support, and (d) were comfortable with technology" (Palak & Walls, 2009, p. 436). Having teacher-centered or student-centered beliefs had little impact as predictors of teachers' practices. However, the quantitative data did reveal that teachers' attitudes toward technology were the most significant predictor of teacher use with a variety of instructional strategies (Palak & Walls, 2009). And finally, their findings indicated "unless the focus of technology integration is explicitly on student-centered pedagogy, technology integration may continue to support teacher-centered practice with inadequate, highly controlled student use in the classroom" (Palak & Walls, 2009, p. 437).

Administrative Support for Technology Integration.

One-to-one access to laptop computers in the classroom could change the complexion of the needs and opportunities of students. Issues of planning and logistical organization need to be considered for successful use in the classroom. Zucker and King (2009) described how laptops were used to teach physics at the Denver School of Science and Technology, which was the first public high school in Colorado to have individual laptop computers available for each student in the school. They confirmed that laptops were used daily by teachers and students in classrooms that included a large percentage of low-income students. Zucker and King (2009) found that "using computers can help make lessons more engaging and can challenge students at their own level—while providing instant feedback to both the teacher and students" (p. 22). They stated, "Computers engage students; encourage independence; support differentiation; and make assessment data, communication, and other common teaching responsibilities more efficient" (Zucker & King, 2009, p.25). They also found that it took more time to effectively teach students in a classroom where every student had the opportunity to use his/her own laptop computer. However, two thirds of the teachers in their study that taught physics to students in grades nine through twelve, where every student had access to the technology, felt that the devices were essential to the teaching practice (Zucker & King, 2009).

Purchasing technology equipment for the classroom can be a difficult proposition due to the on going changes of technology equipment and unforeseen advancements in future equipment designs. Zucker and Light (2009) predicted that a decline in the costs of technology equipment would result in an increase in worldwide technology programs with millions of students having access to laptop computers. They noted that policy-makers often support increased technology access because of concerns related to issues with economics, equity, and interests in education reform, even though at that time there had been little established evidence about the effectiveness of large-scale laptop initiatives.

The value of technology integration is dependent on the availability of equipment and access to relevant knowledge. Organizational success can be limited by the beliefs and concerns of the leaders in the school, or school system. Staples, Pugach, and Himes (2005) conducted a case study of three urban elementary schools in a midsized district in the Midwest. Each school received equal access to technology resources that were provided by a grant from a local university. This qualitative case study included (a) field notes from participants, (b) individual journal entries, (c) interviews with school personnel, (d) and a chronicled timeline of technology-related priorities and events (Staples et al., 2005). Although all the schools received equal amounts of technology resources, principals at each school site prioritized the acquisition of the computers for each school, resulting in an average of five computers per classroom in addition to one computer lab (Staples et al., 2005).

> A dichotomy is often invoked in discussing the implementation of technology in the schools. In this dichotomy, the purchase and upkeep of hardware and software is pitted against investing in professional development for teachers. The conventional wisdom is that the investment in professional development is almost always slighted in favor of the acquisition of equipment and software—which is then used inappropriately or inadequately. (Staples et al., 2005, p. 305)

Despite the fact that they agreed with this dichotomy, their findings in the case studies revealed more complex circumstances associated with integrating technology. Their analysis found "that the ability of a school staff, through professional development activities, to use technology well---defined here as using technology in the service of the curriculum---is not simply the flip side of investing in hardware/software" (Staples et al., 2005, p. 305).

Large-scale attention to strategic communication and specific planning impact the success of technology integration in schools. Staples et al. (2005) suggested that teachers should be deeply informed about ways to move back and forth in a sophisticated manner between technology and the curriculum to ensure successful technology integration. The investigation identified three scaffolds that appeared to have "a significant impact on—and redefine the challenge of—technology integration: alignment with the curriculum/mission, teacher leadership, and public/private roles for technology recognition" (Staples et al., 2005, p. 301).

In the past teachers were able to successfully navigate a variety of expectations and transformations that were passed down to schools as a result of societal changes. Changes in curriculum were based on the new ideas and information, but these changes occurred slowly over time. However, technology advancements have emerged at an exponential rate. Teachers and administrators have been made vulnerable to the bruises and wounds inflicted by information overload. Understanding the need to catch up with technology advancements has become an important issue for classroom teachers and school leaders. Staples et al. (2005) noted that in the past, professional development asked teachers to make changes in their practice in familiar zones of operation, whereas professional development for technology integration challenged their level of comfort. Staples et al. (2005) highlighted the complexity of technology integration and suggested that technology resources should always serve the needs of the curriculum first. They suggested technology integration "requires administrators and teachers to invest real time and effort, real fiscal and human resources in acquiring and learning to use the technology itself and keeping up the technology precisely so that it can serve the curriculum" (Staples et al., 2005, p. 306). And finally, they found that schools needed to create a new layer of professional development to address the alignment of technology integration and the curriculum.

The aims and goals of technology integration have changed less rapidly than the emergence of the new equipment and increased access to the Internet and other resources. Efforts to replicate the qualities experienced in engaging learning environments such those described by Bloom (1984), with access to individualized attention for the learner still provide the impetus for prescribing the professional development of teachers and for determining the purchase and use of technology tools in the classroom.

Often resources for integrating technology are directly affected by the decisions of school superintendents. Shuldman (2004) studied three superintendents in New Hampshire. Findings suggested superintendents have a crucial role in the facilitation of technology integration in schools (Shuldman, 2004). This case study was conducted to investigate superintendents' thinking about what they perceive as important in regard to teachers' efforts to integrate technology, "particularly in light of the implications their conceptions have on the policies that drive or impede the integration process" (Shuldman, 2004, p. 338). Although some school districts have committed large volumes of funding to provide specialized training for teachers with the integration of technology, Shuldman (2004) found superintendents believed leadership must be provided at multiple levels within the district to integrate technology successfully. Findings revealed the need for superintendents to be instructional leaders with a "comprehensive understanding of technology as an instructional tool" (Shuldman, 2004, p. 338). Shuldman (2004) also found that superintendents believed a lack of time available for teacher professional development and the public's hesitation to spend money on improving teacher capacity created barriers that presented negative circumstances for integrating technology in the classroom.

Teachers in the 21st CMC program that was investigated in this study have received on-going professional development provided by the superintendent and the executive director throughout each school year since the program's inception. They were provided with advanced technology equipment, such as laptop computers, iPod touch devices, Promethean boards, and iPad devices, in an effort to improve student learning (Grissom, 2009). The additional training of the 21st CMC program teachers and increased access to technology equipment were intended to have a positive impact on the learning of all students.

The school system superintendent aligned the 21st CMC program goals with the expectations and mission set by the North Carolina State Board of Education "that every public school student will graduate from high school globally competitive for work and postsecondary education and will be prepared for life in the 21st century" (Grissom, 2009, para 1). Another intended outcome of the program was to provide the initial framework for expanding technology integration and improving instruction throughout the school system.

Description of the 21st Century Model Classroom Program

The 21st CMC teachers met in groups by grade level and/or subjects for one full week in August of each school year as a professional learning community (PLC), which was defined as a collaborative team of teachers (Dufour et al., 2006). The summer activity lasted eight hours per day for five consecutive days. The primary focus of this PLC was technology integration. Teachers were grouped by subject area to create six lessons based on the North Carolina Standard Course of Study (NCSCOS). Teachers developed these lessons using the Challenge Based Learning (CBL) framework. Discussions focused on how to use the lessons they had created across curriculum areas and grade levels. 21st CMC teachers also came together as a PLC six times for periodic meetings during each school year. These gatherings lasted 3.5 hours per meeting and were designed to allow teachers to reflect, share ideas, and compare experiences.

Technology training. The Executive Director of Technology for the school system scheduled professional development and training activities within the six periodic PLC meetings. Training sessions began during the first year of the program in 2007-2008 and continued each school year through 2011-2012. Technology facilitators and outside presenters provided in-service training during the PLC meetings. All 21st CMC teachers were expected to participate in professional development activities during the week in August and at all other PLC meetings. Teachers were encouraged to present their new knowledge, skills, and practices at professional conferences. Each 21st CMC teacher was expected to

- learn how to use the latest technology equipment provided by the program;
- share and disseminate information to her/his peers and others in the schools;
- create engaging lessons that use technology;
- know latest trends in the use of technology;
- be able to solve problems with technology equipment;
- train others to use the equipment;
- update wiki pages with new and innovative lessons and ideas;
- share information with fellow teachers, community members, and outside visitors;

- use resources provided and discovered during personal learning experiences with technology;
- gain confidence in using the technology provided in the program; and
- become an instructional leader of technology integration (K. Martin, personal communication, January 15, 2012).

