An Analysis of the Formal and Informal Professional Learning Practices of Middle and High School Mathematics Teachers

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An Analysis of the Formal and Informal Professional Learning Practices of Middle and High School Mathematics Teachers

by

Kelly Elizabeth McCarthy

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Curriculum and Instruction with an emphasis in Adult Education
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Dedication

In loving memory of my mother Lynne.
All of this was possible because of you.
Acknowledgements

I would like to start by thanking my father, Bob. He taught me the value of hard work and the need to take pride in everything that you do--two things that were essential for this degree. To my sister, Shannon, who has been a constant source of support; thank you for listening and offering words of encouragement when I needed it most. To my husband, Kelly; words cannot express how lucky I am to have you. You allowed me to pursue my dream which required numerous sacrifices for us both. Thank you for being so selfless over the last five years.

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Abstract

Although there has been a substantial amount of research on the topic of teacher professional development, few studies adequately captured the types and frequency of formal and informal professional learning teachers undertake to improve as educators. The purpose of this study was to examine the types of activities middle and high school mathematics teachers engaged in to improve their abilities as educators, analyzed by the participants’ school setting, years of teaching experience, level of education, degree major, certificate type, and their school’s Title I status.

Teachers from two large school districts in Florida participated. The Teachers’ Opportunity to Learn (TOTL) survey was used to collect the data. The TOTL measured the professional learning activities of teachers based on seven learning categories: (a) workshops, (b) teacher collaboration, (c) university courses, (d) conferences, (e) mentoring/coaching, (f) informal communication, and (g) individual learning activities. Teachers were solicited to participate two times; which generated 245 responses for analysis.

The results of this study indicated that teachers devoted an extensive amount of time on professional development, with the majority of time spent on informal learning activities. Every participant in the study engaged in at least one professional development activity; most engaged in four or more activities. The activity with the highest amount of participation (99.2%) and greatest amount of time spent (36.62 hours per month) was individual learning activities. Other notable areas of participation were professional development programming, teacher collaboration, and informal communication. When the activities were analyzed by demographic variable, 16 comparisons were found to be statistically significant. Mentoring/coaching activities produced more significant results than any other activity in the study. Analyses also confirmed
that the professional learning practices of new teachers were significantly different from their more experienced peers.

The findings from this study could serve as the impetus for programmatic changes and policy reform within the education community. School districts could benefit by creating professional development programs that support teacher collaboration, informal communication, and self-directed learning. State education departments could encourage these endeavors by redirecting funding and redesigning certification systems to recognize these non-traditional individualized activities.
Chapter One
Introduction

Since the 1983 publication of *A Nation at Risk*, school districts have been tasked to continuously evaluate, strategically plan, and implement improvements to the instructional practices employed by their teachers (Akiba, 2012). In addition to these requirements, districts are expected to demonstrate their students are meeting the necessary content benchmarks for specific grade levels. This proficiency, at least in part, is measured by student performance on state standardized assessments (Griswold, 2005).

In response to *A Nation at Risk* and other congressional hearings, Congress passed the *No Child Left Behind Act* in 2002 (Griswold, 2005). Part of this Act required that school districts ensure teachers are utilizing current research-based strategies in their classrooms. Griswold contends (2005) the most economical and efficient way for districts to provide training on these strategies is through the facilitation of professional development courses. These courses teach educators how to implement effective classroom strategies and empower them to make academic improvements within their school.

Since professional development is seen as the cornerstone for teacher edification and practice (Akiba, 2012; Cervero, 2001; Desimone, 2009; Young, 1998), an influx of federal and state funding has been established for professional development activities. From 2005 to 2014, over 26 billion dollars in Title II Part A (*Improving Teacher Quality State Grants*) funding was distributed to schools across the United States by the Department of Education (U.S. Department of Education, 2014). This funding was intended to recruit and retain teachers and principals, increase the amount of highly qualified teachers, and improve certification programs. These goals were, in-part, to be achieved through the implementation of quality professional
development programming (U.S. Department of Education, 2014). Despite the focus on professional development at the district, state, and federal levels, few large-scale studies have been conducted to quantify the type and frequency of professional development activities teachers engage in to improve their skills as educators (Akiba, 2012; Little, 1993; Wilson & Berne, 1999). Exploring the professional learning activities of teachers is an important first step in understanding the learning needs of educators, determining how funding should be allocated, and deciding overall state and district programming needs (Akiba, 2012).

Professional learning, in the context of this study, can be defined as the purposeful activities of teachers, where they seek to gain greater understanding and obtain new skills in teaching practices and student learning. It is important to recognize that participation in such activities does not guarantee actual learning (Richardson & Placier, 2001; Smylie, 1995), and that often learning can occur outside planned development activities (Smylie, 1995). Although the teaching profession may produce spontaneous learning opportunities, this study focused on the intentional learning activities of classroom teachers, as those experiences can be captured by a survey and be used to affect programmatic and policy changes.

The continuous improvement model used in schools pushes for educators to regularly update their knowledge and skills; therefore, the learning opportunities in which teachers choose to participate in is important to capture and analyze (Akiba, 2012). There has been an abundance of research supporting the use of adult education principles in structured learning activities (Bash, 2003; Edelson, 2006; Knowles, 1970, 1980, 1990; Merriam & Brocket, 2007; Merriam & Caffarella, 1991). Bash (2003) claimed that “adult learners are autonomous and self-directed. They need to be free to have a sense of control over their own learning” (p. 28). Knowles’ (1970) theory of andragogy further supports the idea that adults have an immediacy of learning and seek educational opportunities that can be tailored to address their unique learning needs.
In the literature, teacher professional development is often categorized as formal or informal (Dabbagh & Kitsantas, 2012). Formal learning occurs when participants engage in the activity with the expectation to learn. Informal learning can take on a variety of formats where learners gain new knowledge through collaboration, observation, exploration, daily practice, and reflection. While formal professional development provides a means to acquire basic skills and in-service credit for recertification; informal activities allow teachers to take charge of the content and the delivery methods of their learning. This enables them to acquire knowledge that can be directly applicable to their students and classroom (Dabbagh & Kitsantas, 2012).

Prior research studies have sought to document the formal and informal learning of teachers through the use of case study methods (Scribner, 1999, 2003). Few have sought to quantify these activities using a survey developed specifically to measure professional learning (Akiba, 2012). This study sought to further the findings of Akiba’s (2012) study of middle school mathematics teachers utilizing the Teachers’ Opportunity to Learn (TOTL) survey. Participants’ intentional learning activities were measured by the survey’s seven professional development categories: (a) professional development programming, (b) teacher collaboration, (c) university/college courses, (d) professional conferences, (e) mentoring/coaching, (f) informal communication, and (g) individual learning activities. The results of the survey was then evaluated against teacher and school demographic variables to determine if there were statistical differences based on the participants’ school setting, years of teaching experience, level of education, degree major, certificate type, and their school’s Title I status.

These demographic variables were chosen for analysis as prior studies have found differences in teacher learning preferences based on these variables. According to previous studies, the amount and types of professional learning activities varies depending on a teacher’s years of experience. Smith and Desimone (2003) found that professional development increases during the first eight years of experience, plateaus, and then begins to decline after
25 years of teaching. They also found that mid-career and more experienced teachers engage in more content and methods focused development than new teachers.

Studies have also shown differences in professional development choices based on degree major and education level. Desimone, Smith, and Ueno (2006) studied the responses from the 2000 National Assessment of Educational Progress (NAEP) survey and discovered that mathematics teachers who had a degree in mathematics engaged in more formal content-specific professional development than teachers who did not have a degree in mathematics. Akiba (2012) found that teachers who majored in mathematics took more formal college coursework than non-mathematics majors.

Prior research has indicated that professional development choices may also be based on the subject area taught. Since the No Child Left Behind Act created Title I funding to improve literacy, mathematics, and science education in the classroom (Bush, 2001), it can be surmised that much of the formal development offered by school districts will focus on skills related to these content areas. Birman et al. (2009) found that respondents from the 2005-2006 NAEP survey worked in districts where a greater emphasis was placed on mathematics and reading professional development activities. Based on the continuing trend to promote literacy as well as science, technology, engineering, and mathematics (STEM) education, it is possible that the teachers in these subject areas will engage in more formal professional development than teachers of other subject areas.

The income level of students may also impact teacher professional development. Smith and Desimone (2003) found that teachers in high poverty schools engaged in more content benchmark and technology trainings than teachers in low poverty schools; while teachers in low poverty schools attended more trainings that focused on methods and assessment strategies. Another finding of Birman et al. (2009) concluded that teachers in high poverty schools engaged
in more active learning professional development than those in moderate and low poverty schools.

This study sought to expand on the findings of prior researchers using Akiba’s (2012) study of middle school mathematics teachers as a framework. After reviewing the literature on mathematics teacher professional development, a trend in demographics emerged. Many studies chose to include both middle and high school teachers in their sample (Birman et al., 2009; Desimone et al., 2006; Scribner, 1999, 2003; Smaller, Clarke, Hart, Livingstone, & Noormohamed, 2000; Smaller, Hart, Clarke, & Livingstone, 2001; Smith & Desimone, 2003). Since the instrument for this study was developed using the findings from Scribner’s (1999, 2003) case study research, which captured the professional learning habits of high school teachers, it seemed appropriate to expand this study to include both middle and high school mathematics teachers in this study’s sample.

**Statement of the Problem**

Many school districts encourage teachers to develop and refine their instructional knowledge through participation in formal and informal professional learning activities. Currently, there has been a lack of research investigating the types and frequency of professional development in which middle and high school mathematics teachers engage. Although the topic of teacher professional development has been well represented in the literature, few studies sought to develop an instrument that solely captures the formal and informal professional learning of teachers. Much of the existing qualitative research (Hall, 2007; Scribner, 1999, 2003; Shapiro, 2003) has focused on informal learning and most of the quantitative studies (Birman et al., 2009; Desimone et al., 2006; Smith & Desimone, 2003; Strizek, Tourkin, Erberber, & Gonzales, 2014) have analyzed national survey data such as the NAEP, Schools and Staffing Survey (SASS), and the Teaching and Learning International Survey (TALIS) to report trends in teacher professional development. The existing quantitative
studies of teacher professional development have relied on national administrative surveys, where questions that capture information on teacher professional development represent only a fraction of the total number of questions in the survey. This is problematic as these surveys were designed to collect a wide variety of information and only a small portion was designated to collect information about professional learning. Since most school districts fund and support professional development activities, the outcome of this targeted study may provide district leadership and the research community with additional information regarding teacher learning habits.

**Purpose of the Study**

The purpose of this study was to examine the types of formal and informal professional learning activities middle and high school mathematics teachers engaged in to improve their knowledge, skills, and abilities as educators analyzed by the participants’ school setting, years of teaching experience, level of education, degree major, certificate type, and their school’s Title I status. In addition to examining the types of learning activities, the frequency of their participation was also captured.

This study was one of only a few large-scale studies that sought to quantify the formal and informal learning activities of mathematics teachers. Utilizing an instrument designed specifically to capture the learning habits of mathematics teachers, this research built upon Akiba’s (2012) study of Missouri middle school mathematics teachers. Most specifically, this study captured the learning habits of middle and high school mathematics teachers located in the west central Florida region. Together with Akiba’s (2012) research, this study fills an existing gap in the literature and warrants future large-scale studies of teacher professional development.

**Research Questions**

The results of this study were analyzed based on the following research questions.
1. What types of formal and informal learning activities do middle and high school mathematics teachers engage in to improve their knowledge, skills, and abilities as educators?

2. How often do middle and high school mathematics teachers engage in these formal and informal learning activities?

3. Are there statistically significant differences in the frequency of informal and formal learning activities when analyzed by the participants’ school setting, years of teaching experience, level of education, degree major, certificate type, and their school’s Title I status?

**Theoretical Framework**

This study focused on the activities that surround mathematics teachers’ professional learning. Professional learning can be defined as the process of accumulating skills and knowledge in order to navigate the educational system and to meet the needs of students (Mushayikwa & Lubben, 2009). A teacher’s choice to engage in learning is based both on the content to be learned and the context in which the learning will take place. This study was grounded in Putnam and Borko’s (2000) theory of teacher learning which states:

> The physical and social contexts in which an activity takes place are an integral part of the activity, and that the activity is an integral part of the learning that takes place within it. How a person learns a particular set of knowledge and skills, and the situation in which a person learns, become a fundamental part of what is learned. (p. 4)

In order to understand the learning activities of teachers, the context in which they choose to learn should be identified. Since the subject content was restricted in this study, as it only captured mathematics professional development activities, it was important for the research to fully explore the context in which the learning took place. This study utilized an established instrument, designed to capture a diverse array of formal and informal professional development activities. The results of this research clarified and documented the situational context in which middle and high school mathematics teachers chose to learn.
Despite the fact that the theoretical importance of contextual learning has been established (Borko, 2004), there has been only a few large-scale inquiries that captured the diverse professional learning activities of mathematics teachers (Akiba, 2012). This study sought to further investigate these findings by examining the professional learning habits of middle and high school mathematics teachers.

**Delimitations**

There were three delimitations to this study. First, this study was limited to full-time middle and high school mathematics teachers employed in two school districts located in the west central Florida region. Full-time teachers were solicited as they had full instructional control and responsibility for their classrooms. They also had unlimited access to formal professional development opportunities offered by their school district. Part-time staff and para-professionals were excluded from this study as they serve in a support capacity in the classroom and had limited access to district-sponsored professional development.

Second, the study used an existing instrument to capture the data. Information for this study was collected using the adapted Teachers' Opportunity to Learn (TOTL) survey (Akiba, 2012). The TOTL survey was used in this study as it is an established instrument that effectively collected information in a prior, similar study. The survey was short, provided research-based learning categories that teachers could easily identify, and provided realistic intervals so participants could more effectively report the frequency of their learning for each activity type.

Third, participation in this study was limited to teachers located in the west central Florida region. The choice to limit participation to this geographic area was threefold: the districts were willing to participate in the research study, they were geographically convenient to the researcher, and they represented some of the largest school districts in the state. This pool of potential participants served as an adequate sample for this exploratory study.
Limitations

There were two limitations to this study. First, only two school districts were sampled. Although the potential districts were all large in size, each only represented a small geographic area. Therefore the generalizability of these findings were limited.

The second limitation of the study was the information collected relied on the accuracy of participant reporting. The survey in this study collected information about prior learning activities. For some activities, participants reported the total frequency over a 12-month period; for other activities, they were asked to estimate the average amount of time spent in a typical month. In an effort to control false reporting and accurate recollection, participants were asked to specify only their learning activities within the last 12 months.

Teachers in the sample districts were expected to regularly engage in formal and informal professional development. Since the individuals were solicited through their school email, they may have felt compelled to falsify the amount of activities they participated in. To control for this, the survey did not capture key identifying information from the participants. The survey instructions and the solicitation email were written to emphasize participant anonymity.

An analysis of the reliability information collected in this study revealed variations in the response ranges for two of the professional development areas captured by the TOTL instrument. Individual learning activities had the greatest variation in sub-category activities in the test-retest results of this study. Informal communication also had a weak correlation due to the variation in responses between the two survey administrations.

The information collected by this survey instrument was only as strong as the accuracy of reporting by the participants. Since the survey participants remained anonymous, there was no way to confirm reported activities. To acquire the most accurate data possible, this study was designed to solicit a sample that was representative of the population of interest, utilized an
instrument that was appropriately vetted by experts in the field, and provided safeguards so participants could feel comfortable in reporting their professional learning habits.

**Significance of Study**

Although there are a large number of studies on the topic of professional development, few studies had sought to quantify the amount of formal and informal professional development teachers undertake to improve their practices as educators. Most, specifically, there has been a lack of research on the types of professional development middle and high mathematics teachers engage in to become better educators. Continued legislation as well as increased federal and state funding further emphasizes the need to not only understand the motivations behind teacher learning, but also the types of learning teachers most frequently undertake. By understanding the types of activities teachers seek to satisfy their learning needs, school districts can better plan, promote, and fund desirable learning opportunities. This study sought to identify the types of learning teachers engage in as well as the frequency of those activities by surveying middle and high school mathematics teachers located in the west central Florida region.

**Definition of Terms**

The terms used in this study were defined as follows:

*Formal learning*—“learning that is institutionally sponsored or highly structured, i.e., learning that happens in courses, classrooms, and schools, resulting in learners receiving grades, degrees, diplomas, and certificates” (Dabbagh & Kitsantas, 2012, p. 4).

*High school mathematics teacher*—an individual who is employed in the public school system and teaches mathematics to students in grades 9-12.

*Individual learning*—informal activities that are planned and executed by an individual. Examples include reading, researching, and examining student work (Akiba, 2012).
Informal communication—planned or unplanned exchanges that focus on improving teacher practice (Akiba, 2012).

Informal learning—“learning that rests primarily in the hands of the learner and happens through observation, trial and error, asking for help, conversing with others, listening to stories, reflecting on a day’s events, or stimulated by general interests” (Dabbagh & Kitsantas, 2012, p. 4).

Mentoring/coaching—formal partnerships established by school and/or districts where experienced teachers support new teachers in the classroom (Akiba, 2012).

Middle school mathematics teacher—an individual who is employed in the public school system and teaches mathematics to students in grades 6-8.

Professional Conference—an event where individuals can present and/or learn from other presenters about relevant topics in education (Akiba, 2012).

Professional Development Programming—school or district organized activities that are intended to improve teacher practice and student learning (Akiba, 2012).

Professional learning—the process of accumulating skills and knowledge in order to navigate the educational system and to meet the needs of students (Mushayikwa & Lubben, 2009).

Teacher Collaboration—informal activities established to foster interaction amongst teachers. Examples include professional learning communities (PLC’s), teacher networks, teacher forums, and teacher study groups (Akiba, 2012).

Title I—a federal program designed to “close the achievement gap for disadvantaged students by providing states additional assistance and flexibility in return for implementing rigorous accountability for results” (Bush, 2001, p. 7).

Title I status—schools that serve a population where 40% or more of their students have a combined family income that is at or below the federal poverty level (Bush, 2001).
University/college courses--classes taken in order to earn degree credits.

