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Impact of Student Teaching On the Mathematics Teaching Efficacy Beliefs of Preservice Elementary Teachers

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ACCEPTANCE

This dissertation, IMPACT OF STUDENT TEACHING ON THE MATHEMATICS TEACHING EFFICACY BELIEFS OF PRESERVICE ELEMENTARY TEACHERS, by DON K. BROWN, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Philosophy, in the College of Education and Human Development, Georgia State University.

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IMPACT OF STUDENT TEACHING ON THE MATHEMATICS TEACHING EFFICACY BELIEFS OF PRESERVICE ELEMENTARY TEACHERS

by

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Under the Direction of Dr. Christine D. Thomas

ABSTRACT

Much attention, both nationally and internationally, has been given to mathematics teaching and student mathematical performance (e.g. No Child Left Behind Act (2001), National Council of Teachers of Mathematics (1991, 2000) standards, Common Core State Standards Initiative, Trend in International Mathematics and Science Study (2013), and Program of International Student Assessment PISA (2013)). Teachers of mathematics have come under greater scrutiny and demands for student success have been placed upon them. Research has shown that teacher efficacy and mathematics teaching efficacy, forms of self-efficacy beliefs (Bandura, 1977, 1997), can have a positive impact on teaching and learning. Yet, there has been limited research on the mathematics teacher efficacy of preservice elementary teachers (Swars, 2005).

This study examined the impact of the student teaching experience on the mathematics teaching efficacy beliefs of preservice elementary teachers. What happens to the level of mathematics teaching efficacy beliefs of preservice teachers during the student teaching experience? What are the characteristics of preservice teachers with low and high levels of

efficacy beliefs? What factors from the student teaching experience influenced efficacy beliefs? A qualitative case study (Merriam, 2009) with an embedded survey was used to address the previous questions.

The results of this study demonstrate that mathematics teaching efficacy beliefs of preservice teachers rose significantly during the student teaching experience. However, the change was not uniform. Personal mathematics teaching efficacy (PMTE) increased significantly. Although mathematics teaching outcome expectancy (MTOE) increased, it was not significant. Furthermore, the research indicates four characteristics influenced mathematics teaching efficacy beliefs: attitude toward mathematics, use of manipulatives, motivation to teach, and persistence. Four factors appear to impact the development of efficacy beliefs of preservice teachers: prior experiment with mathematics, student teaching experience, relationship with cooperating teacher, and students served by the preservice teachers.

INDEX WORDS: Mathematics teaching efficacy, Preservice teachers

IMPACT OF STUDENT TEACHING ON THE MATHEMATICS TEACHING EFFICACY BELIEFS OF PRESERVICE ELEMENTARY TEACHERS

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DEDICATION

This work is dedicated to my sister, Pauline.

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CHAPTER 1

INTRODUCTION

> In order to be effective, teachers need more than content and pedagogy knowledge. Compelling evidence indicates that the beliefs that teachers hold regarding their teaching capabilities have a powerful influence on their teaching effectiveness.
>
> – Knoblauch and Woolfolk Hoy, 2008, p. 166

In 1983, the National Commission on Excellence in Education published the *A Nation at Risk: The Imperative for Educational Reform*, an alarm sounding publication designed to convey that there, was a "real crisis" in American education (Urban & Wagoner, 2009). This report referred to education as an economic investment in our country's future and that the United States was falling behind economic giants such as Japan, Korea, and Germany in areas of mathematics, reading and science, areas deemed the sources of economic prowess and potential. The findings of the National Commission on Excellence in Education were that the state of American education needed immediate and long-term improvements. These findings motivated a nation to action.

Each American president, from Jimmy Carter to Barack Obama, has weighed in on the crisis of education in America and its potential for disastrous effects on the nation both economically and militarily. During Jimmy Carter's tenure as president, education was elevated to the status of having a department with a secretary who reported directly to the President. However, the next president, Ronald Reagan, tried to dismantle the Department of Education and send the ultimate responsibility for education back to the state level. The first President Bush wanted American students to be first in the world in mathematics and science by the year 2000. His successor, Bill Clinton, was the first president to call for national standards for students; his attempts, however, failed. The next American president, George W. Bush, was successful in

getting standard-based reforms approved with the passage of The No Child Left Behind Act (NCLB) in 2001. NCLB required all states to adopt assessments to measure students' performance. In addition, it brought about a huge emphasis on teacher qualifications and school performance.

The aforementioned information was an extremely quick movement through more than thirty years of American presidential history and the manner in which these men addressed the perceived "crisis" in America. The intent was not to minimize the efforts of these men, but to draw attention to their endeavors and to highlight the importance given to reform American education. It presents a quick introduction into the diatribe surrounding education and, more specifically, mathematics education. Furthermore, the previous paragraph reveals the sustained longevity and importance bestowed upon educational reform efforts and the continued attention it receives in America.