Professional development in the 21st CMC program included Wimba training, which allows teachers to communicate audibly and share documents through the use of online computer technology. Other training was provided for using document cameras and video recorders. The 21st CMC teachers learned to edit and download pictures and videos for website construction at each school. They participated in training sessions on the use of iMovie, Keynote, Edu.20, and other computer software and Internet applications (K. Martin, personal communication, January 15, 2011). 21st CMC teachers were expected to demonstrate their new knowledge, skills, and practices each spring semester to a group of their peers and system level administrators with a presentation of what they had learned during the training.

Technology equipment. The 21st CMC program furnished each model classroom with a Promethean board, document camera, and wireless Internet access. Each teacher also received the following technology devices:

- 30 MacBook computers for students,
- 30 iPod handheld computing devices for students, and
- 1 personal MacBook laptop computer for creating lessons and syncing lessons for the teacher (K. Martin, personal communication, January 15, 2012).

Other teachers from schools within the system scheduled visits to view the new equipment in the model classrooms as a professional development activity. They were able to see firsthand how these 21st CMC teachers used innovative equipment to impact the delivery of instruction. Educators, school board members, and political leaders throughout North Carolina and across the nation have visited the 21st Century Model classrooms (2009).

The school system provided continuous support to 21st CMC teachers on the use of advanced technology equipment through online communications and face-to-face instruction at PLC meetings. Online communications were provided to emphasize the independent and self-sustaining use of technology equipment. Most training activities included a brief introduction of new knowledge and skills, followed by an allotment of time for teachers to practice their skills with the use of any new equipment (K. Martin, personal communication, January 15, 2011). Much emphasis was placed on using technology equipment to facilitate challenge-based learning (CBL) activities in the classroom.

Challenge-based learning. CBL was developed as a technology-based instructional process in accordance with the benefits associated with problem-based learning, where the teacher's main responsibility changes from disseminating information to guiding the construction of student knowledge by investigating a specific problem that is often related to greater global issues (Johnson, Smith, Smythe, & Varon, 2009). Johnson and Adams (2011) described their findings related to the CBL framework in the following statement:

The students' and teachers' perceptions of technology, and their comfort with

> both the tools and their own skill sets were a key focus of the research, as the very nature of CBL presumes extensive access to technology. Indeed, CBL is a pedagogy that seems ideally suited to teaching in one-to-one classrooms, and especially where every student has access to an Internet-capable device at home and in school. Having such access allows students to continue to muse and reflect on their challenges, and … extends the school day and expands the classroom. (p. 19)

Students were challenged to solve actual problems related to the working world to stimulate interest and real world ideas that demanded greater access to technology than what was normally found in a typical classroom. The 21st CMC program provided the appropriate technology equipment to pursue the objectives noted in the CBL framework.

The research that was reviewed for this study exposed a number of conflicting findings related to providing professional development and technology integration. Nevertheless, the effort to merge these two important aspects of teaching and learning with valid and reliable tools identified in the literature became a complex but intriguing challenge. The process for the development of the first two research questions for this current study on teachers' acquisition and application of knowledge was identified in the findings of Guskey (2000). The third and final research question focused on teachers' beliefs about integrating technology as identified in the works of Levin and Wadmany (2006).

CHAPTER THREE: METHODS

Participants

The population for this study included all K-12 teachers (n=1593) from a school system located in the Piedmont area of the Southeastern United States. Respondents that completed the survey for the study (n=338) were divided into two different categories for the purpose of collecting comparative data. One of the groups identified within the sample of respondents (n=27) received continuous access to advanced technology equipment and intensive professional development as select members of the 21st Century Model Classroom (CMC) program. The other group (n=311) did not have access to the extensive professional development program specifically designed for improving teachers' competencies with integrating technology in the classroom.

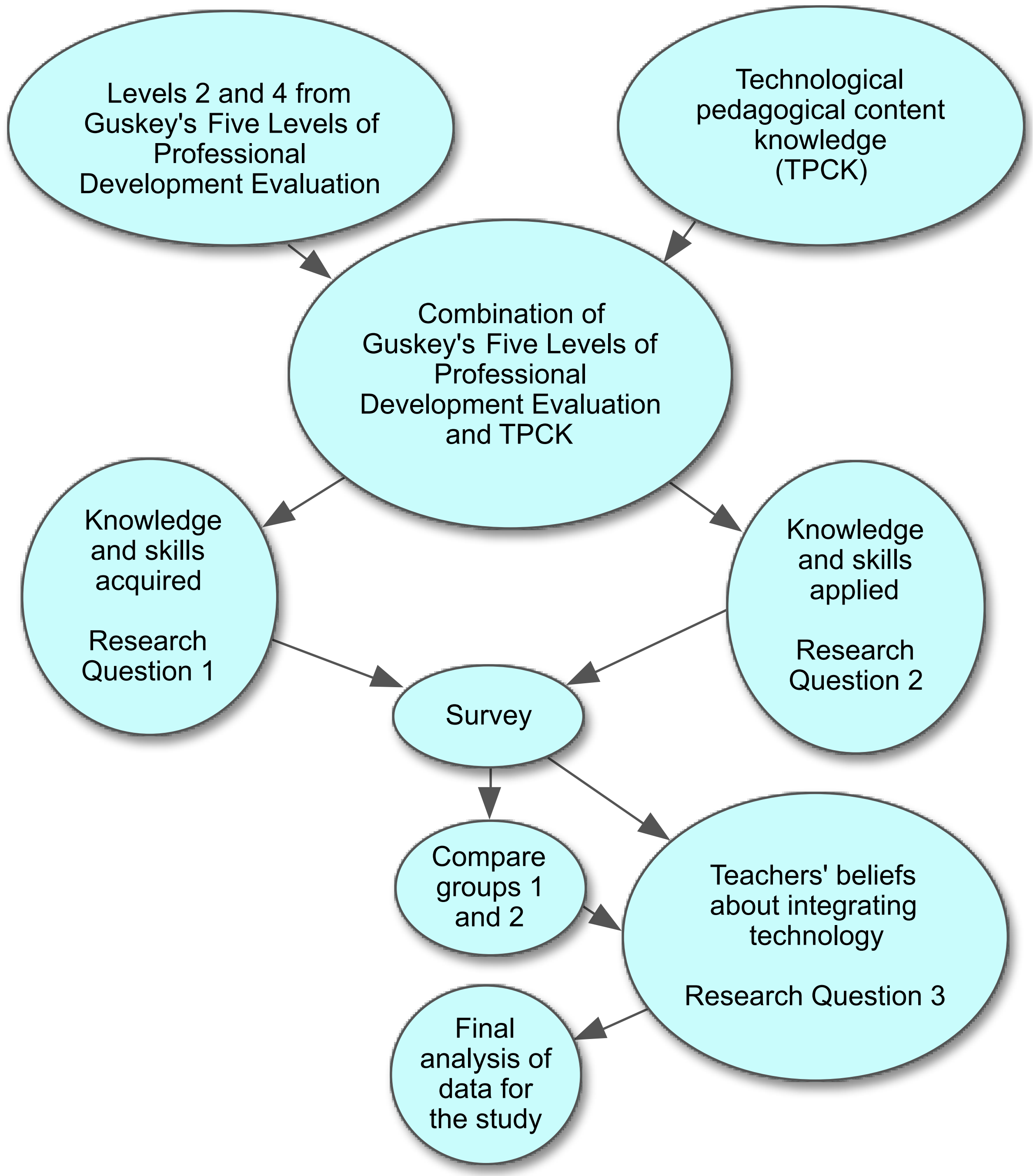
The 21st CMC program teachers. The 21st CMC program required potential candidates to fill out an application. The application process included a written document submitted by teachers to (a) demonstrate their written communication skills, (b) express their level of experience with technology use, and (c) describe their personal vision for fulfilling the responsibilities of a teacher in the 21st CMC program. The final round of the application process included a face-to-face video interview with a committee of technology experts and central office administrators to make the final selections for the program. This extensive application process was used to select K-12 teachers (n=39) who were enthusiastic about integrating technology; therefore, the teachers that were invited to participate in the 21st CMC program did not necessarily represent all teachers in the school system.