Organization of the Study

The first chapter provided an introduction to the research topic, statement of the problem, purpose of the study, research questions, theoretical framework, delimitations, limitations, significance of the study, and provided definitions of terms. The second chapter includes a comprehensive review of the literature. It provides an overview of teacher professional development, importance of teacher learning, factors that influence professional learning, prior studies of professional learning, and a summary of the chapter. The third chapter presents the research design, sample, instrumentation, validity, reliability, variables, data collection, and data analysis. The fourth chapter contains the research questions, participant demographics, analysis of the research questions, and a summary of the chapter. The fifth chapter consists of the summary of the study, conclusions, implications for practice, and recommendations for further research.
Chapter Two
Literature Review

The purpose of this study was to examine the types of formal and informal professional learning activities middle and high school mathematics teachers engaged in to improve their knowledge, skills, and abilities as educators analyzed by the participants’ school setting, years of teaching experience, level of education, degree major, certificate type, and their school’s Title I status. In this chapter, the review of the literature is broken into five sections. The first section provides an overview of teacher professional development. The second section evaluates perspectives that stress the importance of teacher learning at the federal, state, district, school, and individual levels. The third section outlines factors that influence professional learning. The final sections review prior studies of professional learning and provide a summary of the chapter.

Overview of Teacher Professional Development

The effectiveness of public education is measured by the success of its students. Student success is often attributed to the instructional ability of their teachers. In an effort to ensure student success, teachers look to professional development as a method for improving their practice as educators (Cavallini, 1998; Griswold, 2005; Hawley & Valli, 1999; Speck & Knipe, 2001). Due to its critical function in the teaching profession, researchers have sought to categorize and develop models for professional development as well as create principles and procedures for effective practice. An overview of the principles, models, and types of professional development are discussed in the following sections.

Principles of professional development. Teachers seek professional development opportunities in both formal and informal environments. Regardless of the method, teacher
professional development can be seen as “a lifelong collaborative learning process that
nourishes the growth of educators both as individuals and as team members to improve their
skills and abilities” (Speck & Knipe, 2001, p. 4). According to Sparks (2002), teacher
professional development has often been criticized for failing to “focus on teachers’ content
knowledge, instructional skills, or other classroom-related knowledge” (p. 2). Sparks (2002)
contends, however, that effective professional development occurs when it is not treated as
professional development, but instead treated more informally in an environment where
teachers come together for professional growth.

Several researchers have sought to develop comprehensive lists that outline basic
principles for effective professional development. Garet, Porter, Desimone, Birman, and Yoon
(2001) found three core principals of professional development that increased teacher
knowledge and encouraged change in their classroom practices. The three core features of
professional development included: (a) deepening a teacher’s content knowledge in the subject
area in which they teach, (b) providing a sufficient amount of opportunities to engage in active
learning, and (c) creating learning experiences that are aligned with teacher goals and
curriculum requirements as well as including reflective and collaborative components.

In addition to utilizing these three core principals, Garet et al. (2001) argued that learning
activities must also focus on certain design features such as activity type, duration of learning,
and specific grouping. Teachers must be given opportunity to learn in a variety of formats, such
as professional workshops which are very common, but often criticized for their rigidity (Loucks-
Horsley, Hewson, Love, & Stiles, 1998). This is in addition to less structured reform activities
such as coaching, mentoring, and study groups (Garet et al., 2001). Along with activity type,
duration of learning is also an important element. Learning activities that are prolonged allow
teachers to try new practices in their classrooms, reflect on their effects, and seek feedback
from colleagues. Finally, grouping teachers by specific criteria enables the curriculum to
become more targeted, allows for better support during the learning process, and enhances overall professional growth.

Through an extensive review of the literature, Hall (2007) developed a list of principles that outline effective professional development. Hall (2007) states that learning objectives must be created so that instructional outcomes can be targeted to individual or school-based improvement. In addition to addressing short-term needs, these learning goals should address a long-term vision. Each learning activity should highlight classroom application and be based on research best practices. The activities should be planned by those who will participate and the necessary resources must be provided for operational success. Finally, Hall (2007) claims the results of the professional development must be evaluated by teacher practice and student achievement.

Dass and Yager (2009) identified a shift occurring in professional development, where it is moving from a formal didactic design to one that is facilitated and shaped by the participating teachers. They identified 10 elements that encompass this new movement in effective professional development: (a) learning must be contextually based and tailored to certain groups of teachers, (b) trainings must provide a lengthened duration of learning, (c) school site-based trainings should focus on specific populations, (d) outcomes should be focused on student needs, (e) learning opportunities should be provided at both at the district level and school level, (f) teachers should have control over what they are learning, (g) active learning activities should be a part of every training opportunity, (h) teachers should be able to shape what they learn to fit their classroom needs, (i) adult learning principals should be embedded in the curriculum design, and (j) every training’s effectiveness should be measured by the improvements made in teacher practice and student learning.

While the previously discussed researchers have provided broad parameters for planning and executing professional development, Magestro and Stanford-Blair (2000) offer
practitioners a step-by-step template to effectively implement professional development activities. They recommend planning professional development in four steps. The first step is to establish clearly defined learning goals and course objectives for the training session. The second step is to ensure the trainer/facilitator has all the resources necessary to effectively conduct the session. The third step is to develop an agenda that meets the learning objectives of the session, addresses the learning styles of participants, and can be completed in the scheduled time frame. The training agenda should include: an Activator—to stimulate prior knowledge of the subject being discussed; a Brief Input—to provide an opportunity to take in new information using multiple modalities; a Discussion—to allow participants the opportunity to synthesize, share, and learn from others in the room; several Activities—so the participants can practice what they have learned in a safe supportive environment; and a Summarizer—a final reflection on what was learned and how it can be used. The fourth and final step is for the facilitator to assist participants in developing a strategic plan to incorporate what they have learned in their own classrooms. Follow-up support must also be provided as teachers implement, evaluate, and reflect on their newly acquired skills and techniques.

Magestro and Stanford-Blair (2000) stress the need to incorporate active learning in every professional development activity. Birman et al. (2009) defines active learning as “professional development activities that engage teachers in the learning process by having them apply knowledge to real-world classroom tasks” (p.100). Prior research (Birman et al., 2009; Desimone, Porter, Birman, Garet, & Yoon, 2002; Desimone, Porter, Garet, Yoon, & Birman, 2002) has shown that when professional development trainings incorporate active learning, teachers are more likely to retain the information and use the newly acquired skills in their classroom.

While there is a wealth of recommendations in the literature regarding professional development planning and practice, much of the discussion focuses on a few key components.
First, learning objectives must be developed and instructional outcomes must be aligned with the objectives (Garet et al., 2001; Hall, 2007; Magestro & Stanford-Blair, 2000). Second, targeted groups for the activity should be identified so that the content of the training can deepen the content knowledge of participants (Dass & Yager 2009; Garet et al., 2001). Third, the activities chosen should represent a variety of formats, focus on adult learning principles, incorporate active learning, and emphasize application in the classroom (Birman et al., 2009; Dass & Yager, 2009; Desimone et al., 2002a; Desimone et al., 2002b; Garet et al., 2001; Hall, 2007; Loucks et al., 1998; Magestro & Stanford-Blair, 2000; Sparks, 2002). Finally, professional development is most successful when participants can develop an implementation plan, take time to evaluate the results of the implementation, and have access to follow-up support (Dass & Yager, 2009; Hall, 2007; Magestro & Stanford-Blair, 2000).

**Models of professional development.** In addition to identifying key principles of professional development, the literature also supports the evaluation of teacher professional learning by implementation model. Although teacher professional development can take on many forms, Hall (2007) succinctly classifies all teacher professional development into three distinct categories: district-wide, site-based, and individual-improvement. Each of these categories are discussed in the following sections.

**District-wide professional development.** These are learning opportunities that address a greater vision of desired teacher practices, enable teachers to share resources and collaborate across content areas and grade levels, and provide greater efficiency in the sharing of knowledge (Guskey, 2000). Programmatic choices in district-wide professional development are often based on past attendance or needs assessments developed by school district personnel; workshops are then created to fill the identified gaps (Hall, 2007). District-wide professional development models have been criticized because they provide trainings that
address what the district feels is relevant, instead of focusing on the true needs of teachers and administrators (Guskey, 2000).

**Site-based professional development.** Professional learning situations provided at individual school sites are seen as effective forms of training because they encourage collaborative planning, implementation, and evaluation amongst participants (Little, 1993, 1999; Sparks, 2002). Site-based is a rather new model of professional development (Hall, 2007). It “emerges from local needs and interests; is relevant to the teachers, students, and school communities; and is open to a wide variety of methods” (King-Rice, 2001, p. 20). Site-based professional development can be tailored to meet the individual needs of a school by focusing on student achievement and creating a collaborative culture where teachers discuss their issues and learn from one another (Garet et al., 2001). Since site-based models are designed to address the unique challenges of schools, activities can take on many forms such as: action research, coaching, mentoring, analysis of student work, and self-directed learning projects (Hall, 2007).

**Individual-improvement professional development.** These are development activities focused on the self-directed learning efforts of teachers. Teachers reflect on their practices in the classroom and create a plan to address their learning needs. Fishman, Marx, Best, and Tal (2003) contend “that professional development should fundamentally be about teacher learning: changes in the knowledge, beliefs, and attitudes of teachers that led to the acquisition of new skills, new concepts, and new processes related to the work of teaching” (p. 645). The individual-improvement model of professional development empowers teachers to take charge of their own learning and enables them to make transformational changes in the classroom.

It is clear that professional development activities must meet a set of standards in order to be effective at the district, school, and individual levels. Trainings must be relevant to each
content area and grade level, long enough to ensure implementation and reflection, have an active orientation that uses real world data or realistic simulations, and provide opportunities for teacher collaboration. In order to meet the needs of all teachers, districts and schools must accurately assess learning needs and provide support through a variety of training methods (Dass & Yager, 2009; Griswold, 2005; Garet et al., 2001; Hall, 2007; Magestro & Stanford-Blair, 2000).

**Types of professional development.** In addition to models of professional development, much of the literature classifies learning into two categories, formal and informal (Dabbagh & Kitsantas, 2012). According to Desimone (2009) “teachers experience a vast range of activities and interactions that may increase their knowledge and skills and improve their teaching practice, as well as contribute to their personal, social, and emotional growth as teachers” (p. 182). These *vast range of activities and interactions* are facilitated, in part, by formal and informal learning opportunities. Regardless of whether teachers choose to learn formally or informally, it is their engagement in these activities the enables them to experience growth and development as educators (Desimone, 2011). The subsequent sections provide an overview of formal and informal teacher professional development.

** Formal learning.** Traditionally, teacher professional development is viewed from a formal learning lens. Formal learning can be described as activities that are sponsored and structured to achieve a specific educational purpose. Learning occurs in prescribed settings such as classrooms, conferences, and workshops. The results of these activities often generate grades, certificates, continuing education credits, or diplomas (Dabbagh & Kitsantas, 2012).

Formal professional development can be planned at a variety of levels. Administrators can plan courses offered at the district level or principals and teachers can plan workshops at the school level. Schools and districts may also reach out to independent educational organizations to conduct specialty trainings as many of these organizations serve as experts on
a particular instructional strategy or teaching philosophy (Magestro & Stanford-Blair, 2000). Teachers who are part of professional organizations or seek National Board Certification can also take part in the formal professional development offerings from these organizations. Regardless of how and where the trainings are developed, they serve to improve teacher quality and support teacher certification (Akiba, 2012; Cavallini, 1998; Desimone et al., 2002a; Desimone et al., 2002b, Young, 1998).

Despite the support for formal professional development in the literature and legislature, many researchers view the current development opportunities offered to teachers as distressingly inadequate (Ball & Cohen, 1999; Borko, 2004; Petrie & McGee, 2012; Putnam & Borko, 1997). Commissions and educational organizations have continued to stress that high teaching standards can be addressed with formal professional development. Unfortunately, many of these organizations fail to provide a concrete plan as to how these standards can be achieved (Borko, 2004). Sykes (1996) went so far to say that formal professional development is “the most serious unsolved problem for policy and practice in American education today” (p. 465).

Although formal professional development has been criticized for its inability to be flexible in addressing individual and school climate needs, researchers (Birman et al., 2009; Dass & Yager, 2009; Desimone et al., 2002a; Desimone et al., 2002b; Garet et al., 2001; Hall, 2007; Loucks et al., 1998; Magestro & Stanford-Blair, 2000; Sparks, 2002) have indicated that when learning activities are designed to address specific learning goals, teachers are better equipped to use what they have learned in the classroom. Cavallini (1998) argues that when formal in-service professional development is presented correctly, it “is a vehicle for personal and professional growth, the improvement of instructional practice, and, therefore, of educational service to students” (p. 243). Regardless of the opinion in the literature, schools and districts will continue to develop and offer formal learning opportunities to teachers as these
activities are supported by federal funding and seen by the legislature as a critical aspect of teacher reform (Abika, 2012; Griswold, 2005).

**Informal learning.** In addition to participating in courses and workshops, teachers also actively engage in informal learning. These activities are dependent upon the learners themselves and include “observation, trial and error, asking for help, conversing with others, listening to stories, [and] reflecting on a day’s events” (Dabbagh & Kitsantas, 2012, p. 4). Although these activities may not appear to facilitate learning in a traditional sense, they serve an important function in teacher development.

Teaching is a well-established profession. Nowlen (1988) contends that those in a profession often exude "exclusive comradeship of the guild, sharpening the boundaries between "us" and "them"; while performance often demands spirited interpersonal, interoccupational and interorganizational collaboration" (p. 201). One example of informal learning that has resulted from the professionalization of the education field is a professional learning community (PLC) (Lieberman & Pointer Mace, 2009). Although there is not one universally accepted definition for PLC’s, they can be described as groups that share and critique each other’s practices in an effort to enhance learning and school development (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006).

These groups can include individuals inside or outside the school context (Stoll et al., 2006). Often, they are formed by grade level, subject area, common interests, or strategic interdisciplinary partnerships. Stoll et al. (2006) assert there are five common characteristics of a PLC, they have (a) shared values and vision--where participants have a shared sense of purpose focused on the individual needs of students, (b) collective responsibility--each participant has a responsibility to the group to be committed and uphold accountability, (c) reflective professional inquiry--where the group promotes open communication of ideas and issues through observation and analysis, (d) collaboration--each group member engages in
deep conversation and is open to interdependence, and (e) group, as well as individual, learning is promoted--participants serve as both teachers and learners to the group.

Informal learning encompasses more than just participation in professional learning communities. Lohman (2005) found that teachers engaged in a variety of informal learning activities. When surveyed, teachers indicated they relied on the feedback and expertise of others through collaboration, observation, and informal conversations. They also practiced individual learning through reflexive practice, trial and error, and researching published materials. There are several studies that have explored the informal learning of teachers (Lohman, 2005; Hall, 2007; Hoekstra, Beijaard, Brekelmans, & Korthagen, 2007; Scribner, 1999, 2003; Shapiro, 2003). The results of these studies provide similar lists of learning activities utilized by teachers to improve their practice as educators.

To help classify these activities, Eraut (2004) divides them among three typologies: deliberative, reactive, and implicit learning. Deliberative learning is when an individual seeks out information to achieve a specific learning goal. Deliberative learning can represent both formal and informal learning. Participants could attend a course or workshop (formal) or observe a classroom or research materials on a given topic (informal). Reactive and implicit learning are achieved only through informal contexts. Reactive learning is when the individual is aware that learning is taking place, but did not engage in the activity with the intention to learn. An example would be a learning a new skill through a casual conversation with a colleague. Implicit learning is when knowledge is acquired unconsciously. The acquisition of tacit knowledge would fall into this category; through repetitive experiences, teachers inadvertently learn how to improve their practice.

It is clear from the literature that teachers are engaging in professional learning in a variety of formats and much research has been conducted to identify strategies that improve these learning experiences. Studies suggest that professional learning is effective when
learning goals are specific, curriculum is aligned to objectives, learning activities are varied, and support is provided to participants (Birman et al., 2009; Dass & Yager, 2009; Desimone et al., 2002a; Desimone et al., 2002b; Garet et al., 2001; Hall, 2007; Loucks et al., 1998; Magestro & Stanford-Blair, 2000; Sparks, 2002). Researchers have also substantiated the need to not only evaluate how professional learning situations are constructed, but also the context in which they operate (Guskey, 2000; Hall, 2007). Whether it be district-wide, site-based, or individual, each learning situation provides a unique environment where teachers can build upon their existing knowledge and practices as educators.

Through experiences in their classrooms, collaboration with their peers, and feedback and assistance from their communities, teachers are developing ways to improve their skills as educators. In order to fully understand teacher learning, and to quell the debate on which methods are most effective, researchers “must study it within these multiple contexts, taking into account both the individual teacher-learners and the social systems in which they are participants” (Borko, 2004, p. 4).

**Importance of Teacher Learning**

The study of why and how teachers learn is a prevalent topic in the literature and in practice. Even more so in the last few decades as the U.S. educational system has been moving towards “standards-based reform, which include high standards, curriculum frameworks, and new approaches to assessment aligned to those standards; [this shift has] generated new expectations for teaching and student performance” (Desimone et al., 2006, p. 180). Although opinions may vary about the effectiveness of the current educational system, the general public and policy makers are coming to a consensus that high quality teachers are believed to be the key to making large-scale changes in education (Sykes, 1999). Hawley and Valli (2005) state “this recognition, coupled with the belief that comprehensive school reform requires changes in structure, culture, and capabilities, is leading federal, state, and local policymakers to invest
more heavily in teachers’ continuing professional development” (p. 1). Support for further study and implementation of teacher professional development can be seen in federal policy and funding decisions as well as in the literature regarding teacher satisfaction and effectiveness.

**Political reform and funding.** Validation of teacher professional development can be seen in political reform and in federal funding allocations. When the *No Child Left Behind Act* was implemented, policy makers began increasing their attention on public school teachers (Griswold, 2005; Torff, Session, & Byrnes, 2005). The federal government began to analyze distinct academic measures as well as graduation and attendance data to evaluate states, districts, schools, and teachers. In response, states began to re-evaluate their curriculum and turned to professional development as a way to push these reforms into the classroom (Griswold, 2005). In addition to curricular changes, many states moved to adjust their certification requirements so that teachers would have to engage in professional development in order to keep their certifications current. The belief being these new opportunities for professional development would encourage teachers to stay current on best practices and trends in education (Cavallini, 1998; Torff et al., 2005).