To address the crisis in the area of American mathematics education, there were further discussions, debates, and research among various stakeholders in education on how to improve students' mathematics abilities so they would be equipped to compete in a competitive global market (Gresham, 2009). A couple of reports were released comparing the mathematical performance of U.S. students to their counterparts worldwide on international measurements such as the Trend in International Mathematics and Science Study (TIMSS)[1] (TIMSS, 2013) and Program of International Student Assessment (PISA)[2] (PISA, 2013). In addition, national

[1] TIMSS is an international assessment of 4th and 8th grades in mathematics and science. The TIMSS was established by the International Association for the Evaluation of Educational Achievement. The TIMSS was first established in 1995 and is administered every 4 years.

[2] PISA in an international assessment conducted by the Organisation for Economic Cooperation and Development. This instrument is given to 15-year-old students to assess their abilities in mathematics, science and reading. PISA was first administered in 2000 and is given every 3 years.

assessments were conducted using the National Assessment of Educational Progress (NAEP)[3] (NAEP, 2013), also known as "the nation's report card."[4] Regardless of the test or debate, the message was that American students' performance in mathematics was far behind students in other industrialized countries. Therefore, the crisis, whether real or imaginary, is serious, urgent, and a national emergency.

As previously stated, the alarm about the dire state of American education and in particular, mathematics education resonates throughout the nation. It echoes in every crevice of American society. National organizations entered the debate calling for reforms and standards in mathematics education. Composed of teachers and professors from all grade levels and higher education, the National Council of Teachers of Mathematics[5] (NCTM) was one of the organizations that entered the debate and provided suggestions for improvement.

NCTM put forth several recommendations (see, e.g., 1989; 1991; 1995; 2000; 2006; 2014) for mathematics teaching and practice. One of the recommendations stated "students need and deserve the best mathematics education possible, one that enables them to fulfill personal ambitions and career goals in an ever-changing world" (NCTM, 2000, p. 3). This recommendation is based on the presumed urgency that new knowledge and ways of doing mathematics is continuing to evolve; thereby, a far greater demand placed upon students to understand and do mathematics, every day, and especially for employment. According to some,

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[3] NAEP is a congressional mandated national assessment that is administered by the National Center for Education Statistics (NCES), a part of the U.S. Department of Education. It measures the performance of fourth-, eighth- and twelfth-graders in mathematics, reading, science, and writing, additional subject areas are periodically assessed. The first NAEP assessment was 1969. Currently, NAEP is given every 2 years.

[4] The Nation's Report Card is the release of the data on student achievement from NAEP. For more information, see www.nationsreportcard.gov.

[5] NCTM was founded in 1920. It is the world's largest mathematics education organization that provides a public voice for mathematics education. The vision of NCTM is to ensure that all students have access to the highest quality mathematics teaching and learning. See www.nctm.org for more information about NCTM.

many teachers, sadly, have not adopted the reforms put forth by NCTM at the expense of young students and future teachers, (Gresham, 2009).

In an attempt to surpass the various national efforts, each state entered the foray of improving the teaching and learning of mathematics. As previously mentioned, the NCLB Act (2001) added pressure for states to produce standards and show student progress. This act was the catalyst for several initiatives, including the Common Core State Standards Initiative (CCSSI),[6] which was originally developed and launched in the state of Arizona. The CCSSI stated what students should be able to do and know at each grade level. The developers of the CCSSI were various educational stakeholders including governors of various states, educators from various grade levels, and corporate business leaders. Thus far, CCSSI is the adopted set of standards in 45 states and the District of Columbia. The remaining states have developed their own standards. Not surprising, the motivation behind the creation of the CCSSI was to prepare the country's future workforce by improving students' performance in mathematics and science. Therefore, it was not an accident that the standards for mathematics were among the first written.

Many of the standards recommended for mathematics, from NCTM and CCSSI, represented a major paradigm shift for teachers. The expectations of the teachers are to utilize a variety of reform teaching methods, such as more self-directed learning instead of teacher-centered delivery (NCTM, 2000). For many teachers, the expected teaching approaches represented a sharp, drastic change in the way in which they envision effective teaching and the manner in which their teachers taught them. Thus, combining the changes in teaching methods, teacher accountability for students' success, and a set of new standards for teaching, the result placed far greater demands and pressures upon teachers (Charalambous, Philippou & Kyriades,

[6] More information about the CCSSI may be found at http://www.nea.org/home/46653.htm

2008). For elementary teachers, these changes may have added to existing fears and anxieties that some of them possessed.