Non-participants. The second group of participants in the study either did not apply to the program or were not selected to participate in the 21st CMC program. Non-participants (n=1554) from the school system were targeted for the investigation because they did not receive the extensive professional development and technology equipment provided by the 21st CMC program.

Instrumentation

The development of the instrument for this study emerged from the need to find a valid and reliable tool for investigating technology integration in the classroom while examining professional development used for improving teacher competency with technology integration. Previous studies by Koh, Chai, and Tsait (2010) and Hsu (2010) included technological pedagogical content knowledge (TPCK) in their investigation of technology integration. This study logically and strategically combined TPCK with Guskey's (2000) Five Levels of Professional Development Evaluation. This questionnaire was designed by using evaluation levels 2 and 4 of the Five Levels of Professional Development Evaluation identified by Guskey (2000). Level 2 addressed teachers' acquisition of knowledge and skills, and Level 4 addressed teachers' application of knowledge and skills. The TPCK highlighted in Koh et al., (2010) and Hsu (2010) and described by Harris et al. (2009) provided important information and guidance in the development of the survey items for this study. Although the previous studies noted were conducted in countries outside of the United States, they were helpful because of their focus on TPCK in the development of their surveys. A diagram of the instrument for the study is illustrated in Figure 1.

Figure 1. Diagram of the Development of the Technology Survey



This study was developed in effort to gather information about technology integration from teachers by comparing their experiences and highlighting some of the successful strategies that emerged in the classroom. The survey that was used asked participants to include demographic information that was beneficial for analyzing the statistical findings and open-ended responses. The instrumentation was guided by the theories of Guskey (2000) and Harris et al. (2009). Section one of the survey included 13 items that allowed respondents to categorize themselves by their own perspectives in regard their individual level of expertise with integrating technology. The choices that were available on the first 13 Likert-scale responses were developed by using 21st Century skills that were included in the mission and vision of the 21st CMC program. In section two, participants were asked to identify additional activities for integrating technology that were not found among the selections on the provided list. Respondents were asked to respond to this section in the form of an open-ended response. Section three of the survey addressed teachers' acquisition of knowledge and skills with technology integration. This section included a four-item Likert-response scale. Items ranged from *strongly disagree to strongly agree.* This section included 13 items on an even-numbered scale, which eliminated neutral middle responses, which can distort measures of central tendency and variance if a neutral unforced response was provided (Malhotra, 2006). Section four used 18 Likert-response scale items to question respondents about how participants applied their knowledge and skills to integrate technology into the curriculum. Sections five and six used two open-ended items to focus on respondents' access to professional development and technology equipment. Section seven used an open-ended item to question participants about their beliefs in regard to integrating technology in the classroom. The remaining sections of the survey focused primarily on demographics and requested information about teaching experience, gender, degrees earned, National Board Certification status, grade span, and status of the teachers in the 21st CMC program and of non-participants. The last item on the survey provided participants with the opportunity to receive a summary of the results from the study by entering their email address in the space provided.

Previous forms of the instrument. Items for the survey were developed after an extensive review of the literature on professional development and technology integration. The opportunity to consult with practicing professional development and technology experts during the collection of data was an integral component in the development of the items selected for the survey. Items from previous studies were scrutinized and modified in the development of survey items used to address the research questions in this study. A factor analysis performed on survey items from the previous studies of Koh et al., (2010) and Hsu (2010) identified items with high alpha values in relation to TPCK (Harris et al., 2009). A small number of survey items from previous studies were removed because of duplication and similarities found between the original survey items from Koh et al., (2010) and Hsu (2010). A review of the differences between the cultural and educational characteristics of the participants in the previous studies was used to determine the items that were selected, modified, or eliminated for use in this study.

ISTE NETS-T. The International Society for Technology in Education and National Educational Technology Standards (ISTE NETS) and Performance Indicators for Teachers (NETS-T) (2008) were embedded in the survey items used for this study.

The NETS-T standards and indicators were found in the following categories: (a) Facilitate and Inspire Student Learning and Creativity, (b) Design and Develop Digital-Age Learning, Experiences and Assessments, (c) Model Digital-Age Work and Learning, (d) Promote and Model Digital Citizenship and Responsibility, and (e) Engage in Professional Growth and Leadership. The consent form for this study is located in Appendix A. Survey items for this study are located in Appendix B.

Data Collection Procedures

Permission was secured from the superintendent of schools to survey all K-12 teachers in the school system that were willing to respond to the questionnaire developed for the study. All teacher participants were informed about issues of confidentiality and protection from harm (Gay, Mills, & Airasian, 2009). All teachers in the school system were invited to complete the online survey. A consent form allowed teachers to accept or decline the invitation to participate in the study.

Qualtrics online survey software was used to collect the data from participants. Email address contact information was provided to the researcher by the school system for the purpose of conducting the survey. Each participant received access to an online questionnaire. All teachers in the 21st CMC program had a high level of experience with using online communication systems, which should have been beneficial for completing and returning the surveys for the study. All non-participants also had continuous access to the online survey at their individual schools. Teachers could respond to the invitation from off-campus communication systems after working hours. Potential respondents consisted of a small but inclusive sample of 21st CMC teachers and a wide array of non-participant respondents. Since all teachers had ample access to electronic communication systems, the online survey instrument was an effective tool for collecting data in this particular study.

The online survey was provided to participants for a total of two weeks. Recent research related to online survey distribution indicated that the two-week time frame for access was beneficial for this type of study (NPD Online, 2011, para. 3). An email reminder for teachers to complete the survey was sent one week before the end of the process as suggested by Heppner and Heppner (2004) to improve the rate of return. Teachers were offered the chance to participate in a random drawing for a $100.00 cash incentive in return for completing the survey, as recommended by Creswell (2008). The drawing was held at the end of the data collection process.

Data Analysis

Statistical Package for the Social Sciences (SPSS) software was used to examine the quantitative responses in the study. T-tests were run to generate p-values and to determine if there were significant differences between the responses of the 21st CMC program participants and the non-participants. Statistical procedures were also used to compare the demographic information that was submitted by the respondents. Cronbach's (1984) alpha coefficient for determining internal consistency was used to determine the reliability scores of each subscale, and to provide and overall reliability score for the entire survey. Other statistical procedures in the analysis addressed effect size by using Cohen's *d* (1992) scores and scores for power. Effect size was calculated to determine the practical significance of the scores found among the teachers in the 21st CMC and non-participants. Qualitative survey responses were analyzed from both groups of respondents to gain a deeper understanding of their perceived levels of access to professional development and to technology equipment. Finally, qualitative data related to teacher beliefs were analyzed to compare differences between the two groups of survey respondents.

CHAPTER IV: RESULTS

The purpose of this study was to compare differences and similarities between how teachers in the 21st CMC program and non-participants acquired and applied new knowledge and skills for integrating technology in the classroom environment. This investigation also examined how participants described professional development activities, access to technology equipment, and their beliefs about integrating technology in the classroom environment. The research questions included

1. What are the differences and similarities between how teachers in the 21st CMC program and non-participants acquire knowledge and skills for integrating technology?
2. What are the differences and similarities between how teachers in the 21st CMC program and non-participants apply knowledge and skills for integrating technology?
3. How do teachers describe their beliefs about integrating technology in the classroom?

Demographic Profiles of Respondents

Surveys were emailed to all teachers (n=1,593) in a single school system in the Piedmont of the Southeastern United States. Information was gathered from all of the respondents that completed the survey (n=338) for an overall response rate of 24%. Respondents included participants in the 21st CMC program (n=27) and non-participants (n=311). Demographic categories included the following characteristics: (a) years of teaching experience, (b) gender, (c) highest college degree, (d) National Board Certification status, (e) grade span taught, and (f) designation or not as a 21st CMC teacher. Ultimately, the most significant statistical differences in the demographic data were found to be associated with whether or not teachers were designated as a 21st CMC teacher or as a non-participant. However, the qualitative data included relationships and perspectives that included almost every aspect and characteristic noted in Table 1.