Although the *No Child Left Behind Act* was implemented over a decade ago, the call for quality professional development is still prevalent. With the recent implementation of the *Common Core State Standards*, professional development is seen as the impetus to incorporating these new standards into the classroom (Van Driel & Berry, 2012). In response to these policy changes, the federal government has increased its appropriation of professional development funding. From 2005 to 2014, over 26 billion dollars in Title II funding was provided to improve teacher and principal quality (U.S. Department of Education, 2014). Young (1998) asserts that the biggest problem facing continuing professional education is the proper funding of activities and the financial management once the programs are implemented. The security of federal funding as well as the implementation of state standards to promote teacher learning,
ensures that teacher professional development will continue to be a part of the educational
reform agenda for the foreseeable future.

**Teacher support and satisfaction.** While the function and importance of teacher
professional development can be seen in legislative actions, researchers have also sought to
validate its role in the literature. Smith (2003) provides numerous reasons why professional
development is directly important to educators. Engagement in professional development
enhances the profession as teachers come together to share new ideas and in turn improve
their craft. It also heightens curiosity, encourages reflexive practice, and it has been shown that
teachers who challenge themselves are more satisfied and experience fewer occurrences of
burnout. Professional development also enables teachers to advance to new roles. Although
administrative positions often require graduate degrees, teachers who seek to enhance their
existing knowledge base through continuous learning may be better equipped to receive tenure,
greater overall responsibilities, and higher salaries. In addition, professional development not
only influences the learning habits of teachers, it also has the ability to improve the learning
habits of students. Teachers who engage in professional development often become life-long
learners, a skill that has the potential to be imparted upon their students throughout their career
(Smith, 2003).

While professional development can be seen as a valuable tool to providing teachers
with just-in-time information to address a particular learning need, it also serves as a
longitudinal support tool throughout a teacher’s career. Huberman (1989) identifies five stages
of professional crisis that teachers encounter during their career. The first is *Exploration and
stabilization*, where teachers struggle to cope with everyday tasks. The second is *Commitment*,
when teachers encounter difficulty trying to identify the most effective ways to address the
needs of every student. The third is *Diversification*, when teachers encounter a student who
fails to learn. The fourth is *Serenity of distancing*, when a teacher commits to their profession or
makes the decision to leave the profession. The final stage is *Conservatism and regret*, where teachers reflect on their career and either regret decisions or refuse to accept new practices. Huberman’s (1989) classification demonstrates that teaching is an evolving vocation and that educators need a variety of support mechanisms in place to assist them throughout their career.

**Teacher effectiveness.** Arguably, the most important factor in the support of professional development is its connection to teacher effectiveness (Akiba, 2012; Birman et al., 2009; Hawley & Valli, 1999, Sykes, 1999); however, the relationship between student achievement and teacher professional development has been difficult to establish (Loucks-Horsley & Matsumoto, 1999). Yoon, Duncan, Lee, Scarloss, and Shapley (2007) performed a meta-analysis of teacher learning and found that when professional development was prolonged and rigorous, it lead to positive results in student achievement. They discovered that learning activities lasting less than 14 hours resulted in no improvement in student learning; however, programs that lasted longer than 14 hours showed significant positive effects on student achievement. The most notable evidence of student improvement from the analysis was associated with programs that were spread out over a year and offered between 30 and 100 hours of instruction to teachers.

Most studies that have sought to define the relationship between teacher learning and student achievement have focused on math and science educators. Johnson and Fargo (2010) conducted a longitudinal study on the impact of science teachers’ professional development. Teachers who participated in a summer emersion course, as well as monthly professional development, had significantly higher student learning gains than the control group. Research in these areas has also shown that when the professional development has a curricular focus, it results in higher student achievement. Huffman and Thomas (2003) analyzed the professional learning activities of math and science teachers and found that math teachers who engaged in curriculum professional development had statistically significant increases in student test
scores. Cohen and Hill (1998) reported similar results when they reviewed California state math scores and reports of teacher professional development experiences. They found that the average mathematics achievement score was higher if the student’s teacher had engaged in content specific professional development.

The efficacy of districts, schools, and teachers is determined, in part, by the academic success of their students (Akiba, 2012; Birman et al., 2009; Hawley & Valli, 1999). Research has shown that when professional development offerings have a curricular focus, it provides opportunities for improved student achievement as well as support to educators who are teaching outside their field of study (Darling-Hammond, 2000). Not only does professional development positively impact student achievement, it also improves teacher satisfaction. Professional learning produces an environment of exploration, adaptation, and collaboration where teachers can continuously improve the knowledge and skills held within the field (Smith 2003). By investigating why and how teachers learn, administrators and policy makers can make better choices in offering professional development that meets the needs of every educator and works to enhance student learning in the classroom.

Factors That Influence Professional Learning

Prior research has shown differences in professional learning activities based on teacher attributes such as years of teaching experience, subject taught, and educational background as well as school attributes such as poverty level and the school district size (Akiba, 2012, Birman et al., 2009; Desimone et al., 2006; Smith & Desimone, 2003). The following studies outline how teacher and school attributes can influence teachers’ selection of and participation in professional development activities.

Teacher attributes. Several studies have shown differences in professional learning preferences based on years of teaching experience. Smith and Desimone (2003) evaluated the 1993-1994 and 1999-2000 Schools and Staffing Survey (SASS) data and found relationships
between teaching experience and professional development activities. Teachers early in their career (8 or less years of experience) participated in the greatest amount of professional development. The study also showed that learning began to plateau after eight years of teaching and dropped drastically after 25 years. They also found that mid- and advanced-career teachers engaged in more content and instructional methods focused professional development than new teachers.

Birman et al. (2009) found similar trends with new teachers when they investigated the relationship between teaching experience and professional development choices using the 2005-2006 National Assessment of Educational Progress (NAEP) survey data. They found that beginning teachers (less than three years of experience) spent a total of 117 hours engaging in professional development compared to more seasoned teachers who spent only 98 hours.

Previous studies have reported differences in professional development choices based on education level and degree major. Desimone et al. (2006) studied the responses from the 2000 NAEP survey and discovered that mathematics teachers who had a degree in mathematics engaged in more formal content-specific professional development than teachers who did not have a degree in mathematics. Those with a degree in mathematics also participated in more college coursework. No statistically significant differences were found in formal professional development choices between mathematics teachers who had an undergraduate or a graduate degree in mathematics. Akiba’s (2012) study of middle school mathematics teachers found that those who had majored in mathematics spent more time on college coursework. Those who did not major in mathematics, spent more time on self-directed learning activities.

Prior studies have shown that the subjects taught by teachers may also influence their professional development choices. When Smith and Desimone (2003) investigated the learning habits of teachers over a seven-year period, they found that the time spent on professional
development increased across all subject areas. Participation in content specific activities was twice as high as other development areas such as instructional methods. When each subject area was analyzed, only mathematics teachers had a significantly higher level of participation in professional development than other subject areas. Birman et al. (2009) found that respondents from the 2005-2006 NAEP survey indicated their districts placed a greater emphasis on mathematics and reading professional development activities. In addition, special education teachers reported participating less in the areas of content standards and assessment professional development compared to their general education counterparts.

**School attributes.** Researchers have demonstrated that school and district demographics may also influence teacher choices of professional learning activities. Birman et al., (2009) found that teachers in low income and high minority schools were more likely to not have a degree in the content area they were teaching compared to new teachers in high income, low minority schools. Smith and Desimone (2003) found that teachers who are employed by low income schools or are assigned low-achieving students, face greater challenges such as larger classes, fewer classroom resources, greater incidences of behavioral or safety issues, and are often assigned to teach content areas for which they are not certified. Even though teachers at high poverty schools face additional challenges when compared to their peers at low poverty schools, Smith and Desimone (2003) found that between 1993 and 2000, teachers at both low and high income schools increased their professional development. Teachers in low income schools were more likely than those from higher income schools to engage in content, assessment, and instructional methods professional development. In terms of compensation, wealthier schools offered their teachers tuition reimbursement, whereas those from low income schools were more likely to receive stipends for participation. Even with the difference in compensation between the groups, teachers in both high and low income schools, were equally likely to engage in college coursework.
In contrast, Birman et al. (2009) using the 2005-2006 NAEP survey data determined that mathematics and language arts teachers in low poverty schools engaged in more college coursework than high poverty schools. Teachers in high and low poverty schools engaged in more professional development than teachers from average income schools. They also found that educators in high poverty schools participated in a greater amount of active learning professional development when compared to those in moderate and low poverty schools.

In addition to income demographics, researchers have identified that the size of a school district can also influence the type and frequency of professional development activities offered. Smith and Desimone (2003) assert that larger districts are better equipped to offer an assortment of professional development opportunities to their teachers. Larger school districts can benefit from economies of scale, where they can hire specialized staff to develop a variety of educational offerings to teachers. To address these issues of inequity, legislative reforms and well as Title I and II funding has been established to promote greater amounts of professional development to districts of all sizes (Griswold, 2005; U.S. Department of Education, 2014).

Studies have shown that school and teacher attributes can influence professional development choices (Akiba, 2012; Birman et al., 2009; Darling-Hammond, 2000; Desimone et al., 2006; Smith & Desimone, 2003). School attributes appear to be potentially influential as teachers who work for low income schools look for specific activities that can assist them in improving their content knowledge, assessment techniques, and instructional strategies (Birman et al., 2009; Smith & Desimone, 2003). More studies large-scale studies could be conducted, however, to better understand how these attributes influence teacher learning needs (Akiba, 2012; Smith & Desimone, 2003). If distinct patterns emerge through continued research, school districts can make better programmatic choices to meet the diverse learning needs of their educators.
Prior Studies of Professional Learning

To date, there have been a limited number of large-scale studies conducted that sought to understand and quantify teacher learning (Akiba, 2012). Most of the qualitative research (Hall, 2007; Scribner, 1999, 2003; Smaller et al., 2001) has focused on the informal learning habits of teachers. Most of the quantitative studies (Akiba, 2012; Birman et al., 2009; Desimone et al., 2006; Smaller et al., 2000; Smith & Desimone, 2003, Strizek et al., 2014) have used national survey data to derive evidence of learning. The following sections provide an overview of several qualitative and quantitative studies that have sought to quantify teacher learning.

Qualitative studies. Smaller et al. (2001) conducted a qualitative study as a follow-up to a large national study conducted in 2000. For seven days, 13 teachers kept a diary of their learning activities during November/December and again during February/March. After the diaries were analyzed, follow-up phone interviews were conducted with several of the participants. The analysis revealed that teachers spent about seven hours a week on informal learning. These activities included meetings and informal conversations as well as the use of print and digital media. Based on the interview data, Smaller et al. (2001) found that teachers engaged in these activities both at school and at home in an effort to learn more about and to adjust to newly implemented educational reforms.

Hall (2007) interviewed two superintendents, six principals, and 30 teachers to better understand successful district-wide professional development. Results of the study indicated that the participating districts actively encouraged teacher collaboration; focusing on areas such as assessment and the sharing of best practices through informal conversations. The teachers who engaged in formal professional development activities reported improved performance in the classroom as well as improved relationships with their peers.

Scribner (1999) conducted a multi-site case study with 45 urban high school teachers. Participants were interviewed to learn about their past experiences with professional
development. Teachers reported various activities; most fell into the following categories: (a) experiential learning, (b) graduate courses, (c) conferences/workshops, (d) in-service activities, (e) individual inquiries, and (f) collaboration. Participants indicated they engaged in professional development to improve their content knowledge, pedagogical practices, classroom management, and skills to address diverse student learning needs. The desire to improve content knowledge was the largest intrinsic motivating factor. Collaboration and workshop/conferences were viewed to have the most utility. When teachers came together to work collaboratively, they experienced improvement in their classroom management skills. When they attended workshops/conferences, they saw improvement in their content-related skills. Both workshops/conferences as well as collaboration were seen as valuable methods to improve pedagogical skills.

Scribner (2003) conducted a follow-up case study that focused on the professional learning activities of 20 rural high school teachers. Scribner found two driving contexts for teacher learning: student needs and subject matter requisites. Teachers indicated the student needs changed from day to day and year to year. There was no way to predict how a student would comprehend the content or the depth to which the content would need to be explored. Therefore teachers felt immense pressure to develop strong pedagogical and content area skills. Due to these teachers’ geographic limitations, they focused heavily on individual learning activities. These experiential learning activities were found to be non-reflective and lonely.

**Quantitative studies.** Birman et al. (2009) created a federal report using data from two longitudinal studies: The National Longitudinal Study of *No Child Left Behind* (NLS-NCLB), and The Study of State Implementation of Accountability and Teacher Quality Under *No Child Left Behind* (SSI-NCLB). These were used to provide an analysis of teacher quality, school choice and Title I programs, resource provisions, and accountability. Birman et al. (2009) found that despite federal reforms that pushed the implementation of sustained content-focused
professional development, only a small portion of teachers engaged in sustained mathematics and literacy learning activities. Instead, the majority of teachers participated in short-term workshops and courses. Those who participated in these activities were more interested in learning instructional strategies instead of the content itself. The report also specified that the percentage of elementary teachers who participated in reading professional development and the percentage of secondary mathematics teachers that participated in mathematics professional development increased from 2003 to 2006. Finally, elementary teachers from high poverty and high minority schools were more likely to participate in long-term, sustained, reading and mathematics content-focused professional development than teachers from other types of schools.

Smaller et al. (2000) conducted a larger-scale study of teacher professional development of elementary and secondary teachers. The 753 participants were asked to report any formal and informal learning activities within the past 12 months. The vast majority of participants (85%) reported participating in at least one formal course or workshop within the last year. They spent over eight hours a week preparing for assignments and lessons, which was considered a formal activity by the researchers. Participants also spent four hours a week on informal learning activities related to their teaching positions.

Akiba (2012) developed an instrument to study the learning activities of middle school mathematics teachers in the state of Missouri. In order to measure the learning that was occurring, Akiba (2012) developed the Teachers' Opportunity to Learn (TOTL) survey. The seven learning categories measured on the survey were (a) professional development programming, (b) teacher collaboration, (c) university/college courses, (d) professional conferences, (e) mentoring/coaching, (f) informal communication, and (g) individual learning activities. These categories were based on Scribner's (1999, 2003) prior research findings.
In the Akiba (2012) study, 577 mathematics teachers completed the TOTL survey. There were several significant findings from the research. Akiba (2012) found the most common type of learning teachers engaged in was individual activities; 99.8% of respondents participated in learning experiences under this category with an average time spent of 36.1 hours per month. In the study, 78% of the participants reported attending at least one professional development course, with the average time spent being 26.8 hours over the last 12 months. These responses support the idea that teachers actively engage in both informal and formal professional learning.

Analysis of variance and independent means t tests were conducted in the Akiba (2012) study to determine if there were statistically significant differences between teacher demographics and the amount of professional learning reported. Several relationships were found to be significant at the .05 level. When mentoring and coaching activities were evaluated, beginning teachers were found to spend significantly more time engaging in these activities as opposed to their mid-career and more experienced peers. Individuals who were certified in mathematics spent a greater amount of time on individual learning activities when compared to others who were not certified in mathematics. Teachers who served in high poverty schools and those who taught in schools with high ethnic minority populations participated in more professional development programming and engaged in more mentoring and coaching activities than their peers at other schools. Those teachers who served in high ethnic minority schools also collaborated more with their peers. Finally, beginning teachers, experienced teachers, and mathematics majors took more college coursework than other groups in the study.

One of the most recent large scale studies of professional development (Strizek et al., 2014) utilized the Teaching and Learning International Survey (TALIS). This survey was developed by the Organization for Economic Co-operation and Development (OECD) to capture teacher and principal input regarding education practices and policy. In 2013, more than 30
countries distributed the survey which focused on input from lower secondary teachers (grades 7-9). This was the second time the survey was distributed, but it was the first time the United States participated. While the survey captured a variety of information, there were some notable findings regarding teacher professional development practices.

Strizek et al. (2014) produced a technical report highlighting the major findings from the survey. Over 2,000 teachers participated from 140 schools across the United States. The vast majority of teachers surveyed, 95.2%, participated in some type of professional development over the last 12 months. This was higher than the international average of 88.4%. U.S. teachers reported spending 84.2 hours annually on professional development programming such as courses or workshops. This was higher than the international average of 70.9 hours. They also spent 15.4 hours on in-service training sponsored by organizations other than their school district. The average time U.S. teachers spent on conferences or seminars was 48.8 hours annually. Again this was slightly higher than the international average of 43.6 hours. Respondents spent 13.3 hours annually on site visits to other schools, 32.5 hours on mentoring and coaching activities, 16.4 hours on college/university courses, and 47.4 hours networking with teachers for the purpose of professional development—which was 10.5 hours higher than the international average. Participants also spent 41.1 hours annually on individual research projects—which was 10 hours longer than international teachers.

**Summary**

The literature provides a growing number of resources related to designing and evaluating effective professional development programming. Prior studies have shown that if activities are well planned, sustained, content-specific, audience-specific, and interactive, they will result in greater teacher satisfaction and student achievement (Birman et al., 2009; Dass & Yager 2009; Desimone et al., 2002a; Desimone et al., 2002b; Garet et al., 2001; Hall, 2007; Loucks et al., 1998; Magestro & Stanford-Blair, 2000; Sparks, 2002). Research indicates that
professional development activities can be implemented successfully at the district, school, or individual levels and can take place in both formal and informal environments (Dabbagh & Kitsantas, 2012; Desimone, 2011; Hall, 2007; Lieberman & Pointer Mace, 2009; Lohman 2005; Stoll et al., 2006; Strizek et al., 2014). Exploration of teacher interest in professional learning reveals that participation is influenced by a number of individual- and school-related factors (Akiba, 2012, Birman et al., 2009; Desimone et al., 2006; Smith & Desimone, 2003). Finally, continued support for professional development can be found in the literature, federal funding allocations, and standards-based reforms (Desimone et al., 2006; Van Driel & Berry, 2012; Griswold, 2005; Hawley & Valli, 2005; Torff et al., 2005; U.S. Department of Education, 2014).

What is still lacking in the literature is validation, based on large-scale quantitative research, of how teachers choose to learn and if their learning preferences are influenced by personal and school-related factors. To date, Akiba (2012) is the only U.S. researcher to execute a large-scale quantitative study that has measured both the formal and informal learning activities of mathematics teachers and tried to identify the external factors that influence those choices. Akiba’s (2012) study is limited, since it only assessed the learning activities of middle school mathematics teachers in the state of Missouri. This study sought to further Akiba’s findings by studying the professional learning activities of middle and high school mathematics teachers located in the west central Florida region.
Chapter Three

Methods

The purpose of this study was to examine the types of formal and informal professional learning activities middle and high school mathematics teachers engaged in to improve their knowledge, skills, and abilities as educators analyzed by the participants’ school setting, years of teaching experience, level of education, degree major, certificate type, and their school’s Title I status. There were three objectives to this study. The first was to identify the types of informal and formal learning activities middle and high school mathematics teachers participated in as part of their professional development. The second was to quantify the frequency in which they engaged in these activities. The third was to determine if there were statistically significant differences in the frequency and types of activities when analyzed by the participants’ school setting, years of teaching experience, level of education, degree major, certificate type, and their school’s Title I status. This chapter is organized into the following parts: research design, sample, instrumentation, validity, reliability, variables, data collection, and data analysis.