Efficacy Beliefs

Some elementary education preservice teachers[7] have an anxiety and fear about teaching mathematics[8] (Gresham, 2009; Swars, 2004; Swars, Daane, Giesen, 2006). This fear can be debilitating. It can stymy even the performance of people with the strongest skill set by disbeliefs in their abilities (Bandura, 1997). From my nearly thirty years as a teacher of mathematics and a mathematics teacher educator, I have witnessed preservice teachers and other students having fearful, avoidance behavior about learning mathematics. This fear, it has been argued (see e.g. Ashton & Webb, 1986; Bandura, 1997; Czerniak, 1990; Swackhamer, 2009), may be the reason why some teachers are apprehensive about deviating from a teacher-centered lecture style of teaching to one that is more student-centered. In the end, the teachers themselves are a bit uncomfortable and unsure of their mathematical skills and knowledge. These beliefs that preservice teachers possess impacts the effectiveness of some preservice teachers. Researchers (e.g., Armor et al., 1976) have shown that beliefs, about the performance of certain teaching duties, account for differences in the effectiveness of teachers.

A rather powerful and fruitful piece of research found evidence that teachers' beliefs about their instructional abilities may account for variation in the effectiveness of teachers and had a strong relationship with student learning (Gibson & Dembo, 1984). The term *teacher*

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[7] Preservice teachers are students pursuing credentials to teach. In this study, a preservice teacher will be defined as a future teacher who is in their final semester before receiving their credentials to teacher. More information about preservice teachers may be found in the Definition of Terms section.

[8] Anxiety toward mathematics, which is commonly referred to as mathematics anxiety, is a feeling of discomfort when a person is performing a task involving mathematics. The feeling may lead to an avoidance or negative attitude toward mathematics (Gresham, 2009).

efficacy beliefs[9] is the label given these beliefs. There exists a link between efficacy beliefs and the level of motivation, effort, persistence, and resilience (Tschannen-Moran, Woolfolk Hoy & Hoy, 1998). School administrators, teacher educators, and various policy makers became interested in teacher efficacy beliefs and factors that diminish or enhance beliefs, especially with research showing its effect on teaching and learning (Woolfolk Hoy & Burke Spero, 2005).

Additionally, other research about teacher efficacy beliefs added to the interest about teacher efficacy. For example, one point of interest is the fact that teachers' beliefs vary across different subjects (Bandura, 1997). A teacher may be more efficacious about teaching reading and less about teaching mathematics. This belief could translate into less time spent on mathematics instruction than reading. The teachers, who felt more efficient about teaching mathematics, were more willing to try new teaching strategies (Enochs, Smith & Huinker, 2000; Swars, 2004, 2005). They were not afraid to share in the discovery of mathematics with their students (Riggs & Enochs, 1990). Other researchers (e.g., Knoblauch & Woolfolk Hoy, 2008; Palmer, 2006; Woolfolk Hoy & Burke Spero, 2005) found that teachers' efficacy beliefs increased during teacher preparation and student teaching and while others found a slight decrease (e.g., Dembo & Gibson, 1985; Hoy & Woolfolk, 1990; Utley, Moseley & Bryant, 2005).

There have been many studies conducted since the 1970s on teacher efficacy. However, as noted by some researchers (e.g., Charalambous, et al., 2008; Swars, 2004, 2005; Woolfolk Hoy & Burke Spero, 2005), few studies have examined mathematics teaching efficacy[10] and

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[9] Teacher efficacy beliefs refers to the judgments that teachers have in their skills to foster student learning. See the Definition of Terms section.

[10] Mathematics teaching efficacy is a form of teaching efficacy that is related to the teaching of mathematics. See the Definition of Terms section for more explanation.

even fewer have studied the efficacy of preservice teachers. Although limited, existing research on the mathematics teaching efficacy beliefs of preservice teachers has added to our understanding about mathematics teachers' efficacy. For example, Charalambous (2008) and his colleagues found efficacy beliefs toward mathematics are amenable to change during field experience (i.e., student teaching). Other researchers (e.g., Utley, et al., 2005) found that certain aspects of mathematics teaching efficacy beliefs increase and others decrease during student teaching. There exists a negative relationship between mathematics anxiety and mathematics teacher efficacy (Gresham, 2008; Swars, 2004). Furthermore, previous experiences with mathematics were influential upon mathematics teaching efficacy beliefs of student teachers (Swars, 2004, 2005). Thus, these findings, including the impact of efficacy beliefs on instruction, teacher motivation, student achievement, the perceived crises in American mathematics education, and the paucity of research, warrant further investigation concerning the mathematics teaching efficacy beliefs of preservice teachers.