Table 1

Demographic Characteristics of the Respondents

	n	%
Years of Teaching Experience 0 to 4	50	15%
5 to 9	67	20%
10 to 14	73	22%
15 to 19	52	15%
20 to 24	42	12%
25 or more	54	16%
Gender Female	282	83%
Male	56	17%
Highest Degree Earned Bachelor's Degree	189	56%
Master's Degree	135	40%
Advanced Degree	10	3%
Doctoral Degree	4	1%
National Board Certification status	Yes = 61	18%
	No = 277	82%
Grade Span Elementary School	154	46%
Middle School	90	27%
High School	94	28%
Participants & Non-participants		
21st CMC Teachers	Yes = 27	8%
Non-participant Teachers	No = 311	92%

Quantitative Analysis of the Research Questions

Most of the surveys that were returned by the respondents were successfully completed. Twenty-three incomplete surveys were eliminated from the study. The Qualtrics computer program was used to collect and store survey information in the initial stages of the data collection and analysis. A manual process was also used to review the individual data on each survey to gather information beyond the capacity of the computer program. The Statistical Packages for the Social Sciences (SPSS) software was used to compute the most advanced statistical measurements. SPSS was an effective tool for processing the final cleaning and accounting of the data provided by the teacher respondents (Creswell, 2008).

Reliability and validity. The reliability of the survey was examined by using the coefficient alpha to test for internal consistency (Gay, Mills, & Airasian, 2009). When "items are scored as continuous variables the alpha provides a coefficient to estimate consistency of scores on an instrument" (Creswell, 2008, p. 171). Cronbach's alpha is the most widely used measurement for analyzing the reliability of items on Likert-style survey instruments (Steiner, 2003). Table 2 contains the results of the internal consistency reliability tests that were run for each of the quantitative measurements included in this study. An analysis using Cronbach's alpha (1984) was performed on each of the quantitative subscales and for the entire survey (n=44). Each subscale and the overall score for the instrument met the .70 or greater standard of acceptability for Cronbach's alpha coefficient (1984) as noted in Tables 3-6. Content validity was addressed by using Guskey's (2000) Five Levels of Professional Development and TPCK principles as described by Harris et al. (2009) to ensure that widely accepted theories and established standards were used to investigate this topic.

Table 2

Reliability Statistics: Entire Survey Instrument

Test for Internal Consistency Reliability	Cronbach's Alpha Coefficient	n=Survey Items
Entire Instrument	.911	44
Subscale 1: Technology Integration Activities	.799	13
Subscale 3: Technology Knowledge	.929	13
Subscale 4: Technology & Curriculum	.882	18

Statistical Significance. P-values for each of the survey items were examined individually to determine the difference in levels of statistical significance that existed between teachers in the 21st CMC program and non-participants. As an entire instrument the survey did not meet the standard ($p \le .05$) for statistical significance. However, within the total quantitative items (n=44) on the survey, nine of the individual items did meet the value of .05 or less acceptable standard for statistical significance. Items that showed statistical significance in the comparisons between teachers in the 21st CMC and non-participants are listed under the P-value column in Table 3.

Table 3

Item Numbers, P-values, Power, and Cohen's d Values for Survey Items

Statistically Significant Survey Items	**Item #**	**P-value**	**Power**	**Cohen's *d***
1. *Technology Integration Activities				
Shared information with teachers in my school	TA-q1c	.049	.500	*d*=.393
Solved problems with technology equipment	TA-q1f	.011	.710	*d*=.506
Updated wiki pages with innovative lessons	TA-q1h	.009	.925	*d*=.678
Used school resources to enhance student learning	TA-q1k	.022	.440	*d*=.359
Served as an instructional leader of technology integration	TA-q1m	.013	.830	*d*=.584
3. Technology Knowledge				
I combine content, technology, and teaching in my classroom.	TK-q3l	.007	.830	*d*=.592
I provide leadership for helping other teachers with technology.	TK-q3m	.034	.590	*d*=.437
4. Technology in the Curriculum				
I use technology to teach lessons for remediation purposes.	TC-q4g	.000	.930	*d*=.683
I solve hardware problems during class.	TC-q4q	.050	.560	*d*=.430

Code example: TA-q1c = (subscale=TA) (question = q1) and (survey item=c)
*TA= subscale 1 TK= subscale 3 TC= subscale 4

Effect size. The comparisons between 21st CMC program teachers and non-participants, which identified nine items with ($p <= .05$) led to further tests and comparisons, which included measurements for effect size. Effect size measured the degree of practical significance for each item as opposed to statistical significance (D. Scales, personal communication, November, 25, 2012). Because there was a sizeable difference between the number of respondents in the 21st CMC program (n=27) and the non-participants (n=311), it was important to use a measurement that ignored differences in sample size. Effect sizes are standardized measures to determine differences between two different means of groups in a study. Effect size was used to determine the strength and the magnitude of the relationships that existed between the two variables (Durlak, 2009).

Measurements of the quantitative data included a calculation for power based on effect size. In the power measurement, sample size was taken into account in the comparison of the two groups that were studied. A combination of the effect size and sample size were used to calculate the measurement. Sample size was integral to determining the desired level of power analysis needed for a given comparison between groups of respondents. A power table was used to identify the level of strength revealed in the calculation of effect size and sample size (Howell, 2010). An arbitrary power level of .80 is desired in this type of analysis (Heppner & Heppner, 2004).

Cohen's *d* (Cohen, 1992) was also used to examine the effect size of the nine quantitative statistically significant items on the survey. Each of the items demonstrated at least a moderate effect size for Cohen's *d* (1992) measurements (small effect size = 0.20; a moderate effect size = 0.50, and a large effect size ≥.80). Cohen's *d* (1992) is a formula similar to the one used for independent-means *t*-tests, but sample sizes are removed from the calculation (D. Scales, personal communication, November, 25, 2012). As noted in the Cohen's *d* (1992) measurements in Table 3, scores on the nine survey items that showed statistical significance ranged from $d = .358$ to .682 for effect size, which is shows scores which account for scores of practical significance. Of the nine items that were calculated for Cohen's *d*, five were identified in the desirable range of moderate to large as listed in Table 3.

Qualitative Analysis of the Study (Questions One, Two, and Three)

The open-ended survey items created the opportunity to capture teachers' points of view without predetermining prior selections on response scales or question categories (Patton, 2002). The first open-ended item was inserted immediately following the Activity Integration section of the questionnaire. The second open-ended item asked teachers to describe their level of access to professional development for technology integration, which addressed the first research question in the study. The third open-ended item asked teachers to describe their level of access to technology equipment, which also addressed the second research question. The final open-ended item asked teachers to describe their beliefs about integrating technology in the classroom, which addressed the third research question in the study.

The qualitative descriptions provided by the teachers produced an opportunity to categorize information that was organized under three main headings, which included the following headings related to their access to professional development and technology equipment: (a) inadequate, (b) adequate, and (c) more than adequate. The categories were developed based on recurring themes found in the data collected from the respondents (Creswell, 2008). Responses about teachers' beliefs were also placed into categories following an in-depth review of their individual qualitative responses about technology integration. The categories were also generated based on recurring themes that were found in the data about their beliefs, which included: (a) do not believe, (b) believe, and (c) strongly believe in technology integration in the classroom.

Technology integration activities. Respondents were asked to provide technology integration activities that were not provided on the survey list to further reveal tools or strategies they used to integrate technology in the classroom. Many of the additional activities provided by the respondents focused on how teachers included collaboration as a consistent part of their instructional process. Many of the respondents suggested that discussions with other teachers were not limited to in-house communications but also included sharing ideas with colleagues by using online technology throughout the school system and with other educators across the nation. Teachers described online book clubs, catalogs, eBooks, and the EDU 2.0 sharing systems as important tools for collaboration and integration.

Other activities described by teachers included the use of iPads, online assessments, probes and sensors, loading books on iPods, online lessons, Moodles, using Odyssey Ware instructional tools, interactive sites, technology publishing tools, response systems, podcasts, and document cameras. Almost 100% of the 21st CMC program teachers identified their level of access to the activities on the list as more than adequate. The list provided to the respondents in the survey was developed based on goals and expectations that were generated for teachers in the 21st CMC program. However, the survey also revealed a substantial number of non-participants that were using advanced knowledge and skills with technology tools that equaled or even surpassed some of activities noted on the "check all that apply" list.

Access to professional development. The next open-ended question revealed a wide variety of responses related to teachers' access to professional development for technology integration. The largest portion of overall respondents surveyed described their access to professional development in positive terms with levels of access that ranged from daily, to weekly, to monthly, and to periodic access with system-level professional development sessions that were offered. Even more positive, some teachers suggested they had continuous access to on-site professional development and training at all times. All 21st CMC program teachers that completed the survey reported high levels of access to technology integration professional development. Commentary by some respondents included reports of non-participants providing effective leadership with professional development even though they were not in the 21st CMC program.