Research Design

This survey research study was conducted to capture information regarding the types of professional learning activities middle and high school mathematics teachers’ engaged in for professional development. Creswell (2002) asserts, “surveys are most suitable to assess trends or characteristics of a population; learn about individual attitudes, opinions, beliefs, and practices” (p. 421). Since this study sought to capture the learning habits of mathematics teachers, an electronic survey was deemed the most appropriate method to collect this information.
Dillman, Smyth, and Christian (2008) contend there are four attributes to a well-executed survey: (a) all members of a population have the opportunity to be sampled, (b) the participants selected must be sampled using random methods, (c) the questions in the survey must be phrased so that accurate information can be reported by the participants, and (d) everyone who receives the survey responds to it. This study sought to achieve three of the four Dillman et al. (2008) principles. First, the study solicited all the individuals in the sample provided by the participating school districts. Second, the study utilized a survey instrument that was used successfully in a previous study—which collected professional development information from mathematics teachers. This study also conducted a content review with a panel of education experts as well as cognitive interviews to further validate the content and terminology used in the survey and the procedures for data collection. These additional reviews ensured the content and procedures were suitable for the study and better equipped participants to report their responses accurately. Third, the sample in this study was solicited to participate on two separate occasions. By soliciting the sample multiple times, it provided additional opportunities to increase the response rate. The one Dillman et al. (2008) principle that was not utilized in this study was random sampling; as the sample size of this study was not large enough to support this sampling technique.

Sample

A sample of middle and high school mathematics teachers were taken from two large urban public school districts located in the west central Florida region. The school districts chosen for the study were geographically convenient, had not recently been part of a similar study, and could derive benefits from the data collected. In order to participate, those who responded had to be full-time middle and high school mathematics teachers who taught at least one section of mathematics during the work day. Part-time instructional staff were excluded from the study, as they had limited access to paid district professional development activities.
Instrumentation

The Teachers’ Opportunity to Learn (TOTL) survey (Akiba, 2012) was used for this study. The TOTL survey was created in order to understand middle school mathematics teacher’s professional development choices, the quality of the professional development they engaged in, and the relationship between their professional development activities and the achievement scores of their students (Akiba, 2012).

Like the Akiba (2012) research, this study sought to capture the learning habits of mathematics teachers. Since the populations sampled were similar, only minor adjustments were made to the TOTL survey. These adjustments were identified from an evaluation completed by a content validity panel as well as dialogue from cognitive interviews conducted with a separate pilot panel. A copy of the adapted TOTL survey can be found in Appendix A.

The original TOTL instrument was distributed by mail. This study solicited participants by email. Therefore the TOTL was recreated using electronic survey software. To make the response process more efficient for participants, the researcher designed the survey so that it adapted to the participants’ responses. This enabled participants to skip portions of the survey, which were not relevant, based on a question’s response. Permission to use and adapt the TOTL survey instrument was granted by the creator. An email exchange, granting permission to use the instrument, can be found in Appendix B.

In order to statistically analyze the differences in responses by the teacher variables, a short demographic questionnaire was added to the beginning of the TOTL instrument. These additional questions asked participants to indicate their school setting, years of teaching experience, level of education, degree major, certificate type, and their school’s Title I status.

In addition to the six demographic questions, there were seven areas of professional development measured by the TOTL instrument. They were (a) professional development programming, (b) teacher collaboration, (c) university/college courses, (d) professional
conferences, (e) mentoring/coaching, (f) informal communication, and (g) individual learning activities. The activities captured by the TOTL represented formal learning, informal learning, and in some cases, both. Table 1 provides a classification for each activity included in the TOTL.

Table 1

<table>
<thead>
<tr>
<th>Professional Development Type</th>
<th>Formal Activity</th>
<th>Informal Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Development Programming</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Teacher Collaboration</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>University/College Courses</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Professional Conferences</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Mentoring/Coaching</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Informal Communication</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Individual Learning Activities</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

For each of the seven learning categories, participants were asked to provide two pieces of information. First, participants had to indicate if they participated in the activity within the last 12 months. If the participant answered yes, they were then asked to indicate how frequently they engaged in the activity within the last 12 months. If the participant answered no, they skipped over the frequency question and instead were asked to report their participation for the following professional development category. The frequency intervals for the seven learning categories varied. These intervals were established by Akiba (2012) after analyzing results from a pilot study of 114 middle school mathematics teachers as well as teacher interviews.
To acquire the most accurate reporting from the participants, the professional development categories asked for either an hourly total for a typical month or an hourly total for the prior 12 months. For the professional development programming, teacher collaboration, university/college courses, and professional conferences categories—participants were asked to indicate how many hours they engaged in these activities over the last 12 months. For the mentoring/coaching, informal communication, and individual learning activities categories—participants were asked to indicate how many hours they engaged in these activities in a typical month. The instrument was designed to have participants report the latter activities as a monthly total, due to past studies documenting that teachers engage in these activities more frequently than other types of activities (Abika, 2012). By requiring a monthly total, instead of an annual total, respondents were more likely to report participation in these activities accurately.

Validity

The validity of an instrument is important when assessing its value in empirical research. Validity can be described as "the extent to which an empirical measure adequately reflects the real meaning of the concept under consideration" (Babbie, 1989, p. 124). Gall, Gall, and Borg (2007) contend that educational research is most concerned with an instrument’s content, construct, and criterion-related validity. Since validity information had not been published for the TOTL instrument, this study sought to establish content validity.

**Content Validity.** The substantiation of content validity is a process that brings together subject-matter experts to thoroughly inspect an instrument’s content to determine if it accurately reflects what it claims to represent. In order for an instrument to have content validity, it does not need to cover every facet of a particular content area, but “it must cover a representative sample of the content domain” (Gall et al., 2007, p. 196). According to Rubio, Berg-Weger, Tebb, Lee, and Rauch (2003) “using a panel of experts provides constructive feedback about the quality of the newly developed measure and objective criteria with which to evaluate each
item” (p. 95). Content validity was achieved in this research by utilizing the knowledge and experience from a panel of mathematics teachers. Five mathematics teachers were solicited to serve on the content validity panel. This group was requested to meet together, at a specific time, at a geographically convenient middle school. A list summarizing the participants’ demographics for the content validity panel can be found in Appendix C.

The purpose of the panel was to review the instrument and to evaluate each question on two areas: did the activity represent professional development and was the narrative provided clear to the reader? For questions on the survey that had sub-questions, participants were asked to determine if these secondary activities represented the professional development heading under which they were included. Participants were also given the opportunity to provide comments for each question. A content validity form was created to guide the panel’s dialogue and to assist the panel members in completing the activity. A copy of the form can be found in Appendix D.

Panel members were provided the instrument and the evaluation form one week prior to the scheduled meeting. At the meeting, the researcher provided each member with a paper copy of the survey and the review form. The researcher reviewed the form and answered any questions regarding its use from the panel members. The group was then given 30 minutes to review the survey and complete the evaluation form. After each member completed the form, the group discussed their question rankings and comments. For areas where the members may have disagreed, a dialogue was facilitated by the researcher.

A few suggested changes resulted from the panel’s evaluation and subsequent group discussion. For most questions on the survey, the panel felt the content was easy to read and the activities represented teacher professional development. Minor narrative changes were suggested for almost every professional development category. The bulk of the panel’s discussion revolved around teacher collaboration, mentoring/coaching, and individual activities.
For teacher collaboration and mentoring/coaching, the group felt that benefits derived by these professional development activities depended heavily on the interactions of the participants themselves. They concluded that at times these activities could represent professional development and at other times not. The consensus of the group was to keep the categories, because these activities did have the potential to create professional development opportunities if the individuals involved were focused on discussions that led to professional growth.

The other activity that generated discussion from the group was individual learning. The panel felt the text needed to be edited for the student-work and the assessment-tools questions. For student work, the group felt that “to improve instructional practice” needed to be added to the question’s narrative. Many panel members remarked that evaluating student work was only professional development if teachers engaged in that activity to improve their practices as educators. The panel also felt that the word “researching” needed to be added to the developing assessments activity. The group believed that the process of researching assessments created opportunities for professional development. These changes, in addition to the minor narrative changes suggested from the pilot panel, led to the adapted version of the TOTL used in this study.

In addition to a content validity panel, a pilot test was conducted. A convenience sample of six mathematics teachers was solicited to take the TOTL survey. Appendix E contains a list of the demographic characteristics of the pilot panel members. The group convened and participated in cognitive interviews. According to Ryan, Gannon-Slater, and Culbertson (2012), cognitive interviews involve a variety of techniques “(e.g., think aloud protocols, verbal probes) that enable a researcher to deeply analyze how respondents understand the survey questions they are to answer” (p. 4). These interviews confirmed the study procedures and instrument questions were easy to follow and complete. Once the interviews were complete, the group took the adapted TOTL instrument twice to generate reliability statistics for the study.
**Internal validity.** Gay and Airasian (2000) define internal validity as "the condition that observed differences on the dependent variable are a direct result of the independent variable" (p. 345). In order to increase the internal validity of this study, two physical controls were employed. First, only full-time teachers were sampled in this study. Full-time teachers have access to more formal professional development courses and more opportunities to engage in the various types of professional development captured by this study. Second, the participants in the study only reported the types of professional development activities they engaged in over the prior 12 months. By limiting the responses to the prior 12-months, participants were better able to accurately report the frequency of their learning activities. The use of a content validity panel and the pilot panel to review the instrument also helped to increase the internal validity of the study.

**Reliability**

Reliability can be described as the degree to which an error of measurement exists (Gall et al., 2007). Prior to this study, reliability information was not published for the TOTL instrument. In order to establish reliability, a test-retest approach was utilized. Test-retest reliability estimates the degree to which an "individual's scores on a test administered at one point in time are correlated with their scores on the same test administered at another point in time" (Gall et al., 2007, p. 656). As previously mentioned, in order to conduct this analysis, the participants from the pilot panel were asked to complete the TOTL two times. The second request to complete the survey was sent one week after the participants initially completed the survey.

Correlation coefficients were calculated for each question from the two survey administrations. Cohen, Manion, and Morrison’s (2011) scale of correlation coefficients was used to evaluate results. Cohen et al. (2011) state coefficients that are “<0 +/- 0.1 = weak, <0 +/- 0.3 = modest, <0 +/- 0.5 = moderate, <0 +/- 0.8 = strong, and ≥0 +/- 0.8 = very strong” (p. 656).
Based on the data collected from the pilot panel, the overall reliability for the adapted TOTL instrument was 0.82. According to Webb, Shavelson, and Haertel (2006) achieving a correlation coefficient that is 0.8 or higher indicates the measure is sufficiently reliable.

Although the overall reliability for the instrument was strong, the reliability per question did vary throughout the instrument. Every question that asked the participants to indicate if they did or did not engage in an activity achieved a very strong positive correlation. For areas where participants had to select an hourly range, the reliability varied. Questions regarding professional development programming (0.77), teacher collaboration (0.95), professional conferences (1.00), and mentoring/coaching (1.00) had strong and very strong positive correlations. Individual communication (0.33) achieved a moderate positive correlation. Individual learning activities had the greatest range of correlations with responses representing modest to very strong positive correlations; analyzing and evaluating student work (0.79) and reading journals/books (0.92) had the highest correlations from the individual learning activities group. Correlations were not able to be calculated for the university/college courses and professional conferences categories as no one on the pilot panel engaged in these activities.

Variables

Six demographic variables were collected in this study. Two of the variables were nominal: degree major and Title I status; three were ordinal: school setting, level of education, and certificate type; and one variable was ratio: years of teaching experience. School setting had two levels: middle school or high school. Certificate type had two levels: permanent certificate or temporary certificate. Level of education had three levels: bachelor’s degree, master’s degree, or specialist/doctorate degree. Degree major had three levels: mathematics degree, mathematics education degree, or other. Title I status had three levels: the teacher was employed at a Title I school, they were not employed at a Title I school, or they were unsure.
Years of teaching experience had three levels: 0-5 years, 6-15 years, and over 15 years. The demographic variables for this study served as the independent variables.

There were seven dependent variables for this study: (a) professional development programming, (b) teacher collaboration, (c) university/college courses, (d) professional conference, (e) mentoring/coaching, (f) informal communication, and (g) individual learning activities. For each of these categories, participants indicated if they participated in the activity within the last 12 months, and if so, how frequently. Due to the diversity of activities within some of these professional development categories, the instrument included sub-categories for some of the areas.

For three of the seven professional development categories (university/college courses, professional conferences, and individual learning activities), Akiba (2012) created additional sub-categories. For university/college courses, participants were asked to specify how many hours they spent in the last 12 months in courses focused on (a) mathematics content, (b) mathematics instruction/pedagogy, (c) foundations (e.g., diversity, social contexts of schools), (d) research on mathematics education, and (e) other. For professional conferences, participants were asked to specify how many hours they spent in the last 12 months as a conference attendee and/or as a conference presenter. For individual learning activities, participants were asked to specify how many hours they spent in a typical month on (a) analyzing and evaluating student work (e.g., homework, worksheet, student responses to your questions in class), (b) reading teachers’ manual for adopted textbook, (c) researching and developing student assessment tools and materials, (d) searching web-based resources for curriculum and instructional techniques, (e) reading professional journals or books on mathematics teaching and learning (e.g., Mathematics Teaching in the Middle School, Mathematics Teacher), and (f) other.
Data Collection

This study sought to establish a confidence level of .05, power level of .80, and an effect size of .30 for the Independent means t tests and an effect size of .25 for the one-factor analysis of variance (ANOVA) tests. Based on these parameters, the study had to obtain at least 159 participants. Since the survey was sent electronically, it was necessary to solicit a sample large enough to generate the required number of participants.

Several school districts in west central Florida were solicited to partner in this study. Two school districts agreed to participate. These districts served rural, suburban, and urban student populations who were diverse both ethnically and socio-economically. The districts were comprised of traditional, charter, virtual, alternative, K-8, career-technical, and adult schools. Both districts provided a pool of potential participants large enough to achieve the required sample size for the study.

As part of the agreement to participate, these districts provided the researcher with the email addresses for all full-time middle and high school mathematics teachers, who taught at least one section of mathematics during the work day. Between the two participating districts, 1,847 teacher email addresses were provided to the researcher. A copy of the informed consent form, which was provided to participants in the electronic survey, can be found in Appendix F. The letter from the University of South Florida’s Institutional Review Board is included in Appendix G. The study was classified as exempt.

Every teacher on the provided district lists received an email with a link to the electronic survey recruiting them to participate in the study. See Appendix H for the initial survey email sent to the participants. Three weeks after the initial solicitation, a follow-up email was sent. A copy of the follow-up email can be seen in Appendix I. The online questionnaire was available to participants to complete for a period of six weeks.
Data Analysis

A variety of statistical techniques were employed in this study; both descriptive and inferential statistics were utilized to analyze the data collected. Descriptive statistics provide an efficient method for reporting quantitative data (Gall et al., 2007) and understanding the demographics of the sample population is important when evaluating the results of the research questions. Therefore, descriptive statistics were reported for the participant demographic information as well as the frequency and types of professional development the participants self-reported on the survey.

Inferential statistics from independent means $t$ tests, one-factor analysis of variance (ANOVA), and chi-square test of independence were reported for the professional development categories when analyzed by the demographic variables captured in this study. Confidence limits were also calculated. Identifying confidence limits enables the researcher to generate assumptions about the population from where the sample data were derived (Glass & Hopkins, 1996). In order to generate reasonable assumptions, a confidence level of 95% was used in this study. Confidence limits were reported for research questions one and two. Table 2 provides an illustration of which research questions were answered by the survey questions in the study.

Research question 1 sought to determine the types of professional development activities teachers engaged in to improve their skills as educators. In the survey, teachers indicated if they did or did not engage in a particular professional development activity. Descriptive statistics and confidence limits were reported for the responses to these survey questions.

Research question 2 sought to quantify the frequency in which teachers engaged in the professional development activities. In the survey, teachers indicated how frequently they participated in each of the seven professional learning activities. Interval ranges varied based
on the activity type. Confidence limits and descriptive statistics were reported to demonstrate how frequently teachers took part in these activities in an average month or on an annual basis.

Research question 3 sought to determine if there were statistically significant differences in the frequency of these professional development activities when analyzed by the demographic variables in the study. Inferential statistics were used to report these findings. Inferential statistics are “a set of mathematical procedures for using probabilities and information about a sample to draw conclusions about the population from which the sample presumably was drawn” (Gall et al., 2007, p. 137). Independent means $t$ tests, ANOVAs, chi-square tests of independence were used to analyze the data from this study.

Table 2

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Survey Question Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What types of formal and informal learning activities do middle and high school mathematics teachers engage in to improve their knowledge, skills, and abilities as educators?</td>
<td>1a, 2a, 3a, 4a, 5a, 6a, 7a, 7b, 7c, 7d, 7e, 7f</td>
</tr>
<tr>
<td>2. How often do middle and high school mathematics teachers engage in these formal and informal learning activities?</td>
<td>1b, 2b, 3b, 3c, 3d, 3e, 3f, 4b, 4c, 5b, 6b, 7a, 7b, 7c, 7d, 7e, 7f</td>
</tr>
<tr>
<td>3. Are there statistically significant differences in the frequency of informal and formal learning activities when analyzed by the participants’ school setting, years of teaching experience, level of education, degree major, certificate type, and their school’s Title I status?</td>
<td>1a, 1b, 2a, 2b, 3a, 3b, 3c, 3d, 3e, 3f, 4a, 4b, 4c, 5a, 5b, 6a, 6b, 7a, 7b, 7c, 7d, 7e, 7f</td>
</tr>
</tbody>
</table>
An Independent means $t$ test should be used when a researcher is interested in analyzing the difference in means between two sample groups (Gall et al., 2007). Three of the six demographic variables, school setting, certificate type, and Title I status had two levels to be analyzed. Therefore independent means $t$ tests were the most appropriate statistical method to use to measure the differences between these groups. Responses for these questions were coded with a 0 or a 1 for analysis. When participants indicated how frequently they engaged in an activity, they made their selection from a series of provided time intervals. The median from the selected range was used for the calculations. For the intervals that indicated a range greater than a set number (e.g., $> 30$), small incremental values were add to the highest number listed among the options. See Appendix J for a complete list of the values that were used for calculations.