Negative responses reported on the survey included concerns with a lack of professional development and training because of perceived disparities among the 35 different schools in the system and among the various grade spans. Concerns about equity in the professional development activities among schools ranged from simple issues of limited access to concerns about needing more time to practice, more individual assistance, and more time scheduled to meet with system-level technology facilitators. Middle school teachers appeared to have the most complaints about their perceived lack of access to professional development for integrating technology. This could be due to the fact that much of the technology training and equipment was provided to elementary schools and high schools before the focus of the program was directed toward middle schools.

Within the range of concerns provided by over three hundred teachers, a number of interesting views about accessing professional development were identified. One individual respondent complained that the professional development failed to meet the needs of advanced technology users. Conversely, another teacher revealed a lengthy list of professional development activities and conferences that she had attended at the state, local, and national level. Several teachers had concerns about a lack of access, focus and assistance provided to non-core/elective area teachers. These teachers expressed a need to receive more intensive professional development for integrating technology. And finally, a small but vocal number of respondents were upset because of what they perceived as "too much mandatory" professional development for technology integration. Although there were a number of criticisms about access to professional development leveled by some non-participants on the survey, over 75% of all teacher respondents, which included nearly 100% of the teachers in the 21st CMC program, described their access to professional development for technology integration as adequate or more than adequate.

Access to technology equipment. The open-ended survey item that asked respondents to describe their access to technology equipment also included a total of more than 300 teachers. The range of responses produced in the survey varied greatly. Descriptions from the respondents specifically addressed the amount of technology equipment provided to individual classroom teachers as noted in the following response: "Unlimited access, I have 30 MacBooks, 30 iPads, headphones, interactive whiteboard, document reader, digital camera and a video camera." In contrast, another respondent expressed concern about access to technology equipment and stated, "I have very poor access. Other comments stated "almost impossible to get computers when needed," and "money wasted on 21st century teachers-no need for them to have laptops, iPads, and iPods in the same classroom that they cannot share." A related concern stated "the 21st

CMC program perpetuated inequities in the learning environment that create haves and have not's" when it comes to accessing technology equipment.

Concerns about checkout procedures for accessing equipment from labs and media centers at each of the 35 schools varied widely. Much of the data discussed ways that teachers were sharing equipment and utilizing computer labs to minimize issues with their lack of opportunity to access technology equipment.

Some of the less satisfied respondents voiced concerns about needing more laptops to individualize student learning, "not enough to go around" and "too much responsibility for damage and/or loss of equipment" for teachers. Other comments included concerns about "equipment repairs" and "training provided for iPad use without access to the devices in the classroom," although they noted iPads were suppose to be on their way from the warehouse at the central office. Additional comments included concerns about limits on acquiring additional equipment due to funding, restrictions imposed on Internet access, and educational sites blocked by the technology department. Some respondents suggested this process was the best opportunity to access equipment while others felt that it was the worst. The disparities between access to professional development and technology equipment between the schools were highlighted by a number of teachers that completed the survey. Imbalances in the amount of equipment provided at each school were affected by the funding allocated by the school district and by the individual beliefs and ambitions of the building level principals. Some of the choices that contributed and sometimes detracted from the growth of technology in each building was due to discretionary spending that was provided by donating organizations such as PTA, Booster Clubs and individual matching fund options provided the school district and grant funded projects.

A large number of respondents had a positive view of their access to technology equipment in the schools. Many of the descriptions included complimentary perspectives such as "good access, easy access, excellent, quite a bit, plenty of access, always available, enough, massive, and endless," just to name a few of the more positive statements. Regardless of the concerns mentioned in the descriptions by some of the teachers, over 70% of all respondents, and 100% of the teachers in the 21st CMC program that responded, felt their access to technology equipment was adequate or more than adequate.

Beliefs about integrating technology. The final open-ended item on the survey addressed the third research question in the study. Teachers were asked to describe their beliefs about integrating technology in the classroom. This question seemed to strike an emotional chord with many participants, based on their varied responses. Teachers who claimed that tools for technology integration were "essential" to the learning process accounted for the largest number of respondents on this item.

Table 4

Results: Most Prevalent Themes Concerning Teachers' Beliefs

It is essential to the learning process.	58
It increases student engagement.	41
It is important but should not replace all direct instruction.	27
It is vital for competing in the 21st century society.	27
It increases student motivation.	24
It is a useful tool	22
It enhances student learning.	18
Important but we need more resources.	17

The second largest number of teachers attempted to substantiate the benefits of technology integration because of its impact on "increased" student engagement. Other positive descriptions that were well represented among respondents included "it is vital for competing in the 21st century" society. It "increases" student motivation. It "should be used" and students must become "technology savvy" in today's world. Other responses stated 'it is a useful tool" and "it enhances" and "it's a must for student learning," and "it should be a natural part of teaching not a special event" in the classroom. Further responses about beliefs included "it is crucial for some students who might normally struggle with direct instruction but succeed with technology " and "I can barely teach without it" and "it brings learning to life" and "it can set their desire to attain knowledge on fire" in the classroom. One teacher's response suggested that technology integration allowed her to "eliminate the physical walls and barriers that hindered her ability to address all learning styles." Many of the respondents highlighted the potential that exists for differentiating instruction by using technology integration.

Contrasting responses related to teachers' beliefs about technology integration were represented by a fairly strong contingent of respondents that believed technology was "important but should not replace all" direct instruction. Another considerable number of respondents suggested that technology was "important but we need more resources" for the classroom. A sizeable number of respondents believed that technology was effective "as needed" for the lesson "but not an end all" for successful instruction. Other multiple concerns identified by respondents' beliefs included statements such as technology "can be a distraction" and "it's important but we need more time" to plan. Technology needs to be "more available" and more "reliable" in the classroom and "there always needs to be a plan B" with this type of instruction. Other respondents suggested there "needs to be a focus on proper use" by students, it's "too expensive," and we have become "too reliant" and "sometimes paper and pencil do just as well" in the classroom. One teacher suggested that technology integration was an excellent tool "but it will not make poor teaching suddenly and magically become good teaching."

Respondents had strong opinions and beliefs that were explicitly illustrated through their commentary about technology integration. As noted in the previous open-ended items, almost all 21st CMC program teachers strongly believed in the importance of using technology to enhance instruction. But the final accounting of all teachers surveyed in the study revealed that over 72% of all respondents, and 100% of the teachers in the 21st CMC program, reported positive beliefs about integrating technology in the classroom. Even under the varying levels of professional development and technology equipment provided at each of the 35 schools in the system, most teachers have bought into the desire, or at least the need to integrate technology as a part of their instructional plan and process.

Summary of the Results

Quantitative measurements that were calculated for the study revealed that the overall reliability of the survey was very high. The reliability measurement used for the entire instrument produced a score of .911, which fell into the category of excellent in regard to Cronbach's alpha (1984) coefficient for internal consistency. Initial findings for statistical significance in the comparison of the two groups revealed that only nine of the items on the survey proved to be significant. However, when measurements for effect size were calculated on those same nine items using Cohen's *d* and power level analysis (Cohen, 1992) showed moderate to high levels of practical significance found in the scores of the effect size scores between the two groups. Five of the nine findings for power proved to be strong.

The qualitative findings for the open-ended questions revealed that many teachers, both inside and outside the 21st CMC program attempted to take advantage of opportunities to learn more about the integration of technology. Some 21st CMC teachers provided commentary on activities they used that were not listed in the survey. A large portion of the teachers, who spoke about using collaboration and advanced technologies such as probes and sensors, document cameras, and Moodles, were non-participants. The qualitative responses varied greatly among the participants throughout the 35 schools that were surveyed. A number of respondents commented on the role of leaders and the degree of leadership provided in the schools by 21st CMC teachers, non-participants, technology facilitators, and administrators who were involved with technology integration in the schools. Many teachers felt that their building level administrators were in full support of their efforts to integrate technology and provide the latest tools for technology integration. A smaller number indicated they felt that best and most advanced technology tools were being provided to a chosen few teachers in their building and that other schools were benefiting from having stronger leaders that were able to procure more technology.