Gall et al. (2007) assert that ANOVA should be used when a researcher is interested in analyzing the difference in means between three or more sample groups. Three of the six demographic variables (level of education, degree major, and years of teaching experience) in the study had more than two levels. Therefore ANOVA was the most appropriate statistical method to utilize when analyzing the differences between these groups. Responses for these survey questions were coded with either a 0, 1, or 2. Again, the median of the frequency ranges, selected by the participants, were used for the statistical calculations (see Appendix J).

Finally, participation percentages for the demographic variables were analyzed using chi-square test of independence. The chi-square test for independence should be used when a researcher is interested in determining if frequency counts are distributed differently among sample groups within a study (Gall et al., 2007). To conduct the analyses, responses to the questions that asked whether or not the teacher participated in a professional development category were coded with either a 0 or 1.
Chapter Four

Findings

The purpose of this study was to examine the types of formal and informal professional learning activities middle and high school mathematics teachers engaged in to improve their knowledge, skills, and abilities as educators analyzed by the participants’ school setting, years of teaching experience, level of education, degree major, certificate type, and their school’s Title I status. This chapter presents the research questions, describes the participant demographics, provides an analysis of the research questions, and details a summary of the chapter.

Research Questions

1. What types of formal and informal learning activities do middle and high school mathematics teachers engage in to improve their knowledge, skills, and abilities as educators?

2. How often do middle and high school mathematics teachers engage in these formal and informal learning activities?

3. Are there statistically significant differences in the frequency of informal and formal learning activities when analyzed by the participants’ school setting, years of teaching experience, level of education, degree major, certificate type, and their school’s Title I status?

Participant Demographics

Two districts participated in this research. District A had a higher rate of participation than District B. District A’s response rate was 14.20% \( (n = 182) \) and District B’s response rate was 11.15% \( (n = 63) \). Together they generated 254 responses. Nine survey responses were
eliminated, as they were incomplete, leaving a total of 245 usable responses for this study. A complete breakdown of the participant demographic variables can be found in Table 3.

Each group provided a diverse group of participants. There was a relatively equal split between middle school and high school respondents. The majority of participating teachers (70.61%) earned either a bachelor’s or master’s degree; very few participants had obtained a specialist or doctoral degree. The years of teaching experience was also relatively equally divided with about a third of the sample representing each career stage--early-career (0-5), mid-career (6-15), and advanced-career (over 15 years). Most of the participants (66.53%) in the study held permanent teaching certificates.

The most noticeable differences in responses, by district, were generated by the school’s Title I status and degree major questions. The percentage of teachers from Title I schools was lower for District B than District A. District A had 43.41% of their respondents indicate they taught in a non-Title I school, while District B had 55.56%. District B also had a greater number of teachers (11.11%) who were unsure about whether they taught at a Title I school compared to District A.

The majority of the participants in this study did not have a degree in mathematics or mathematics education. A little more than half the teachers in District B (53.97%), and only 32.97% of the teachers in District A, held a degree in mathematics or mathematics education. Participants who indicated they held an “other” degree were asked to write in their degree subject area. After analyzing the responses, 47.02% of those who did not major in mathematics or mathematics education held a degree in some other education-related discipline area. Of this education group, almost half held a degree in special education (44.00%), elementary teachers represented 34.00%, and the remaining degrees (22.00%) were comprised of other education subject areas and STEM education. Further analysis of the non-education majors revealed that 23.74% of the participants held a degree in a social science field, 14.39% held a
degree in a science, engineering, or computer science field, and 14.39% held a degree in business.

**Analysis of Research Questions**

A variety of statistical methods were utilized in this study. Descriptive statistics were employed for research questions one and two. Inferential statistics were utilized to determine information regarding the population of study for research question three. To answer research questions two and three, participants were asked to indicate how frequently they engaged in each professional development activity given a set of hourly ranges. The median of these ranges were used for the calculations. To view a detailed list of these values, by survey question, see Appendix J.

**Research question one.** This research question sought to determine the types of professional development activities teachers engaged in over the last 12 months. The amount of participation varied depending on the activity. Professional development programming (88.57%), teacher collaboration (82.04%), and individual activities (99.18%) had the highest percentage of participation. Individual learning had the greatest amount of participation, with all but two of the participants indicating they engaged in this activity. Informal communication also had a high percentage of participation with 66.53% of the sample indicating they communicated with their peers informally over the last 12 months. About a third of the respondents (30.61%) noted participation in mentoring/coaching activities. University/college courses (5.71%) and professional conferences (20.00%) had the lowest rate of participation among the activities captured in this study. A summary of participation counts, percentages, and confidence limits are provided in Table 4.
Table 3

**Breakdown of the Participant Demographic Variables**

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>District A¹</th>
<th>District B²</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td><strong>School type</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle School</td>
<td>105</td>
<td>57.69</td>
<td>30</td>
</tr>
<tr>
<td>High School</td>
<td>77</td>
<td>42.31</td>
<td>33</td>
</tr>
<tr>
<td><strong>Level of education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelor’s Degree</td>
<td>89</td>
<td>48.90</td>
<td>29</td>
</tr>
<tr>
<td>Master’s Degree</td>
<td>84</td>
<td>46.16</td>
<td>32</td>
</tr>
<tr>
<td>Specialist or Doctoral Degree</td>
<td>9</td>
<td>4.94</td>
<td>2</td>
</tr>
<tr>
<td><strong>Years of teaching experience</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-5 Years</td>
<td>55</td>
<td>30.22</td>
<td>17</td>
</tr>
<tr>
<td>6-15 Years</td>
<td>63</td>
<td>34.62</td>
<td>23</td>
</tr>
<tr>
<td>Over 15 Years</td>
<td>64</td>
<td>35.16</td>
<td>23</td>
</tr>
<tr>
<td><strong>Degree Major</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td>20</td>
<td>10.99</td>
<td>11</td>
</tr>
<tr>
<td>Mathematics Education</td>
<td>40</td>
<td>21.97</td>
<td>23</td>
</tr>
<tr>
<td>Other</td>
<td>122</td>
<td>67.04</td>
<td>29</td>
</tr>
<tr>
<td><strong>Certificate Type</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanent Teaching Cert</td>
<td>163</td>
<td>89.56</td>
<td>54</td>
</tr>
<tr>
<td>Temporary Teaching Cert</td>
<td>19</td>
<td>10.44</td>
<td>9</td>
</tr>
<tr>
<td><strong>Title I School</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title I</td>
<td>99</td>
<td>54.39</td>
<td>21</td>
</tr>
<tr>
<td>Non-Title I</td>
<td>79</td>
<td>43.41</td>
<td>35</td>
</tr>
<tr>
<td>Unsure</td>
<td>4</td>
<td>2.20</td>
<td>7</td>
</tr>
</tbody>
</table>

Note. N = 245.
¹District A n = 182. ²District B n = 63.

For three of the activities (e.g., university/college courses, professional conferences, and individual activities), participants were asked to indicate their participation in sub-categories for
the activities. For those who took university/college courses, everyone had enrolled in a mathematics content course. The second most common type of course was mathematics instructional/pedagogical strategies (61.54%). Everyone who attended professional conferences spent time as an attendee; only 26.53% of this group also served as presenters. For individual activities, 96.73% responded that they analyzed and evaluated student work for professional development. Researching and developing assessment tools (95.92%) and searching for web-based resources (96.32%) were also popular individual professional learning activities.

Table 4
Frequency of Participation by Activity Type

<table>
<thead>
<tr>
<th>Activity Type</th>
<th>Participated</th>
<th>Confidence Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Individual Activities</td>
<td>243</td>
<td>99.18</td>
</tr>
<tr>
<td>Professional Development Programming</td>
<td>217</td>
<td>88.57</td>
</tr>
<tr>
<td>Teacher Collaboration</td>
<td>201</td>
<td>82.04</td>
</tr>
<tr>
<td>Informal Communication</td>
<td>163</td>
<td>66.53</td>
</tr>
<tr>
<td>Mentoring/Coaching</td>
<td>75</td>
<td>30.61</td>
</tr>
<tr>
<td>Professional Conferences</td>
<td>49</td>
<td>20.00</td>
</tr>
<tr>
<td>University/College Courses</td>
<td>14</td>
<td>5.71</td>
</tr>
</tbody>
</table>

Note. N = 245.

Based on the data collected from the survey, it appeared that teachers were actively engaging in both formal and informal professional learning activities. They frequently took part in school district-sponsored professional development programming as well as guided teacher collaboration activities. They also sought to learn from informal activities such as informal
communication with their peers and individualized self-directed learning. Every participant in this study engaged in some type of professional development activity; 98.37% of the teachers participated in two or more activities and 72.24% took part in four or more of the activities captured in the survey.

**Research question two.** This research question sought to determine how frequently teachers engaged in professional development activities over the last 12 months. The survey in this study was designed to capture the frequency of participation in professional development activities based on two parameters--average amount of hours spent per month or average amount of hours spent per year. This was undertaken to improve the accuracy of participant reporting. A breakdown of the means, standard deviations, and confidence limits from the collected data are presented in Table 5.

<table>
<thead>
<tr>
<th>Time Spent by Activity Type</th>
<th>Mean</th>
<th>SD</th>
<th>Confidence Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hours per Year</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher Collaboration</td>
<td>33.67</td>
<td>37.83</td>
<td>28.91 38.43</td>
</tr>
<tr>
<td>Professional Development Programming</td>
<td>23.13</td>
<td>25.21</td>
<td>19.95 26.30</td>
</tr>
<tr>
<td>Professional Conferences</td>
<td>3.89</td>
<td>11.40</td>
<td>2.45  5.32</td>
</tr>
<tr>
<td>University/College Courses</td>
<td>2.50</td>
<td>15.92</td>
<td>0.49  4.50</td>
</tr>
<tr>
<td><strong>Hours per Month</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual Activities</td>
<td>36.62</td>
<td>31.91</td>
<td>32.60 40.63</td>
</tr>
<tr>
<td>Informal Communication</td>
<td>3.01</td>
<td>3.77</td>
<td>2.54  3.48</td>
</tr>
<tr>
<td>Mentoring/Coaching</td>
<td>1.25</td>
<td>2.63</td>
<td>0.92  1.58</td>
</tr>
</tbody>
</table>

*Note. N = 245.*
Of the four professional development activities that were assessed by average hours per year, participants spent the most time on teacher collaborations ($M = 33.67, SD = 37.83$). Since most classroom teachers work a 10-month appointment, the amount of time teachers spent on this activity averaged about 3 hours and 22 minutes per month. The amount of time spent on professional development programming was also one of the higher means found, with teachers spending on average 23.13 hours per year. Based on a 10-month appointment, this would equate to 2 hours and 19 minutes per month.

To calculate the statistics for the university/college courses and professional conference activities, the reported hours for their sub-categories were summed and used for the final calculations presented in Table 5. The mean hours for university/college courses ($M = 2.50, SD = 15.92$) and professional conferences ($M = 3.89, SD = 11.40$) were lower than the other two activities in this group. The low means were affected by the low participation rate for these activities. If those who did not participate were excluded from the calculations, the mean for university/college courses would be 43.71 hours ($SD = 53.10$) per year with confidence limits of 13.06 and 74.37 and the mean for professional conferences would be 19.44 hours ($SD = 18.77$) per year with confidence limits of 14.05 and 24.83.

Three of the professional development activities in the survey were assessed by average hours per month. Informal communication had a notable amount of participation with teachers spending 3.01 hours ($SD = 3.77$) per month informally communicating with their peers. The amount of time spent on mentoring/coaching was 1.25 hours ($SD = 2.63$) per month; only 30.61% of the respondents noted participation in this activity. If those who did not participate were removed, the mean for teachers who engaged in this activity would be 4.07 hours ($SD = 3.33$) per month with confidence limits of 3.31 and 4.84.

Individual activities had the greatest mean when compared to all the other activities captured in this study ($M = 36.62, SD = 31.91$); making it the most common professional
development activity for the participants in this sample. Due to the high amount of participation, a separate analysis was undertaken for the sub-categories of individual activities. A summary of the participation percentage, mean hours, standard deviation, and confidence limits for these activities can be viewed in Table 6.

Table 6

Analysis of Individual Learning Activities

<table>
<thead>
<tr>
<th>Activity Type</th>
<th>%</th>
<th>Mean</th>
<th>SD</th>
<th>Confidence Limits Lower</th>
<th>Confidence Limits Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyzing and evaluating student work</td>
<td>96.73</td>
<td>12.17</td>
<td>10.82</td>
<td>10.81</td>
<td>13.53</td>
</tr>
<tr>
<td>Researching and developing student assessment tools and materials</td>
<td>95.92</td>
<td>8.71</td>
<td>8.89</td>
<td>7.59</td>
<td>9.83</td>
</tr>
<tr>
<td>Searching web-based sites for curriculum and instructional resources</td>
<td>96.32</td>
<td>8.27</td>
<td>8.58</td>
<td>7.19</td>
<td>9.35</td>
</tr>
<tr>
<td>Reading the teachers’ manual for adopted textbook(s)</td>
<td>76.73</td>
<td>5.00</td>
<td>7.71</td>
<td>4.03</td>
<td>5.97</td>
</tr>
<tr>
<td>Reading professional journals or books on mathematics teaching and learning</td>
<td>59.18</td>
<td>2.47</td>
<td>4.37</td>
<td>1.92</td>
<td>3.02</td>
</tr>
</tbody>
</table>

Note. N = 245.

Of all the individual learning activities captured, the participants in this study spent the greatest amount of time analyzing and evaluating student work ($M = 12.17$, $SD = 10.82$) to improve instructional practice. They also spent time each month developing and studying assessment tools ($M = 8.71$, $SD = 8.89$) and searching web-based sites for instructional resources ($M = 8.27$, $SD = 8.58$). The two least common activities were reading the teacher textbook manuals ($M = 5.00$, $SD = 7.71$) and reading professional mathematics publications ($M = 2.47$).
The data demonstrated that teachers were not only taking part in various professional development activities, they were also spending a sizable amount of their personal time engaging in them. Teachers spent a combined average of 63.19 hours ($SD = 59.67$) annually on professional development programming, teacher collaborations, university/college courses, and professional conferences. They also spent a combined average of 40.88 hours ($SD = 33.30$) monthly on mentoring/coaching, informal communications, and individual learning activities. Communication, both through formal meet-ups and informal conversations with peers, individual self-directed learning, and formal in-service professional development proved to be the most common activities for the mathematics teachers in this study.

**Research question three.** Research question three examined the differences in the types and frequency of professional development activities when analyzed by the demographic variables captured in this study. Independent means $t$ tests were utilized for the analysis of the participant’s school setting, certificate type, level of education, and their school’s Title I status. One-factor analyses of variance (ANOVARs) were used when evaluating the years of teaching experience and degree major. These tests required that the data met three assumptions: homogeneity of variance, independence of observations, and normality of population distributions (Glass & Hopkins, 1996). This study sampled from two large school districts and each person received an individual invitation to participate in the research; enabling the assumption of independence of observations to be satisfied. For most variables, the groups were large and balanced, which ensured that normality and homogeneity of variance were not violated. For each calculation, skewness, kurtosis, and the Shapiro-Wilk values were used to evaluate the normality of the data. To check the homogeneity of variance, Pooled or Satterthwaite $p$ values were appropriately applied for the $t$ tests and results from Levene’s tests were used for the ANOVA calculations. If statistically significant results were found with the
ANOVA calculations, post hoc Tukey tests were used to determine the differences between groups.

There was only one independent variable, level of education, which violated the assumptions of normality and homogeneity of variance when the ANOVA results were analyzed. This was due to a small number of participants who earned either a specialist or doctoral degree. To correct the violations, teachers who earned a specialist or doctoral degree were included with the master’s degree data for analysis; *t* tests were run comparing the responses of teachers who held a bachelor’s degree and those who held a master’s degree or above.

In addition to *t* tests and ANOVAs, chi-square tests of independence were also calculated to determine if there were statistically significant differences in the participation percentages, among the demographics variables, for each professional development category. The following sections outline the findings from the data that were analyzed.

**School setting.** This study surveyed both middle and high school mathematics teachers. Participation percentages were similar between the groups for some of the professional development activities; however, a few activities had significant differences. For teacher collaboration activities, middle school teachers participated significantly more often than high school teachers \(X^2 (1, N = 245) = 7.61, p = .0058\). This was also the case for informal communication activities; middle school teachers again were more likely to participate than high school teachers \(X^2 (1, N = 245) = 4.96, p = .0259\). The mean values were similar between the two groups across many of the professional development activities; however, middle school mathematics teachers reported spending significantly more time collaborating with their peers than high school mathematics teachers, \(t(243) = -2.33, p = .0208\). A complete summary of the results can be viewed in Table 7.

**Years of teaching experience.** In the survey, years of experience was broken into three groups: 0-5 years, 6-15 years, and over 15 years. There were notable differences in
participation percentages when analyzed by years of teaching experience. New teachers, who had been teaching five years or less, participated significantly more often in university/college courses than those who had been teaching for six or more years, $X^2 (2, N = 245) = 12.65, p = .0018$. There was also a significant relationship with teachers who had been teaching five years or less and their participation in mentoring/coaching activities, $X^2 (2, N = 245) = 25.8951, p < .0001$.

Table 7

*Analysis of Professional Development Activities by School Setting*

<table>
<thead>
<tr>
<th>Activity Type</th>
<th>High School$^a$</th>
<th>Middle School$^b$</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Mean SD</td>
<td>% Mean SD</td>
<td></td>
</tr>
<tr>
<td><strong>Hours per Year</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional Development Programming</td>
<td>90.91 23.89 25.00</td>
<td>86.67 22.50 25.46</td>
<td>0.43</td>
</tr>
<tr>
<td>Teacher Collaboration</td>
<td>74.55 27.50 36.52</td>
<td>88.15 38.70 38.27</td>
<td>-2.33*</td>
</tr>
<tr>
<td>University/College Courses</td>
<td>3.64 1.57 14.34</td>
<td>7.41 3.25 17.12</td>
<td>-0.82</td>
</tr>
<tr>
<td>Professional Conferences</td>
<td>18.18 4.02 10.79</td>
<td>21.48 3.78 11.91</td>
<td>0.17</td>
</tr>
<tr>
<td><strong>Hours per Month</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mentoring/Coaching</td>
<td>32.73 1.21 2.54</td>
<td>28.89 1.27 2.70</td>
<td>-0.18</td>
</tr>
<tr>
<td>Informal Communication</td>
<td>59.09 2.77 3.81</td>
<td>72.59 3.21 3.74</td>
<td>-0.91</td>
</tr>
<tr>
<td>Individual Learning Activities</td>
<td>99.09 37.75 30.11</td>
<td>99.26 35.69 33.38</td>
<td>0.50</td>
</tr>
</tbody>
</table>

*Note. N = 245. t values with significance < .05 are boldface.
$^a$High School n = 110. $^b$Middle School n = 135. *p < .05.*

Statistically significant differences were found for two professional development areas when analyzed by years of experience. An analysis of variance indicated the mean hours spent on professional development programming activities was significant, $F(2,242) = 4.14, p = .0170$. 

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Post hoc analyses using Tukey tests indicated that the average number of hours spent on professional development programming was significantly higher for teachers who had been in the profession for less than six years than those who were more advanced in their careers. ANOVA results also revealed the mean hours spent on mentoring/coaching activities were statistically significant, $F(2,242) = 10.94$, $p < .0001$. Post hoc Tukey tests indicated that teachers early in their career (0-5 years) spent significantly more time on mentoring/coaching activities than their peers who had taught six or more years. Results from the years of teaching experience data can be reviewed in Table 8.

**Level of education.** Respondents to the survey were asked to indicate their highest degree, which was broken into three categories: bachelor’s degree, master’s degree, or specialist/doctoral degree. ANOVA analyses revealed the data for several of the professional development activities violated the assumptions for normality and homogeneity of variance. These violations were due to the unbalanced nature of the specialist/doctoral degree group. The number of participants who indicated they held a bachelor’s or master’s degree were similar; however, the total amount of participants who indicated they earned a specialist or doctoral degree were significantly lower. Since only 11 individuals held these higher degrees, their responses were included with the master’s degree data and $t$ tests were run using the two groups. A summary of the results can be seen in Table 9.

Participation percentages for certain professional development activities varied between the groups, but the greatest difference was evident with mentoring/coaching activities. Teachers who held a bachelor’s degree participated in mentoring/coaching activities significantly more often than teachers with master’s degrees or higher, $X^2 (1, N = 245) = 10.8582$, $p = .0010$. Independent means $t$ tests revealed the amount of time spent on mentoring/coaching activities was significant. Teachers with bachelor’s degrees spent
significantly more time on mentoring/coaching activities than teachers with master’s degrees or higher, $t(243) = 2.23, p = .0269$.

Table 8

Analysis of Professional Development Activities by Years of Teaching Experience

<table>
<thead>
<tr>
<th>Activity Type</th>
<th>0-5 Yearsa</th>
<th>6-15 Yearsb</th>
<th>Over 15 Yearsc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Hours per Year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional Development Programming</td>
<td>88.89</td>
<td>30.22</td>
<td>32.34</td>
</tr>
<tr>
<td>Teacher Collaboration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University/College Courses</td>
<td>75.00</td>
<td>31.53</td>
<td>39.32</td>
</tr>
<tr>
<td>Professional Conferences</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hours per Month</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mentoring/Coaching</td>
<td>52.78</td>
<td>2.33</td>
<td>3.06</td>
</tr>
<tr>
<td>Informal Communication</td>
<td>69.44</td>
<td>2.85</td>
<td>3.59</td>
</tr>
<tr>
<td>Individual Learning Activities</td>
<td>98.61</td>
<td>40.93</td>
<td>39.01</td>
</tr>
</tbody>
</table>

Note. $N = 245$. $F$ values with significance < .05 are boldface.
a0-5 Years $n = 72$. b6-15 Years $n = 86$. cOver 15 years $n = 87$.
*p < .05. **p < .01.

**Degree major.** In addition to capturing the participants’ levels of education, they were also asked to specify their degree major. Respondents were directed to pick one of three categories: mathematics degree, mathematics education degree, or “other” degree. Differences in participation percentages were notable for one professional development category. Teachers who held a mathematics degree or an “other” degree were significantly less likely to participate
in mentoring/coaching activities than those who held a degree in mathematics education, \( \chi^2(2, N = 245) = 6.15, p = .0463 \). After conducting ANOVA analyses, there were no statistical differences found between the means of the different degree majors and the professional development activities captured in the survey. Results from the analysis are provided in Table 10.

Table 9

Analysis of Professional Development Activities by Level of Education

<table>
<thead>
<tr>
<th>Activity Type</th>
<th>Bachelor's Degree(^a)</th>
<th>Master's Degree and Higher(^b)</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td><strong>Hours per Year</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional Development Programming</td>
<td>88.98</td>
<td>25.19</td>
<td>27.91</td>
</tr>
<tr>
<td>Teacher Collaboration</td>
<td>77.97</td>
<td>33.26</td>
<td>39.15</td>
</tr>
<tr>
<td>University/College Courses</td>
<td>6.78</td>
<td>2.28</td>
<td>16.33</td>
</tr>
<tr>
<td>Professional Conferences</td>
<td>22.03</td>
<td>4.45</td>
<td>13.05</td>
</tr>
<tr>
<td><strong>Hours per Month</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mentoring/Coaching</td>
<td>40.68</td>
<td>1.63</td>
<td>2.83</td>
</tr>
<tr>
<td>Informal Communication</td>
<td>68.64</td>
<td>3.15</td>
<td>3.83</td>
</tr>
<tr>
<td>Individual Learning Activities</td>
<td>99.15</td>
<td>37.43</td>
<td>32.30</td>
</tr>
</tbody>
</table>

Note. \( N = 245 \). \( t \) values with significance < .05 are boldface.  
\(^a\)Bachelor’s Degree \( n = 118 \). \(^b\)Master’s Degree and Higher \( n = 127 \).  
*\( p < .05 \). **\( p < .01 \).

**Certificate type.** As part of the survey, participants were asked to indicate if they held a permanent or temporary teaching certificate. When the participation percentages were analyzed, two statistically significant differences were revealed. Teachers with temporary certificates participated significantly more often in university/college courses than teachers with
permanent certificates, $X^2 (1, N = 245) = 8.65, p = .0033$. There was also a significant relationship with teachers who held temporary certificates and their participation in mentoring/coaching activities, $X^2 (1, N = 245) = 45.19, p < .0001.

Table 10

Analysis of Professional Development Activities by Degree Major

<table>
<thead>
<tr>
<th>Activity Type</th>
<th>Mathematics a</th>
<th>Mathematics Ed b</th>
<th>Other Degree c</th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours per Year</td>
<td>%</td>
<td>Mean</td>
<td>SD</td>
<td>%</td>
</tr>
<tr>
<td>Professional Development Programming</td>
<td>91.18</td>
<td>23.60</td>
<td>23.88</td>
<td>92.06</td>
</tr>
<tr>
<td>Teacher Collaboration</td>
<td>76.47</td>
<td>32.65</td>
<td>36.35</td>
<td>82.54</td>
</tr>
<tr>
<td>University/College Courses</td>
<td>5.88</td>
<td>1.82</td>
<td>9.17</td>
<td>9.52</td>
</tr>
<tr>
<td>Professional Conferences</td>
<td>29.41</td>
<td>5.57</td>
<td>12.39</td>
<td>19.05</td>
</tr>
<tr>
<td>Hours per Month</td>
<td>%</td>
<td>Mean</td>
<td>SD</td>
<td>%</td>
</tr>
<tr>
<td>Mentoring/Coaching</td>
<td>23.53</td>
<td>1.12</td>
<td>2.67</td>
<td>42.86</td>
</tr>
<tr>
<td>Informal Communicate</td>
<td>52.94</td>
<td>2.59</td>
<td>4.10</td>
<td>65.08</td>
</tr>
<tr>
<td>Individual Learning Activities</td>
<td>100.00</td>
<td>39.26</td>
<td>34.93</td>
<td>98.41</td>
</tr>
</tbody>
</table>

Note. $N = 245$.

aMathematics $n = 34$. bMathematics Ed $n = 63$. cOther Degree $n = 148$.

When certificate types were analyzed using $t$ tests, two activities were found to be statistically significant. Teachers with temporary certificates reported spending more hours on professional development programming than teachers with permanent teaching certificates, $t(30.496) = -2.26, p = .0309$. Teachers with temporary certificates also engaged in more
mentoring/coaching and activities than those with permanent certificates \( t(30.917) = -4.48, p < .0001 \). Table 11 provides a summary of the results for this analysis.

Table 11

*Analysis of Professional Development Activities by Certificate Type*

<table>
<thead>
<tr>
<th>Activity Type</th>
<th>Permanent Certificate</th>
<th>Temporary Certificate</th>
<th>( t ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td><strong>Hours per Year</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional Development Programming</td>
<td>88.02</td>
<td>21.43</td>
<td>23.49</td>
</tr>
<tr>
<td>Teacher Collaboration</td>
<td>82.49</td>
<td>34.65</td>
<td>38.38</td>
</tr>
<tr>
<td>University/College Courses</td>
<td>4.15</td>
<td>1.78</td>
<td>13.17</td>
</tr>
<tr>
<td>Professional Conferences</td>
<td>21.20</td>
<td>4.08</td>
<td>11.78</td>
</tr>
<tr>
<td><strong>Hours per Month</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mentoring/Coaching</td>
<td>23.50</td>
<td>0.93</td>
<td>2.37</td>
</tr>
<tr>
<td>Informal Communication</td>
<td>66.36</td>
<td>2.89</td>
<td>3.70</td>
</tr>
<tr>
<td>Individual Learning Activities</td>
<td>99.08</td>
<td>35.89</td>
<td>31.31</td>
</tr>
</tbody>
</table>

*Note.* \( N = 245 \). \( t \) values with significance < .05 are boldface.

\(^a\)Permanent Certificate \( n = 217 \). \(^b\)Temporary Certificate \( n = 28 \).

\(*p < .05. **p < .01.\)

School's Title I status. In the survey, teachers were asked to specify their school's Title I status. Eleven respondents selected “unsure” for this question and were therefore excluded from the analysis. Significant differences were only found for mentoring/coaching activities. Teachers from Title I schools participated in mentoring/coaching activities significantly more often than teachers at non-Title I schools, \( \chi^2 (1, N = 234) = 14.95, p = .0001 \). Independent means \( t \) tests revealed mean differences for mentoring/coaching activities were significant. Teachers at Title I schools spent significantly greater amounts of time on mentoring/coaching activities compared to teachers employed at non-Title I schools, \( t(191.91) = \)
-4.22, \( p < .0001 \). The complete analysis of the participants’ school Title I status can be found in Table 12.

### Table 12

**Analysis of Professional Development Activities by School’s Title I Status**

<table>
<thead>
<tr>
<th>Activity Type</th>
<th>Non-Title I Schools</th>
<th>Title I Schools</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td><strong>Hours per Year</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional Development</td>
<td>90.35</td>
<td>24.53</td>
<td>26.07</td>
</tr>
<tr>
<td>Programming</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher Collaboration</td>
<td>85.09</td>
<td>34.82</td>
<td>39.80</td>
</tr>
<tr>
<td>University/College Courses</td>
<td>4.39</td>
<td>1.18</td>
<td>7.30</td>
</tr>
<tr>
<td>Professional Conferences</td>
<td>24.56</td>
<td>5.01</td>
<td>14.15</td>
</tr>
<tr>
<td><strong>Hours per Month</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mentoring/Coaching</td>
<td>18.42</td>
<td>0.54</td>
<td>1.81</td>
</tr>
<tr>
<td>Informal Communication</td>
<td>64.04</td>
<td>2.76</td>
<td>3.63</td>
</tr>
<tr>
<td>Individual Learning Activities</td>
<td>99.12</td>
<td>36.45</td>
<td>33.48</td>
</tr>
</tbody>
</table>

**Note.** \( N = 234 \). \( t \) values with significance < .05 are boldface.

\( a \)Non-Title I Schools \( n = 114 \). \( b \)Title I Schools \( n = 120 \).

\* \( p < .05 \). \** \( p < .01 \).

### Summary

This study employed both descriptive and inferential techniques to analyze the data collected. Research question one sought to determine the participation percentages for the seven professional development activities in the TOTL survey. Frequency statistics confirmed that individual activities (99.18%), professional development programming (88.57%), and teacher collaboration (82.04%) generated the highest amount of participation. Every single respondent in the study participated in at least one professional development category; 98.37%
participated in two or more activities, and 72.24% participated in four or more activities. Research question 2 sought to identify the frequency in which teachers engaged in the professional development activities. Professional development programming \((M = 23.13, SD = 25.21)\), and teacher collaboration \((M = 33.67, SD = 37.83)\) had the highest means from the activities that captured annual averages. Informal communication \((M = 3.01, SD = 3.77)\) and individual learning activities \((M = 36.62, SD = 31.91)\) had the highest mean hours of the activities that captured monthly averages. Research question three examined if there were statistical differences for the professional development activities when analyzed by the demographic variables. There were seven instances where ANOVAs and \(t\) tests revealed statistically significant differences with the mean values among the independent variables. There were also nine instances where chi-square tests of independence found statistically significant results with the participation percentages among the independent variables in this study.

Although only some of the professional development activities generated statistically significant findings, this study was able to find notable information for every activity. Looking at learning as a whole, teachers spent a total of 63.19 hours \((SD = 59.67)\) annually on professional development programming, teacher collaborations, university/college courses, and professional conferences. They also spent 40.88 hours \((SD = 33.30)\) monthly on mentoring/coaching, informal communications, and individual learning activities. Given that most teachers work a 10-month appointment, the average time spent on professional development activities by the participants in this study were 47.19 hours \((SD = 35.90)\) per month.
Chapter Five

Summary, Conclusions, Implications, and Recommendations

The purpose of this study was to examine the types of formal and informal professional learning activities middle and high school mathematics teachers engaged in to improve their knowledge, skills, and abilities as educators analyzed by the participants’ school setting, years of teaching experience, level of education, degree major, certificate type, and their school’s Title I status. The parts of this chapter include a summary of the study, conclusions of the research, implications for practice, and recommendations for future research.

Summary of the Study

Although there had been a substantial amount of research on the topic of teacher professional development, few studies had adequately captured the types and frequency of formal and informal professional learning activities teachers undertake to improve as educators. Most of the qualitative research has focused on informal learning activities, whereas qualitative studies have utilized national survey data. While this information has helped to provide a snapshot of teacher professional development, there was a lack of studies that had sufficiently explored the vast array of professional learning activities available to classroom teachers.

This study sought to add to the existing literature by investigating the professional learning practices of middle and high school mathematics teachers. Teachers from two large school districts in west central Florida agreed to participate. An existing instrument, the Teachers’ Opportunity to Learn (TOTL) survey (Akiba, 2012), was used to collect the data as it had been used successfully in a previous study of Missouri middle school mathematics teachers. The TOTL measured the professional learning activities of teachers based on seven learning categories: (a) professional development programming, (b) teacher collaboration, (c)
A content validity panel and a pilot panel were utilized to achieve three things in this study: (a) ensure the content of the survey appropriately represented the various professional development activities accessible to teachers, (b) verify the study procedures and survey narrative were easy to follow and understand, and (c) establish reliability information for the instrument. Minor changes were made to the instrument based on the suggestions from the content validity panel. Once implemented, reliability data were generated from the pilot panel. The survey was then sent, via email, to all eligible teachers in the two participating school districts. Teachers were solicited to participate two times; the solicitations were spaced three weeks apart. Of the 254 responses obtained, nine were discarded as they were incomplete, leaving 245 responses for analysis.

Conclusions

The results of this study generated several pertinent conclusions.

Teachers participated in a wide variety of professional development activities. For the formal learning categories, participation consisted primarily of professional development programming and teacher collaboration activities. For the informal categories, participation consisted predominantly of informal communication and individual learning; almost every respondent in this study engaged in individual learning activities. Summarizing overall participation across each activity, every respondent in the study participated in at least one professional development activity with the majority of teachers engaging in four or more
activities. These participation patterns were similar to findings from other professional development studies of elementary and secondary teachers (Akiba, 2012; Smaller et al., 2000; Strizek et al., 2014).

In regards to the amount of time spent on professional development, the same activities that generated high participation rates also dominated participation time. Among the formal activities, teachers dedicated the most time to professional development programming and teacher collaboration. Of the informal activities, teachers regularly engaged in informal communication and individual learning activities. Teachers in this study engaged in more individual learning activities than any other professional development category. The individual learning sub-activities revealed that teachers focused mainly on analyzing student work, researching and developing assessment tools, and searching web-based sites for instructional resources. The times teachers devoted to these activities were greater than other comparable studies (Smaller et al., 2000, 2001; Strizek et al., 2014); however, the results were similar to that found by Akiba’s (2012) study of middle school mathematics teachers.

While all teachers in the study engaged in professional development, the professional learning habits of new teachers were notably different from their more experienced peers. Teachers who had been teaching fewer years participated in more professional development, and devoted greater amounts of time to these activities, than teachers who were more advanced in their careers. These findings were consistent with Smith and Desimone’s (2003) analysis of the 1993-1994 and 1999-2000 SASS data. Most specifically, new teachers were found to expend more time on professional development programming activities than teachers with more experience. This result confirmed a similar finding by Birman et al.’s (2009) analysis of National Assessment of Educational Progress (NAEP) survey data. New teachers also engaged in greater amounts of mentoring/coaching activities then those who were more advanced in their career; which validated a similar finding in the literature (Akiba, 2012).
In the state of Florida, all new teachers obtain a temporary certificate and have three years to complete the requirements for a permanent certificate. Teachers in this study who held temporary certificates participated in more professional development programming activities and mentoring/coaching activities compared to teachers with permanent certificates. Given the parameters for a temporary Florida teaching certificate, these findings confirm existing literature (Akiba, 2012; Birman et al., 2009) which state new teachers engage in greater amounts of professional development courses and mentoring/coaching activities than their more experienced colleagues.