Negative and positive comments were clearly communicated in the findings, ranging from teachers that felt they did not receive enough professional development and training, to those who were upset about the fact that principals and other school leaders were demanding more time spent on increasing knowledge and skills with technology integration. Many of the responses related to professional development appeared to parallel their views on their access to technology equipment. Some of the individuals that complained about not receiving enough training also complained of limited access to equipment. Some participants voiced their frustration with mandates for having to use too many types of equipment, and some felt as though they would never be able to use it successfully. Other reports included a fear of technology integration due to their lack of knowledge, while an even smaller group of respondents suggested they were in rebellion about the changing role of teachers that included so much technology integration. Most survey responses on teacher beliefs appeared to be motivated by their strong level of enthusiasm for embracing advanced technology integration or by a deep concern for what some teachers perceived as a loss of importance being placed on direct instruction by school leaders. Among the positive responses, which included the majority of the teachers that took the survey, most suggested that they welcomed the opportunity to gain more knowledge through professional development and the chance to use more technology equipment.

CHAPTER V: CONCLUSIONS

The purpose of this study was to compare differences and similarities between how teachers in the 21st CMC program and non-participants acquired and applied new knowledge and skills for integrating technology in the classroom environment. This study also examined how participants described their use of professional development activities and their beliefs about integrating technology in the classroom environment. The research questions included

1. What are the differences and similarities between how teachers in the 21st CMC program and non-participants acquire knowledge and skills for integrating technology?
2. What are the differences and similarities between how teachers in the 21st CMC program and non-participants apply knowledge and skills for integrating technology?
3. How do teachers describe their beliefs about integrating technology in the classroom?

Discussion of the Findings

Quantitative discussion of research questions. The analysis of the data highlighted numerous findings that both converged and diverged with previous studies (Heppner & Heppner, 2004). Quantitative survey items provided highly reliable findings, which exposed a large number of similarities between the teachers in the 21st CMC program and non-participants. The initial statistical findings indicated that only nine of forty-four items showed statistically significant differences between the two groups, which was important for answering the 1st and 2nd research questions. The lack of differences found between the two groups appeared to indicate a positive relationship between how the two groups of teachers acquired and applied knowledge and skills for integrating technology. However, the nine items on the survey that showed significant differences between the teachers in the 21st CMC program and non-participants were then measured for effect size, which led to the discovery of five strong relationships in the magnitude of differences between the two groups when the items were measured for power. Findings in the commentary provided by qualitative survey items supported many of the differences that were reflected in the quantitative findings.

The third research question used an open-ended item to gain a meaningful understanding (Patton, 2002) of how teachers' beliefs impacted technology integration in the classroom. The study indicated that many of the differences found between the two groups were much easier to identify through the "lived experiences of teachers" as described by (Budd, 2005), which were specifically described in the qualitative findings. One major difference found in the open-ended items was related to the increased amount and high quality of the professional development and technology equipment provided to the teachers in the 21st CMC program, and the lesser amount and quality of the resources provided to the non-participants. Although some of the respondents expressed resentment about the differences in the amount of access provided between the two groups, most appeared to understand the program goals and were grateful for the opportunities that accompanied the addition of a 21st CMC program in their school. Interestingly, there were also a number of non-participants in some schools that appeared to enjoy levels of training and equipment that rivaled the amount provided to teachers in the 21st CMC program. However, respondents who highlighted large discrepancies in the resources between the two groups tended to blame building-level and central office administrators for the perceived inequities that existed from school to school.

As a whole, a review of the quantitative findings indicated many similarities between the two groups of teachers. The largest volume of descriptions in the findings about access to professional development and technology equipment, as well as beliefs about technology integration was favorable. These data suggest that there was a positive relationship between the implementation of the 21st CMC program and an increase in the amount of technology integration in the school system. The qualitative data provided an opportunity to include subjective views of teachers. Both positive and negative remarks were fully described in the qualitative responses on the survey item related to teacher beliefs. However, in the final tally, teachers indicated that most had positive attitudes and perspectives in relation to their beliefs about integrating technology in the classroom.

Summary of the findings. The unique and diverse perspectives of both groups of respondents revealed both expected and unanticipated findings in the qualitative data. The 21st CMC program was implemented more than four years ago. Until now, the program was not examined or evaluated with a measure as extensive or as reliable as the survey developed for this study. This study captured the real world perspectives of the respondents who faced the authentic daily challenges of integrating technology in the classroom.

Altogether, the findings suggested that the superintendent's focus on promoting system-wide technology initiatives, such as the 21st CMC program, minimized the effect of barriers that often limit teachers' access to the knowledge and equipment needed for integrating technology. Teachers' views were freely expressed in their own voice, which added a rich level of clarity and meaning to the findings. Multiple remarks found in the qualitative responses helped to compensate for many of the expected limitations associated with conducting a cross-sectional survey. Findings in the survey reinforced many of the claims in the previous literature, which suggested teachers who have access to effective professional development were more likely to make systematic pedagogical changes and have positive beliefs about integrating technology (Guskey, 2000; Lowden, 2005).

Negative comments provided important information for researchers and practitioners about the difficulties and concerns involved with integrating technology on a system-wide scale. This study was planned and conducted with a specific focus on the need to gather broad perspectives of individual circumstances from respondents. The difficulties associated with integrating technology were well represented among the qualitative responses, which substantiated much of what was found in the previous literature. However, the quantitative findings in this study from both groups suggested that respondents had similar experiences with professional development and technology equipment. The largest number of respondents from both groups acknowledged their overall satisfaction with integrating technology. Since over two-thirds of all respondents in both groups felt their access to professional development and technology equipment was adequate or better indicated a level of stability and success within the program. Two thirds of all respondents also acknowledged their positive beliefs about technology integration, which further substantiated the success of the 21st CMC program. Wang, et al. (2004) found that teachers were useful indicators for predicting success with technology integration, which reinforced the value of the survey responses in this study.

Comparisons with previous research. The findings in previous studies guided the direction of this investigation and substantiated many of the findings that were discovered in the study. Previous findings were very diverse and often conflicting, particularly in regard to the rapid changes affecting professional development, technology equipment and teacher beliefs. Three areas of concern identified by the respondents are discussed in this section: a focus on direct instruction, collaboration, and leadership. This section also includes important aspects of student engagement and constructivism that were highlighted in the literature and confirmed in the survey responses.

Direct instruction. A number of the respondents in this study were steadfast in their beliefs that direct instruction should not be replaced or be overshadowed by the changing methodologies related to technology integration. MacDonald's (2008) findings warned that teachers' resistance to new ideas or innovations could interfere with professional development and technology use. MacDonald (2008) noted differences in resources, problems with allocating computer time for classes, and a lack of technology skills and knowledge as obstacles related to technology integration in the classroom. These issues mirror many of the same concerns found in the responses of teachers in this study. A considerable number of non-participants and even some teachers in the 21st CMC program expressed the benefits associated with traditional methods of teaching. That is, there appears to be a gap between how teachers perceive the value of direct instruction and the potential that exists for enhancing direct instruction through technology integrations for some teachers. Many appear to have an either/or perspective on using technology, rather than an open view on how professional development and technology equipment might help facilitate the richness of their direct instruction.

There was a considerable amount of discomfort and tension revealed in some of the responses of the non-participants. Some of the barriers that effect teachers' willingness to embrace the benefits associated with technology integration in this study were also recognized in the previous literature. Kotrlik and Redmann (2005) suggested that teachers were at varying points of knowledge and skill on the continuum of technology expertise, which was clearly indicated in the responses of many of the non-participants who completed the survey. They investigated anxiety levels associated with integrating technology (Kotrlik & Redmann, 2005). Their comments and concerns about the changing roles of teachers and students and increased expectations with technology integration strongly correlate with the findings of Wexler (2000). However, many of the teachers in the 21st CMC program and non-participants made claims of increasing confidence and enthusiastic anticipation, while they eagerly await the chance for more professional development and technology equipment.

Fijor (2010) noted that a failure to recognize the evolving aspects of student engagement related to technology integration could limit teachers' ability to fully impact student learning with the changing complexion of future classrooms. A lack of desire to embrace the attributes of engagement theory, as described by Kearsley and Shneiderman (1999), was represented among some of the non-participants. Their reluctance to embrace professional development and change their strategies and practices, as described by Steiner (2004), to a more constructivist approach could limit the overall growth of technology integration in the school system. Some of the respondents were locked into comfort levels with their traditional methods of teaching because a variety of concerns related to fear, complacency, denial, and/or rebellion.