Of all the professional development activities captured by the TOTL, mentoring/coaching activities had the greatest variation in participation and time dedicated among the groups studied in this research. As mentioned above, teachers who were early in their career and those who held temporary teaching certificates participated in more mentoring/coaching activities than teachers who were more advanced in their career or teachers who had obtained permanent certificates. Teachers who earned bachelor’s degrees devoted more time to mentoring/coaching activities than teachers with a master’s degree or higher. Educators who majored in mathematics education participated more in mentoring/coaching activities than teachers who majored in mathematics or “other” degree areas. Lastly, educators who worked in Title I school’s engaged in more mentoring/coaching activities than teachers at non-Title I schools. This finding was consistent with Akiba’s (2012) study of middle school mathematics teachers.

**Implications for Practice**

This study can contribute several key findings to the existing literature on teacher professional development and could provide several implications for practice for the education community. Continuing research on teacher professional development practices provide school districts with a clear context in which teachers choose to learn. Currently, school districts
allocate much of their financial and staff resources on formal professional development, such as in-service workshops and trainings. While these courses have proven to be important resources for new teachers (Akiba, 2012; Birman et al., 2009) and provide an efficient method for sharing information on curriculum changes and new standard-based reforms (Akiba, 2012; Griswold, 2005; Hawley & Valli, 2005), this study suggested that teachers did not use this method frequently for their professional development.

Therefore to better address the diverse learning needs of teachers, school districts may benefit by finding alternative methods, beyond traditional professional development programming, to support teacher learning. Districts could develop new professional development systems that encourage collaboration, informal communication, and self-directed learning among their teachers. These systems could assist educators with planning, implementing, and evaluating their learning endeavors.

Even though researchers suggest the current state of district-sponsored professional development is insufficient (Ball & Cohen, 1999; Borko, 2004; Petrie & McGee, 2012; Putnam & Borko, 1997), the federal government continues to provide funding at the state level to support teacher professional learning. Currently, much of this funding is appropriated to district-sponsored in-service workshops and trainings. Instead of focusing solely on this traditional professional development model, policy makers could support other avenues of professional learning. In this study, few teachers engaged in professional conferences and university/college courses. It may therefore be beneficial to financially support teachers who are interested in participating in these activities. Funding support could also be provided to specialty programs, like the national board certification, that assist teachers in becoming the most qualified educators within their respective subject areas.

The results of this research, and similar studies, could assist policymakers in redefining the parameters for professional development funding. Guidelines could be provided to states
that specifically outline how funding should be allocated, to ensure that different types of professional development activities are supported. In addition to re-evaluating funding distributions, the Department of Education could also redefine the ways in which teachers earn credit for recertification. Systems could be developed to capture, measure, and apply continuing education credits for sanctioned informal activities. If reform is provided at the federal level, with revised budgetary allocations and recertification credits, districts could become more responsive in redesigning their systems that support teacher professional development.

Regardless of the changes that could occur at the state and district levels, teachers and principals could use the results of this study to improve professional development at their individual school sites. Since almost all the teachers engaged in informal learning activities, principals and teachers could join together to develop programs and practices that address the specific learning needs of the educators and students at their school site. These activities could be collaborative or self-directed; depending on the learning goals set by the teachers within the schools. Faculty and administrators could also view the results of this study as confirmation that teachers are active learners, who regularly engage in professional learning activities with the specific purpose of improving as educators.

While the results of this study may be valuable to the K-12 community, non-profit education organizations and universities could also benefit from the findings of this research. In the districts that were studied, there were very few systems in place to encourage informal learning among teachers. Based on the results of this study, non-profit education organizations may have an opportunity to develop programs, both face-to-face and online, that facilitate and encourage informal learning. These solutions could be valuable to smaller districts or those that lack administrative support to implement innovative professional development programming for their teachers.
The results of this study also indicated that new teachers spent a considerable amount of time on professional development programming and mentoring/coaching activities. While many universities have established internship programs with local school districts, they may also benefit by establishing collaborative partnerships around professional development programming. The benefits from such a partnership are two-fold. Through collaborative exchanges, universities could develop a better understanding of the professional development supports that will be offered to their new teachers once they enter the field. With that knowledge, faculty could ensure that the current curriculum adequately prepares them for the classroom and faculty could provide pre-service teachers with additional resources to assist in filling any potential gaps the students may encounter in their first few years of teaching. Districts could benefit from this relationship by leveraging the expertise of faculty at universities to provide resources and curriculum consultation to enrich the professional development programming they offer to in-service teachers.

**Recommendations for Further Research**

Based on the results of this study, there are several recommendations for future research. These recommendations include improving the instrument’s design, enhancing the data collection of the instrument, and identifying alternative areas of study.

**Instrument Design.** While the TOTL is unique in its design to capture mathematics teachers’ learning habits, more modifications could be made to further improve the narrative within the instrument. Currently, the definition for the mentoring/coaching activity is written to only generate responses from new teachers who have been formally assigned a mentor or coach. Although the definition was written to collect information about formal mentoring/coaching activities for new teachers, responses from this study collected information from teachers in every career stage: early (0-5 years), mid (6-15 years), and advanced (over 15 years). While it was impossible to determine why these mid- and advanced- career teachers
responded to the survey question, it supports the idea of modifying the definition so that it includes both formal and informal relationships, as well as mentee and mentor experiences, which may occur across the career continuum.

Another activity on the TOTL that could benefit from revision is the individual learning category questions. Teacher informal learning has been studied almost exclusively through qualitative research. The activities teachers engage in on their own are vast and therefore difficult to quantify for large-scale surveys. Of all the activities on the TOTL, the individual learning categories generated the most dialogue from the content validity panel in this study. Panel participants struggled to justify and accept analyzing student work and researching and developing assessment tools as professional development activities. While the group agreed there were times when the activities resulted in improved instructional practice, they were unsure how often this occurred. The panel felt teachers would be inclined to tally the total amount of time they spent on these activities and not accurately report the percentage that actually resulted in professional learning. It is recommended that future researchers who use the TOTL, utilize teacher panels to review and discuss the validity of the instrument’s content and make recommendations to improve the narrative used in the survey.

In the TOTL, several professional development categories had sub-categories included in the survey. Since almost all teachers engaged in professional development programming in this study, it may be beneficial to add additional subcategories to this activity as well. The sub-categories used for university/college courses could be utilized or a new list could be generated by soliciting feedback from teacher focus groups.

Including sub-categories for the teacher collaboration category may also generate more information about the types of formal communication relationships that exist among teachers. The activities currently listed in the definition for category (e.g., Professional Learning Community (PLC), teacher network, group action research) could serve as the survey options;
however, it may also be constructive to hold teacher focus groups to identify other formal communication networks that could exist in the K-12 system.

This was the first study to publish reliability data for the TOTL. Although the instrument achieved a strong positive correlation, the reliability information for some of the activities was unclear. The pilot panel members of this study did not participate in university/college courses or professional conferences. Therefore no reliability information existed for these activities. Also, the correlation coefficients for the individual learning activities were varied. Therefore continued reliability analysis from other studies could validate the coefficients found in this study or make a case for further narrative refinement within the instrument.

Enhancing Data Collection. Given the comprehensiveness of the TOTL, it may be beneficial to incorporate other complementary areas of data collection into the instrument. Questions regarding teacher satisfaction of professional development could be added after each activity in the survey. This would not only capture the types and frequency of professional learning, but could also provide a context to better understand teachers’ satisfaction from these activities.

A needs analysis could also be incorporated at the end of the questionnaire to generate additional information from specific populations. The survey would not only provide districts with a summary of the current professional learning practices of their teachers, but it may also assist them in more effectively planning their future professional development offerings. The incorporation of this additional information may also increase the likelihood of school districts partnering in future research.

Alternative Avenues of Study. Currently, the TOTL has only been used to collect information from teachers in the state of Missouri and west central Florida. Researchers could study other areas within the state of Florida to determine if professional development preferences vary by region.
Researchers could administer the TOTL to teachers in other states, outside of Missouri and Florida. Expansion to other areas in the United States could confirm prior findings from national surveys.

This study focused on the professional learning habits of middle school and high school mathematics teachers. With some slight modifications, the TOTL could easily be utilized to collect professional development information beyond secondary mathematics teachers. Researchers could adapt the instrument to capture the professional learning habits of all subject areas in middle schools and high schools. Gathering information on other subject areas could assist researchers in determining if learning preferences differ depending on the subject area taught.

Modifications could also be made to TOTL so that the professional development of elementary teachers could be studied. By capturing this information, comparisons of professional learning could be made between primary and secondary teachers.

**Opportunities for qualitative research.** Based on the results of this study, more in-depth research could be undertaken to further study the differences in professional development practices between new and experienced teachers. Researchers could use a variety of qualitative methods (e.g., interviews, focus groups, case studies) to obtain this information.

Given that teachers spent the majority of their time on informal learning in this study, the research community could benefit by gaining a deeper understanding of the perceived and actual benefits educators derive from participation in formal and informal learning activities. This information could most effectively be acquired through qualitative research techniques.

The overall response rate of this study (13.26%) was lower than expected. Responses in this study indicated that teachers spend the majority of their time on informal, non-district or site-based sponsored professional development. More qualitative research could be conducted
to determine if teachers are apathetic towards the topic of teacher professional development due to the lack of support by district and site-based programming.

Professional conferences and university/college courses had the lowest amount of participation among all the professional learning areas captured by this study. More research could be conducted to determine possible barriers to entry as well as perceived benefits for these two activities.

Finally, school board members, administration, union officials, and faculty leaders are often the drivers of change when it comes to program funding or policy reform. In-depth research could be conducted with these groups to better understand their perspectives on professional development, how they feel it is functioning in its current state, and what operational and philosophical changes they believe are possible for the future.
References


Appendix A: Adapted Teachers’ Opportunity to Learn Survey

1. PROFESSIONAL DEVELOPMENT PROGRAMMING

Professional development programming is an organized activity for the purpose of improving mathematics teaching and student learning (e.g., school, district, or organizational sponsored in-service training or workshop).

1a) During the past 12 months, have you participated in a professional development program related to mathematics teaching or learning?

☐ Yes
☐ No

*If yes, the person is directed to the question below. If no, they are directed to section 2.*

1. PROFESSIONAL DEVELOPMENT PROGRAMMING

Professional development programming is an organized activity for the purpose of improving mathematics teaching and student learning (e.g., school, district, or organizational sponsored in-service training or workshop).

1b) How many total hours of professional development programming on mathematics teaching or learning have you participated in during the past 12 months? Please include hours spent for a take-home task or a project required by the professional development program.

☐ 1 - 2 hours
☐ 3 - 5 hours
☐ 6 - 10 hours
☐ 11 - 20 hours
☐ 21 - 40 hours
☐ 41 - 60 hours
☐ 61 - 80 hours
☐ > 80 hours

2. TEACHER COLLABORATION

Teacher collaboration is an ongoing activity such as a study group, Professional Learning Community (PLC), teacher network, group action research, and any other form of interaction among teachers for the purpose of improving mathematics teaching and learning. Teacher collaboration can be formally organized by professional developers or informally practiced by a group of teachers. **Mentoring or coaching is not teacher collaboration.**
Appendix A Continued

2a) Have you participated in an ongoing teacher collaboration(s) focused on mathematics teaching and learning during the past 12 months?

☐ Yes
☐ No

If yes, the person is directed to the question below. If no, they are directed to section 3.

2. TEACHER COLLABORATION

Teacher collaboration is an ongoing activity such as a study group, Professional Learning Community (PLC), teacher network, group action research, and any other form of interaction among teachers for the purpose of improving mathematics teaching and learning. Teacher collaboration can be formally organized by professional developers or informally practiced by a group of teachers. Mentoring or coaching is not teacher collaboration.

2b) How many total hours did you spend in teacher collaboration(s) during the past 12 months?

☐ 1 - 10 hours
☐ 11 - 20 hours
☐ 21 - 40 hours
☐ 41 - 60 hours
☐ 61 - 80 hours
☐ 81 - 100 hours
☐ 101 - 120 hours
☐ > 120 hours

3. UNIVERSITY/COLLEGE COURSES

University/College courses may be taken for a degree or professional development credits.

3a) Have you taken university or college courses in mathematics or mathematics education for credit during the previous 12 months?

☐ Yes
☐ No

If yes, the person is directed to the question below. If no, they are directed to section 4.

3. UNIVERSITY/COLLEGE COURSES

University/College courses may be taken for a degree or professional development credits.

How many actual hours (not credit hours) have you spent attending university or college courses on the following topics during the past 12 months?
Appendix A Continued

3b) Mathematics content
- None
- 1 - 5 hours
- 6 - 10 hours
- 11 - 20 hours
- 21 - 40 hours
- > 40 hours

3c) Mathematics instruction/pedagogy
- None
- 1 - 5 hours
- 6 - 10 hours
- 11 - 20 hours
- 21 - 40 hours
- > 40 hours

3d) Foundations (e.g., diversity, social contexts of schools, ESOL)
- None
- 1 - 5 hours
- 6 - 10 hours
- 11 - 20 hours
- 21 - 40 hours
- > 40 hours

3e) Research and measurement in mathematics education
- None
- 1 - 5 hours
- 6 - 10 hours
- 11 - 20 hours
- 21 - 40 hours
- > 40 hours

3f) Other areas
- None
- 1 - 5 hours
- 6 - 10 hours
- 11 - 20 hours
- 21 - 40 hours
- > 40 hours
Appendix A Continued

4. PROFESSIONAL CONFERENCES

A professional conference is an opportunity to present your practices or research as well as to learn from presenters about new ideas in mathematics teaching or learning.

4a) Have you attended a local, regional, state, or national conference(s) on mathematics teaching or learning during the previous 12 months?

☐ Yes
☐ No

*If yes, the person is directed to the question below. If no, they are directed to section 5.*

4. PROFESSIONAL CONFERENCES

A professional conference is an opportunity to present your practices or research as well as to learn from presenters about new ideas in mathematics teaching or learning.

How many total hours have you spent for each of the following activities at a conference(s) on mathematics teaching or learning during the past 12 months?

4b) Conference attendee

☐ None
☐ 1 - 2 hours
☐ 3 - 5 hours
☐ 6 - 10 hours
☐ 11 - 20 hours
☐ 21 - 40 hours
☐ > 40 hours

4c) Conference presenter

☐ None
☐ 1 - 2 hours
☐ 3 - 5 hours
☐ 6 - 10 hours
☐ 11 - 20 hours
☐ 21 - 40 hours
☐ > 40 hours
Appendix A Continued

5. MENTORING/COACHING

Mentoring/Coaching is a formal district or school sponsored activity to provide new teachers with induction experiences and professional development.

5a) Do you currently have a formal mentor or a coach assigned by your district or school to work individually with you?

☐ Yes
☐ No

If yes, the person is directed to the question below. If no, they are directed to section 6.

5. MENTORING/COACHING

Mentoring/Coaching is a formal district or school sponsored activity to provide new teachers with induction experiences and professional development.

If you have multiple formal mentors or coaches, please choose the mentor or coach who has most influenced your mathematics teaching and learning.

5b) How many hours do you spend communicating with your assigned mentor or coach during a typical month? Please include both face-to-face time and communication through phone or email.

☐ < 1 hour
☐ 1 - 3 hours
☐ 4 - 5 hours
☐ 6 - 10 hours
☐ > 10 hours

6. INFORMAL COMMUNICATION

Informal communication refers to planned or unplanned interactions with co-workers or friends outside of the previously listed activities in this survey.

6a) Do you have someone, other than a formal mentor or coach, with whom you informally rely on and communicate with for your professional learning of mathematics teaching?

☐ Yes
☐ No

If yes, the person is directed to the question below. If no, they are directed to section 7.
Appendix A Continued

6. INFORMAL COMMUNICATION

Informal communication refers to planned or unplanned interactions with co-workers or friends outside of the previously listed activities in this survey.

If you have multiple persons with whom you communicate with for your professional learning of mathematics teaching, please choose the person who has most influenced your mathematics teaching.

6b) How many hours do you spend communicating with this person during a typical month? Please include both face-to-face time and communication through phone or email.

- < 1 hour
- 1 - 3 hours
- 4 - 5 hours
- 6 - 10 hours
- > 10 hours

7. INDIVIDUAL LEARNING ACTIVITIES

Individual learning activities refer to activities you engage in by yourself outside of the previously listed activities in this survey such as reading professional journals, analyzing student work, and researching resources for curriculum and instruction.

How many hours during a typical month do you usually spend on your own for the following activities?

7a) Analyzing and evaluating student work (to improve instructional practice)

- Never
- 1 - 2 hours
- 3 - 5 hours
- 6 - 10 hours
- 11 - 20 hours
- 21 - 30 hours
- > 30 hours
Appendix A Continued

7b) Reading the teachers’ manual for adopted textbook(s)
   - Never
   - 1 - 2 hours
   - 3 - 5 hours
   - 6 - 10 hours
   - 11 - 20 hours
   - 21 - 30 hours
   - > 30 hours

7c) Researching and developing student assessment tools and materials
   - Never
   - 1 - 2 hours
   - 3 - 5 hours
   - 6 - 10 hours
   - 11 - 20 hours
   - 21 - 30 hours
   - > 30 hours

7d) Searching web-based sites for curriculum and instructional resources
   - Never
   - 1 - 2 hours
   - 3 - 5 hours
   - 6 - 10 hours
   - 11 - 20 hours
   - 21 - 30 hours
   - > 30 hours

7e) Reading professional journals or books on mathematics teaching and learning
   - Never
   - 1 - 2 hours
   - 3 - 5 hours
   - 6 - 10 hours
   - 11 - 20 hours
   - 21 - 30 hours
   - > 30 hours
Appendix A Continued

7f) Other *(please specify the activity then indicate the number of hours spent, per month, on that activity):*

Activity: ____________________

- 1 - 2 hours
- 3 - 5 hours
- 6 - 10 hours
- 11 - 20 hours
- 21 - 30 hours
- > 30 hours
Appendix B: TOTL Survey Permission Correspondence

From: Akiba, Motoko [mailto:makiba@fsu.edu]
Sent: Monday, February 15, 2016 8:00 AM
To: McCarthy, Kelly <kmccart@health.usf.edu>
Subject: RE: TOTL Instrument

Hi Kelly, sorry I must have overlooked your prior email.
I went through your revision quickly and all look fine to me.
Good luck with your dissertation research!