Liu and Szabo's (2009) findings highlighted teachers' concerns about how to keep up with rapid changes in procedures, methods, and resources related to technology integration. Their findings noted on-going concerns by teachers about the extensive commitment of time and energy needed to integrate technology in the classroom. Such concerns were heavily reflected in the open-ended survey responses of some non-participants.

Guskey's (2000) theories have been widely used in schools as well as business and industry to evaluate professional development in a wide variety of programs and organizations throughout the world. Lowden (2005) conducted a study that also included Guskey's Five Levels of Professional Development Evaluation (Guskey, 2000, 2002a). Although the current study used only levels 2 and 4 of Guskey's (2000) Five Levels of Professional Development Evaluation, a comparison between the two studies revealed a positive relationship between Lowden's (2005) findings on teacher beliefs and the qualitative responses on the questionnaire for this study. Findings of both studies indicated that the teachers involved in highly effective professional development activities, such as the 21st CMC program, were more likely to strongly agree with statements that support a change in their attitudes and beliefs about teaching and learning than teachers who participated in less effective forms of professional development (Lowden, 2005). Both studies also revealed there was a strong correlation between teachers' reported implementation of new knowledge and skills in the classroom and the impact on student learning outcomes.

Lowden's (2005) findings supported Guskey's (2000) Model of Teacher Change theory, which indicated that systematic changes in instructional pedagogy are more likely to occur when teachers participate in highly effective professional development. Similarities between the two groups of teachers in the current study on the quantitative items and in the comparisons of self-reported responses related to 21^{st} CMC program supported Guskey's (2000) Model of Teacher Change theory.

Collaboration. Since the goals of the 21^{st} CMC program included a strong focus on collaboration and professional learning communities, data collected from teachers in the 21^{st} CMC program fittingly correlated with the findings of Joyce and Showers (2003), Dufour (2004), Stoll et. al (2005), and Reeves (2005), which suggested collaboration was essential for ensuring successful learning in the 21^{st} century classroom. Surprisingly, a large number of the non-participants also indicated high levels of participation and a substantial level of familiarity connected to the attributes of the PLC structures that were noted in the previous literature. Schmoker (2005) suggested PLCs were the richest example of mechanisms for authentic school improvement. Findings in this study suggested there was an overall increase in the level of collaboration in the school system, which appeared to correlates with the increases in the amount of professional development and technology equipment provided to respondents since the inception of the 21^{st} CMC program. However, there were a considerable number of respondents in both groups of teachers who identified a need for more cooperation among colleagues and more access to system-wide collegial sharing for non-participants.

Leadership. Rogers (1995) found that the addition of innovative ideas and equipment meant nothing unless the innovation was relevant to the needs of the individual participants, compatible with their attitudes, and in line with their beliefs. Based on the findings in this study, most respondents indicated that technology integration was relevant in some way to their needs and situated within their spectrum of accepted beliefs. Many respondents seemed to place a level of importance on the issue of relevance that could be integral for leaders to consider when they attempt to inspire their potential followers and to justify the motives of their vision for integrating technology.

Responses indicated that discounting the relevance and actual needs at any of the 35 schools could lead to concerns about the leadership. Most questions and concerns were related to issues of funding, motives for technology use, and issues of trust due to the perceived discrepancies between resources at the various schools. Although all of the teachers in the 21st CMC program and many of the non-participants were comfortable with their access to professional development and technology equipment, there was a small but vocal group of respondents who were not fully on board with the growing expectations of the leaders in the schools and in the school system.

Zucker and Light (2009) found that leaders often increased teachers' access to technology knowledge and equipment due to issues of equity, economics, and educational reform. They suggested that equipment purchases and professional development were often initiated without much concern for any established evidence of the effectiveness of the tools. A few of the respondents in this study suggested their experience with using technology integration did not fit their expected level of relevance, needs, or beliefs. Although this particular category of comments did not appear to be indicative of the overall views in the study, school leaders should be cognizant of the need to be prescriptive and mindful of individual teaching and learning situations that exist in large-scale technology initiatives. After reflecting on these findings, leaders might consider reevaluating programs regularly and providing new layers of assistance based on the changing status of the technology integration at each school.

Staples et al. (2005) found that in the past, teachers have been accustomed to making changes in their practices within familiar zones of knowledge and operations. Findings in this study accentuated the fear and anxiety of integrating technology on some teachers' levels of comfort. Based on the qualitative responses and additional suggestions noted in the teachers' comments, leaders need to have an interest in providing remedies for minimizing the complexities associated with increased technology integration.

Most teachers were optimistic about moving forward with technology integration in the schools. However, even teachers with positive perspectives often had concerns about a need for more human resources and more time to contend with the changes and growing expectations of school leaders. The findings in this study indicated that some concerns about technology integration had been mitigated by their access to structural layers of assistance that were provided in the overall design of the integration program, which included peers in the 21st CMC program, technology facilitators, school level administrators, and central office staff.

Limitations

Although the research for this study was carefully planned and conducted, it has limitations. First, the lack of baseline data limited opportunities to compare findings in this study with previous information about the 21st CMC program. In an optimum situation, a collection of baseline data would have provided an opportunity to measure increases and/or trends. However, individual respondents had not taken a pretest for use in a longitudinal study; therefore, there was no baseline data to compare the two groups on changes that might have occurred since the inception of the program.

Second, although a large number of respondents completed the survey (n=338), this number only represented 24% of all teachers who had access to the survey in the school system. However, the demographic data provided a representative sample for the comparison between the two groups of teachers in the school system. The sample was also closely aligned with the numbers of teachers that were represented in the national statistics on teachers' gender and advanced degrees provided by the National Center for Education Statistics and the Institute of Education Sciences (2011).

The third concern among the limitations was found in the obvious difference between the number of respondents surveyed in the 21st CMC program (n=27) and the number of non-participants that were surveyed (n=311). Fortunately this initial concern was mitigated by the statistical findings for effect size and power as described by Cohen (1992) that were calculated for the study.

Conclusions

Shuldman (2004) highlighted the critical role that superintendents play in the facilitation of technology integration in schools. The superintendent in this study had a strategic plan to establish 21st CMC programs in each of the 35 schools in the system. This plan required on-going communication, cooperation, and buy-in among a wide variety of stakeholders. The diverse levels of positive and negative findings in the qualitative responses appeared to indicate an overall high level of enthusiasm among a large number of the respondents, while contrasting views provided a deeper understanding about the enormity of this undertaking. Many of the barriers that were noted in the previous literature (Ertmer & Ottenbreit-Leftwich, 2010) were also reinforced in the comments of some of the non-participants. The superintendent's vision, which included a plan to increase levels of equitable technology integration to over 21,000 students and nearly 1,600 teachers system-wide, was not immune to a level of criticism by the respondents in this study or to the scrutiny of the public and the press.

During the four years since the implementation of the first 21st CMC program, the school system has been awarded with a number of local, state, and national recognitions for technology integration. This school system was recently recognized as one of the top ten school districts in the nation for "Technology Know-how" (Center for Digital Learning, 2012, April 24). The Office of the Governor also recently recognized one of the high schools in the system as one of the "top ten schools and districts" (Salisbury Post, 2012, December 13) in the state of North Carolina for "Innovative Digital Learning" (Salisbury Post, 2012, December 13). Additionally, further grant allocations have been provided to expand new technology programs and enhance existing ones in the school system.

Finally, the survey responses revealed valuable information about similarities, critical concerns, areas of agreement, and contrasting views among the respondents in the study. The qualitative findings provided useful insights on how teachers acquire and apply the knowledge and skills needed to integrate technology. Fortunately, the study provided some encouraging information about increased levels of technological pedagogical content knowledge and technology skills and identified a number of changes in practice among the teachers, which were clearly evidenced in the qualitative findings of both groups of respondents. In addition, the open-ended responses indicated that many of the teachers embraced the superintendent's vision for the program, which appeared to create a domino effect throughout the school system. The findings appeared to indicate that this phenomenon may have occurred due to the efforts of an "innovative opinion leader" (Rogers, 1995), when the superintendent inspired a level of organizational enthusiasm rather than a resistance to change.

Implications for Future Research

The overall reliability score was α=. 911 for internal consistency of the survey for this study, which was noted as "excellent" on the standard set for Cronbach's (1984) alpha coefficient calculation. This survey provides school leaders with an instrument for evaluation of professional development and technology integration in other educational settings. The tool could also be used in the implementation of a new technology integration program. Finally, a future investigation could include the use of this survey to establish baseline data for conducting a longitudinal study related to professional development and technology integration over a period of time.