Motoko

From: McCarthy, Kelly <kmccart@health.usf.edu>
Sent: Monday, February 15, 2016 7:52 AM
To: Akiba, Motoko <makiba@fsu.edu>
Subject: RE: TOTL Instrument

Good morning Dr. Akiba,

I hope this email finds you well. I just wanted to touch base regarding the TOTL instrument as I'm not sure if you've had an opportunity to review the proposed adjustments that I sent. I'm happy to report that two large Tampa Bay school districts have agreed to partner with me on my dissertation research. I am waiting to disseminate the survey until I receive confirmation from you that the proposed adjustments are acceptable. Should you have any questions or concerns about the document please let me know.

Thank you again for your willingness to allow me to use your instrument. I look forward to your response.

From: Akiba, Motoko [mailto:makiba@fsu.edu]
Sent: Monday, September 07, 2015 6:54 PM
To: McCarthy, Kelly <kmccart@health.usf.edu>
Subject: Re: TOTL Instrument

Kelly, you are welcome to use the TOTL survey instrument.
Best of luck with your dissertation research.
Motoko

----- Original message-----
From: McCarthy, Kelly
Date: Mon, Sep 7, 2015 4:51 PM
To: Akiba, Motoko;
Cc: McCarthy, Kelly;
Subject: TOTL Instrument

Dear Dr. Akiba,

My name is Kelly McCarthy and I am an Adult Education doctoral candidate at the University of South Florida in Tampa. For the last several years, I've conducted many studies that have investigated teacher learning habits as well as the characteristics of quality teacher professional development. I am in the process of writing my dissertation proposal and have been actively seeking an instrument I could use for my research. After reading your article Professional Learning Activities in Context: A Statewide Survey of Middle School Mathematics Teachers, I became interested in the TOTL instrument. My study is seeking to investigate the learning habits of secondary (middle and high) mathematics teachers in the central Florida area; I believe the TOTL would be an excellent tool to capture this data. At present, I do not foresee a need to modify the instrument; however, I wanted to get your permission first before sharing it with my committee members. Should they request any changes, which I do not expect, I would seek your approval.

I have attached my CV so that you can better understand my background and interests. I look forward to your response.

Kelly McCarthy
### Appendix C: List of Content Validity Panel Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Years of Teaching Experience</th>
<th>Gender</th>
<th>Ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valerie Donatiello</td>
<td>Teacher</td>
<td>4</td>
<td>F</td>
<td>Caucasian</td>
</tr>
<tr>
<td>Elisa Humphrey</td>
<td>Lead Teacher / National Trainer</td>
<td>26</td>
<td>F</td>
<td>Caucasian</td>
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<tr>
<td>Chandra Todd</td>
<td>Coach / Subject Area Leader / District Trainer</td>
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<td>F</td>
<td>African American</td>
</tr>
<tr>
<td>Samantha Stephens</td>
<td>Teacher / Subject Area Leader</td>
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<td>F</td>
<td>Caucasian</td>
</tr>
<tr>
<td>Peter Wyida</td>
<td>Teacher</td>
<td>11</td>
<td>M</td>
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</tbody>
</table>
## Appendix D: Content Validity Review Form

<table>
<thead>
<tr>
<th>Demographic Questions</th>
<th>How clear is the narrative written in this section?</th>
<th>Please list any adjustments that should be made to this section</th>
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<tr>
<td></td>
<td>1 = narrative is not clear</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 = narrative revisions to be clear</td>
<td></td>
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<td></td>
<td>3 = narrative is clear</td>
<td></td>
</tr>
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<table>
<thead>
<tr>
<th>Survey Instructions</th>
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<table>
<thead>
<tr>
<th>Section 1 Definition &amp; Participation</th>
<th>How clear is the narrative written?</th>
<th>Please list any adjustments that should be made to this item</th>
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<tbody>
<tr>
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<td></td>
<td>2 = narrative revisions to be clear</td>
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</tr>
<tr>
<td></td>
<td>3 = narrative is clear</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section 1 Professional Development Programming</th>
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<th>How clear is the item written?</th>
<th>Please list any adjustments that should be made to this item</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1 = yes, the item is a professional development activity</td>
<td>1 = item is not clear</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 = no, the item is not a professional development activity</td>
<td>2 = item needs revisions to be clear</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 = item is clear</td>
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<th>How clear is the narrative written?</th>
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<th>Does the activity listed represent the professional development heading?</th>
<th>Please list any adjustments that should be made to this item</th>
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</thead>
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<td>1 = item is not clear</td>
<td>1 = yes, the item represents the professional development heading</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 = no, the item is not a professional development activity</td>
<td>2 = item needs revisions to be clear</td>
<td>2 = no, the item does not represent the professional development heading</td>
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</tr>
<tr>
<td></td>
<td>3 = item is clear</td>
<td>3 = item is clear</td>
<td>3 = item is clear</td>
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</table>

<table>
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<th>How clear is the item written?</th>
<th>Does the activity listed represent the professional development heading?</th>
<th>Please list any adjustments that should be made to this item</th>
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</thead>
<tbody>
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<td>1 = item is not clear</td>
<td>1 = yes, the item represents the professional development heading</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 = no, the item is not a professional development activity</td>
<td>2 = item needs revisions to be clear</td>
<td>2 = no, the item does not represent the professional development heading</td>
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<td>3 = item is clear</td>
<td>3 = item is clear</td>
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<table>
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<th>Section 3C University &amp; College Courses</th>
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<th>Does the activity listed represent the professional development heading?</th>
<th>Please list any adjustments that should be made to this item</th>
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<tbody>
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<td>1 = item is not clear</td>
<td>1 = yes, the item represents the professional development heading</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 = no, the item is not a professional development activity</td>
<td>2 = item needs revisions to be clear</td>
<td>2 = no, the item does not represent the professional development heading</td>
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<tr>
<td></td>
<td>3 = item is clear</td>
<td>3 = item is clear</td>
<td>3 = item is clear</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Section 3D University &amp; College Courses</th>
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<th>How clear is the item written?</th>
<th>Does the activity listed represent the professional development heading?</th>
<th>Please list any adjustments that should be made to this item</th>
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</thead>
<tbody>
<tr>
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<td>1 = yes, the item is a professional development activity</td>
<td>1 = item is not clear</td>
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<tr>
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<td>2 = no, the item is not a professional development activity</td>
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<td>3 = item is clear</td>
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Appendix D Continued

<table>
<thead>
<tr>
<th>Section</th>
<th>Definition &amp; Participation</th>
<th>How clear is the narrative written?</th>
<th>Please list any adjustments that should be made to this item</th>
<th>Does the activity represent professional development?</th>
<th>How clear is the item written?</th>
<th>Does the activity listed represent the professional development heading?</th>
<th>Please list any adjustments that should be made to this item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 5</td>
<td>Mentoring &amp; Coaching</td>
<td>Does the activity represent professional development?</td>
<td>How clear is the item written?</td>
<td>Does the activity listed represent the professional development heading?</td>
<td>Please list any adjustments that should be made to this item</td>
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<td></td>
</tr>
<tr>
<td>Section 6</td>
<td>Internal Communication</td>
<td>How clear is the narrative written?</td>
<td>Please list any adjustments that should be made to this item</td>
<td>Does the activity represent professional development?</td>
<td>How clear is the item written?</td>
<td>Does the activity listed represent the professional development heading?</td>
<td>Please list any adjustments that should be made to this item</td>
</tr>
<tr>
<td>Section 7</td>
<td>Individual Learning Activities</td>
<td>Does the activity represent professional development?</td>
<td>How clear is the item written?</td>
<td>Does the activity listed represent the professional development heading?</td>
<td>Please list any adjustments that should be made to this item</td>
<td></td>
<td></td>
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### Appendix D Continued

<table>
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<th>Section</th>
<th>Does the activity represent professional development?</th>
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<th>Does the activity listed represent the professional development heading?</th>
<th>Please list any adjustments that should be made to this item</th>
</tr>
</thead>
</table>
| 7C      | 1 = yes, the item is a professional development activity  
         2 = no, the item is not a professional development activity | 1 = item is not clear  
         2 = item needs revisions to be clear  
         3 = item is clear | 1 = yes, the item represents the professional development heading  
         2 = no, the item does not represent the professional development heading | |
| 7D      | 1 = yes, the item is a professional development activity  
         2 = no, the item is not a professional development activity | 1 = item is not clear  
         2 = item needs revisions to be clear  
         3 = item is clear | 1 = yes, the item represents the professional development heading  
         2 = no, the item does not represent the professional development heading | |
| 7E      | 1 = yes, the item is a professional development activity  
         2 = no, the item is not a professional development activity | 1 = item is not clear  
         2 = item needs revisions to be clear  
         3 = item is clear | 1 = yes, the item represents the professional development heading  
         2 = no, the item does not represent the professional development heading | |

Any other comments you would like to share?
### Appendix E: List of Pilot Panel Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Years of Teaching Experience</th>
<th>Gender</th>
<th>Ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theodore Coleman</td>
<td>Teacher</td>
<td>21</td>
<td>M</td>
<td>African American</td>
</tr>
<tr>
<td>Carole Cruzado</td>
<td>Teacher</td>
<td>6</td>
<td>F</td>
<td>Caucasian</td>
</tr>
<tr>
<td>Jeffrey Dimapasoc</td>
<td>Teacher</td>
<td>11</td>
<td>M</td>
<td>Asian American</td>
</tr>
<tr>
<td>Stanley Glover</td>
<td>Teacher</td>
<td>18</td>
<td>M</td>
<td>African American</td>
</tr>
<tr>
<td>Tracy Rios</td>
<td>Teacher</td>
<td>8</td>
<td>F</td>
<td>Caucasian</td>
</tr>
<tr>
<td>Chandra Todd</td>
<td>Coach / Subject Area Leader / District Trainer</td>
<td>17</td>
<td>F</td>
<td>African American</td>
</tr>
</tbody>
</table>
Appendix F: Informed Consent to Participate in Research

Information to Consider Before Taking Part in this Research Study

Pro #24681

Researchers at the University of South Florida (USF) study many topics. To do this, we need individuals to take part in our research studies. We are asking you to take part in a research study called: Exploring the Formal and Informal Professional Learning Activities of Middle and High School Mathematics Teachers. The person who is in charge of this research study is Kelly McCarthy; she is the Principal Investigator.

Purpose of the Study
The purpose of this study is to examine the types of professional development activities middle and high school mathematics teachers engage in to improve their knowledge, skills, and abilities as educators.

Why are you being asked to take part?
We are asking you to take part in this research study because you are currently a full-time middle or high school mathematics teacher employed at a Tampa Bay area school district.

Study Procedures
If you take part in this study, you will be asked to answer a series of professional development questions that will be collected using an online electronic survey.

Alternatives / Voluntary Participation / Withdrawal
You should only take part in this study if you want to volunteer; you are free to participate in this research or withdraw at any time. Your decision to participate or not to participate will not affect your employment or job status.

Benefits and Risks
We are unsure if you will receive any benefits by taking part in this research study. Therefore, this research is considered to be minimal risk.

Compensation
We will not pay you for the time you volunteer to participate in this study.

Privacy and Confidentiality
We must keep your study records as confidential as possible; however, certain people may need to see your study records. By law, anyone who looks at your records must keep them completely confidential. The only people who will be allowed to see these records are: Kelly McCarthy, the Principal Investigator for the study, and The University of South Florida Institutional Review Board (IRB).

It is possible, although unlikely, that unauthorized individuals could gain access to your responses because you are responding online. Confidentiality will be maintained to the degree permitted by the technology used. No guarantees can be made regarding the interception of data sent via the Internet. However, your participation in this online survey involves risks similar
Appendix F Continued

to a person’s everyday use of the Internet. If you complete and submit an anonymous survey and later request your data be withdrawn, this will not be possible as the researcher is unable to extract anonymous data from the database.

Contact Information
If you have any questions about your rights as a research participant, please contact the USF IRB at 974-5638. If you have questions regarding the research, please contact the Principal Investigator at 813-974-2544 or at kemccart@mail.usf.edu.

We may publish what we learn from this study. If we do, no key identifying information will be released. Only aggregate information will be published. You can print a copy of this consent form for your records.

By clicking the button below, I freely give my consent to take part in this study. I understand that by proceeding with this survey that I am agreeing to take part in research and I am 18 years of age or older.
Appendix G: USF IRB Exempt Study Approval

January 27, 2016

Kelly McCarthy, M.B.A.
L-CACHE - Leadership, Counseling, Adult, Career & Higher Education
College of Education
4202 E. Fowler Avenue, EDU105
Tampa, FL 33620

RE: Exempt Certification
IRB#: Pro00024681
Title: Exploring the Formal and Informal Professional Learning Activities of Middle and High School Mathematics Teachers

Dear Ms. McCarthy:

On 1/27/2016, the Institutional Review Board (IRB) determined that your research meets criteria for exemption from the federal regulations as outlined by 45CFR46.101(b):

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:
(i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects’ responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects’ financial standing, employability, or reputation.

Approved Items:

Dissertation Study Protocol
Consent Document provided by IRB

As the principal investigator for this study, it is your responsibility to ensure that this research is conducted as outlined in your application and consistent with the ethical principles outlined in the Belmont Report and with USF HRPP policies and procedures.

Please note, as per USF HRPP Policy, once the Exempt determination is made, the application is closed in ARC. Any proposed or anticipated changes to the study design that was previously declared exempt from IRB review must be submitted to the IRB as a new study prior to initiation.
Appendix G Continued

of the change. However, administrative changes, including changes in research personnel, do not warrant an amendment or new application.

Given the determination of exemption, this application is being closed in ARC. This does not limit your ability to conduct your research project.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John A. Schinka, Ph.D.
Chairperson
USF Institutional Review Board
Subject: Invitation to Participate in a USF Research Study

Dear Educator,

You are invited to participate in a University of South Florida research study (Pro#24681). The purpose of this research is to learn more about the types and frequency of professional development middle and high school mathematics teachers engage in to improve their knowledge, skills, and abilities as educators. As a mathematics teacher for XXX County Schools, we are interested in learning more about your professional development habits.

No key identifying information will be collected in this survey; therefore your responses will remain anonymous. The survey should take between 5 to 10 minutes to complete. You can access it by clicking on the link below.

Survey link

Participation in this study is completely voluntary. Should you have any questions regarding the survey please do not hesitate to contact me. Thank you in advance for your consideration to participate.

Kind regards,

Kelly McCarthy
Adult Education Doctoral Candidate
University of South Florida
kemccart@mail.usf.edu
813-974-2544
Appendix I: Follow-up Participant Survey Email

Subject: Invitation to Participate in USF Research Study

Dear Educator,

A few weeks ago you received an email soliciting your participation in a University of South Florida research study (Pro#24681) that is examining the professional learning habits of mathematics teachers. If you have already taken the survey – thank you! If you’ve not yet had the opportunity, your participation would be greatly appreciated. As a former mathematics teacher, I understand the immense demands on your personal time. Please know that your input is incredibly important to helping the research community better understand the types and frequency of professional development middle and high school mathematics teachers engage in to improve their knowledge, skills, and abilities as educators.

No key identifying information will be collected in this survey; therefore your responses will remain anonymous. The survey should take between 5 to 10 minutes to complete. You can access it by clicking on the link below.

Survey link

Participation in this study is completely voluntary. Should you have any questions regarding the survey please do not hesitate to contact me. Thank you in advance for your consideration to participate.

Kind regards,

Kelly McCarthy
Adult Education Doctoral Candidate
University of South Florida
kemccart@mail.usf.edu
813-974-2544
### Appendix J: Median Values Used for TOTL Analysis

<table>
<thead>
<tr>
<th>Survey Questions</th>
<th>Survey Values</th>
<th>Input Values</th>
<th>Survey Questions</th>
<th>Survey Values</th>
<th>Input Values</th>
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</thead>
<tbody>
<tr>
<td>Indicate your school setting.</td>
<td>High</td>
<td>1</td>
<td>Have you participated in university/college courses?</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Middle</td>
<td>2</td>
<td></td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>Indicate your highest level of education.</td>
<td>Bachelor</td>
<td>1</td>
<td>How many total hours of university/college courses have you participated in over the last 12 months?</td>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Master</td>
<td>2</td>
<td>1-5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Special / Doc</td>
<td>3</td>
<td>6-10</td>
<td>8</td>
<td></td>
</tr>
<tr>
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<td>1</td>
<td>11-20</td>
<td>15</td>
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</tr>
<tr>
<td></td>
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<td>3</td>
<td>&gt;40</td>
<td>50</td>
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<tr>
<td>Indicate your degree major.</td>
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<td>0</td>
</tr>
<tr>
<td></td>
<td>Math Ed</td>
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<td></td>
<td>Yes</td>
<td>1</td>
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<tr>
<td></td>
<td>Other</td>
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<td></td>
<td>None</td>
<td>0</td>
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<td>Indicate your certificate type.</td>
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<td>How many total hours of professional conferences have you participated in over the last 12 months?</td>
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<td>1-2</td>
<td>1.5</td>
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<tr>
<td>Do you currently teach at a Title I school?</td>
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<td>3-5</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>2</td>
<td>6-10</td>
<td>8</td>
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<td>&gt;40</td>
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<td>Indicate the school district.</td>
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<td>Have you participated in mentoring/coaching activities?</td>
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<td>District B</td>
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<tr>
<td>Have you participated in professional development programming?</td>
<td>No</td>
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<td>How many hours per month have you spent participating in mentoring/coaching activities?</td>
<td>&lt;1</td>
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<td>6-10</td>
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<td></td>
<td></td>
<td>&gt;10</td>
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<tr>
<td>How many total hours of professional development programming have you participated in over the last 12 months?</td>
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<td>Have you participated in informal conversations?</td>
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<td>4</td>
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<td>Have you participated in individual learning activities?</td>
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<tr>
<td>How many total hours of teacher collaborations have you participated in over the last 12 months?</td>
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<td>5</td>
<td>How many hours per month have you spent engaging in informal conversations?</td>
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About the Author

Kelly Elizabeth McCarthy earned her Ph.D. in Curriculum and Instruction with an emphasis in Adult Education from the Leadership, Counseling, Adult, Career, and Higher Education Department at the University of South Florida. For the past 10 years, Kelly has been involved with the education and training of both adolescents and adults. She has worked in a variety of organizations that represent the non-profit, for-profit, and higher education sectors. Her career as a secondary mathematics teacher served as the inspiration for her dissertation research. As an out-of-field teacher, she relied heavily on formal and informal professional development to improve her skills as an educator. She has been recognized for her contributions both as an educator and as a researcher. Her research interests include professional development, mentoring, self-directed learning, assessment, and cognitive learning styles.