Implications for Practice

Embarking on the idea of implementing a comprehensive technology integration program in a school system must include the following: awareness of obstacles that could impede success and for issues surrounding the allocation of technology resources. This study provides building-level and district administrators with statistically accurate values and uncensored commentary about the organizational realities that could influence the success or failure of future technology integration initiatives. The mixed method approach that was used to collect and analyze the data for this study provided multiple strands of diverse information and perspectives on how leadership and administrative vision impact the success of technology integration. Because the data collection process was confidential, teachers were very open and expressive with the commentary that was provided in their responses. Survey results included teachers' explicit views on how they felt about their access to professional development and technology equipment and addressed concerns related to their beliefs about these topics. The findings in this study could also provide information that would be helpful for the initiation and/or facilitation of future efforts to integrate technology and provide a practical resource for avoiding many of the barriers and obstacles that were highlighted in the literature and discovered within the survey responses.

Implications for Policy

The various technology resources provided to teachers in this study created a unique opportunity to examine the impact of inducements on teacher capacity, compliance with policies, and the overall buy-in of technology integration for instructional purposes. The multilayered access to increasing levels of professional development and equipment appeared to encourage a level of capacity building without lowered levels of productivity, which are often associated with mandated policy changes. The technology-related inducements appeared to have a substantial impact on meeting the goals and objectives of the central office level leadership because of the on-going proximity and tangibility of the training and technology equipment (McDonnell & Elmore, 1987). Data collected in this study provided a lens to investigate the dynamics connected to key relationships that impact overall organizational operations, progress, and change.

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APPENDICES

Appendix A: Consent Form

Dear Rowan-Salisbury School System Teacher,

As a doctoral student at Western Carolina University, I am requesting your participation in a study concerning K-12 professional development and technology integration in the Rowan-Salisbury School System. For this study, I am asking you to complete this online questionnaire. I value your participation and the information you can provide is VERY important.

This questionnaire may be completed at your convenience and will take only a few minutes of your time. You will have access to the online survey for a two-week period. Information will be collected from 9/--/12 until 10/--/12. Putting your email address in the space provided on the survey will enter you in a random drawing for a chance to win a $100.00 cash incentive. Even if you include your email address, the information on the survey will remain confidential.

Your participation in this study is voluntary, and you may conclude your participation at any time during the survey by simply closing your browser. Only data entered and submitted will be processed. The data collected will be used only in a combined (aggregate) format, and no one will be able to identify you or your information.

There are no foreseeable risks. However, by participating in this study you will help to further the knowledge base regarding professional development and technology integration. You may contact the Principal Investigator Darrell McDowell at (704) 636-4420 or at mcdowelldg@rss.k12.nc.us (You can also contact Dr. Ellen Sigler, faculty director of the project at Western Carolina University, at (828) 227-3369 or esigler@email.wcu.edu) if you have any questions or concerns. If you have concerns about your treatment as a participant in this study, please contact the chair of WCU's Institutional Review Board through the office of Research Administration at WCU (828) 227-7212.

All K-12 teachers in the Rowan-Salisbury School System will be given the opportunity to complete the questionnaire. By completing the survey, you are giving your consent to participate in the study.

To get started, you may click on the first link or CLICK HERE.

Thank you,
Darrell McDowell, Ed.S

Appendix B: Survey Instrument

1. TECHNOLOGY INTEGRATION ACTIVITIES

Please click on all items that apply to you.

- Used the latest technology equipment provided by the school system
- Shared information with teachers in my school
- Shared information with others in the school system
- Created engaging lessons that use technology
- Learned the latest trends in the use of technology
- Solved problems with technology equipment
- Trained others to use the technology equipment
- Updated wiki pages with innovative lessons
- Shared information with outside visitors
- Discovered technology resources during personal learning experiences
- Used school resources to enhance student learning
- Gained confidence in using technology for instructional purposes
- Served as an instructional leader of technology integration

2. In the space provided below, describe activities ***not*** found in the "check all that apply" list above that you have used to integrate technology in your classroom.

TECHNOLOGY KNOWLEDGE

3. Click on the response that best describes your level of knowledge with integrating technology in your classroom.

1=Strongly Disagree 2=Disagree 3=Agree 4=Strongly Agree

I assess student performance in my classroom.	1	2	3	4	
I adapt my teaching strategies to meet the needs of all students.	1	2	3	4	

I adapt my teaching style to students with different learning styles.	1	2	3	4	
I use effective teaching approaches to guide student learning.	1	2	3	4	
I know how to manage the instruction in my classroom.	1	2	3	4	
I have sufficient knowledge about the curriculum.	1	2	3	4	
I have a strong understanding of my subject matter.	1	2	3	4	
I have a diverse set of strategies for developing content.	1	2	3	4	
I choose technology that enhances my approach to each lesson.	1	2	3	4	
I use technology equipment in the development of the curriculum.	1	2	3	4	
I select technology to use in my classroom that enhances student learning.	1	2	3	4	
I combine content, technology, and teaching in my classroom.	1	2	3	4	
I provide leadership for helping other teachers with technology.	1	2	3	4	

TECHNOLOGY and the CURRICULUM

4. Click on the response best describes how you use technology in your classroom.

1=Never 2=Rarely 3=Sometimes 4=Often 5=Always

I analyze student participation during group technology activities as part of students' evaluation process.	1	2	3	4	5	
I design different evaluation criteria for students' technology integration activities.	1	2	3	4	5	
I divide students into groups while teaching lessons with technology integration.	1	2	3	4	5	
I differentiate lessons for students who lack technology skills.	1	2	3	4	5	
I design different technology learning activities for different student achievement levels.	1	2	3	4	5	
I ensure students have the technology resources to complete homework.	1	2	3	4	5	
I use technology to teach lessons for remediation purposes.	1	2	3	4	5	
I instruct students on how to search the web for useful resources.	1	2	3	4	5	
I remind students about rules related to Internet etiquette before they ever go online.	1	2	3	4	5	
I ask students to obey intellectual property rights on the Internet.	1	2	3	4	5	
I remind students to avoid adult websites.	1	2	3	4	5	
I let students know about the possible negative effects of overusing technology.	1	2	3	4	5	

I arrange time for students to rest during long periods of computer use.	1	2	3	4	5	
I use the Internet to search for information to provide supplementary course material for students.	1	2	3	4	5	
I use technology to incorporate music in my course material.	1	2	3	4	5	
I use presentation software in my class.	1	2	3	4	5	
I solve hardware problems during class.	1	2	3	4	5	
I use Internet communication to contact parents.	1	2	3	4	5	
I use email to connect with students.	1	2	3	4	5	

ACCESS TO PROFESSIONAL DEVELOPMENT AND TECHNOLOGY

5. Describe the amount of access you have to participate in professional development for integrating technology in your classroom.

6. Describe the amount of access you have to the equipment needed for integrating technology in your classroom.

7. Describe your beliefs about integrating technology in your classroom.

DEMOGRAPHICS

8. Click on the response that indicates the number of years you have been teaching (years of experience).

- ○ 0 to 4 years
- ○ 5 to 9 years
- ○ 10 to 14 years
- ○ 15 to 19 years
- ○ 20 to 24 years
- ○ 25 or more

9. Click on the response that describes your gender.

- ○ Female
- ○ Male

10. Click on the response that describes your highest earned degree.

- ○ Bachelor's degree
- ○ Master's degree
- ○ Educational Specialist or other advanced degree
- ○ Doctoral degree

11. I have successfully earned National Board Certification status.

- ○ Yes
- ○ No

12. Click on the response that best indicates the grade span in which you currently teach.

- ○ Elementary school
- ○ Middle school
- ○ High school

13 I am a teacher in the 21st Century Model Classroom program.

DISPLAY LOGIC USED based on (**YES** or NO) to determine whether a participant even got the chance to see item 14.

- ○ Yes
- ○ No

*Item 14 was not used as an active part of the survey data that was collected. Respondents were not contacted about collecting e-Pub projects due to the large volume of useable information collected among the other 43 remaining items on the survey.

14. I give permission for the researcher to view my e-Pub project as another source of data for this study.

- ○ Yes
- ○ No

15. If you wish to receive a summary of the aggregate results from this study, enter your email address in the space provided below. This will also allow you to be entered in a drawing for a chance to win a $100.00 cash incentive for completing this survey. The drawing will be held at the end of the data collection process.