Problem Statement

Efficacy beliefs are future-oriented judgments about one's ability to perform a task (Bandura, 1977, 1997). In terms of teaching, teacher efficacy is a teacher's belief "in their ability to have a positive effect on student learning" (Ashton, 1985, p. 142), regardless of environmental factors. These beliefs vary depending on the task and content (Bandura, 1986; Gresham, 2009; Tshannen-Moran et al., 1998). A teacher may feel more efficacious about teaching reading and less efficacious about teaching mathematics. Therefore, mathematics teacher efficacy, a form of teacher efficacy, is a teacher's belief in her or his abilities to be an "effective" mathematics teacher. These beliefs have a profound effect on the activities a teacher chooses to engage and the amount of effort she or he will expend (Bandura, 1997).

Several researchers (Lin & Gorrell, 2001; Pajares, 1999; Ross, 1992; Tschannen-Moran, et al., 1998) noted there is a correlation between teacher efficacy beliefs and a teacher's professional behavior and practices. Efficacious teachers most often are more willing to try innovative teaching methods (Allinder, 1994; Riggs & Enochs, 1990; Ross, 1994; Swars, 2005), to spend additional time working with students who are experiencing some difficulty (Gibson & Dembo, 1984), share the discovery of knowledge in the classroom with students (Riggs & Enochs, 1990), and possess less mathematics anxiety (Swars et al., 2006). Overall, there continues to be a strong case showing that efficacious teachers tend to embrace the changes in the teaching and learning of mathematics currently espoused by various stakeholders such as the recommendations from NCTM (Enochs et al., 2000; Swars, 2004, 2005) and the standards presented in the CCSSI.

Although there have been a plethora of research studies concerning teacher efficacy, most of it has been quantitative (Tschannen-Moran et al., 1998) and focused on in-service teachers (Tschannen-Moran & Woolfolk Hoy, 2001). The problem with a quantitative focus is that it lacks an exploration of the influences that may lead to the development of efficacy beliefs (Tschannen-Moran et al., 1998). In other words, quantitative approaches may reveal that a phenomenon such as teacher efficacy does exist and influence a teacher's behavior. A qualitative analysis, however, may help to examine the development and reason for the behavior. Labone (2004) recommends the need for more qualitative studies to help understand teacher efficacy.

Recall, there has been limited research concerning the development of efficacy beliefs among preservice teachers and even a smaller amount involving mathematics teaching efficacy beliefs. Bandura (1997) noted that efficacy beliefs are formed early, are resistant to change, and are most malleable to change during the early period of development. As previously noted,

Woolfolk Hoy and Burke Spero (2005) found that efficacy increased during actual fieldwork of preservice teachers, but decreased after the first year of teaching. However, there exist a need for further research on mathematics teaching efficacy belief and its impact on the preparation of future teachers (Enochs, et al., 2000). Therefore, using Bandura's (1977, 1986, 1997) social cognitive theory, particularly the self-efficacy component, the purpose of this basic qualitative, interpretive study[11] is to add to the limited research concerning the mathematics teacher efficacy beliefs of preservice teachers during their student teaching experiences. The research questions that will guide this study are state below.

Research Questions

What happens to the mathematics teaching efficacy beliefs of preservice teachers during the student teaching experience? The three sub-questions are:

1. During the student teaching experience, what happens to the level of mathematics teaching efficacy beliefs of the preservice teachers?
2. What are the characteristics of preservice teachers with low and high levels of mathematics teaching efficacy beliefs after the student teaching experience?
3. What factors from the student teaching influenced the mathematics teaching efficacy beliefs of preservice teachers?

Rationale

The purpose for this study is to add to the limited knowledge concerning the influences and development of mathematics teaching efficacy beliefs among preservice teachers during their student teaching experiences. The reason for the focus on preservice teachers' teacher

[11] A basic qualitative, interpretive study, also known as a basic qualitative study, is the most common form of qualitative research where the researcher is interested in the interpretations people give to their experiences, constructions of their worlds and the meaning they assign to their experiences (Merriam, 2009). This research paradigm does include some quantitative methods.

efficacy beliefs is because these beliefs form early and once formed they become very difficult to change (Bandura, 1977, 1997; Tschannen-Moran, et al., 1998; Woolfolk & Hoy, 1990). Furthermore, it is rather difficult to change the efficacy beliefs of experienced teachers (Ross, 1994). Based on previous research (Charalambous et al., 2008; Woolfolk Hoy & Burke Spero, 2005), efficacy beliefs of preservice teachers are yielding to change.

In addition, because of the national spotlight placed on the importance of teaching and learning of mathematics, the impact that teacher efficacy beliefs has on teaching effectiveness, and the limited amount of research concerning the mathematics teacher efficacy of preservice teachers, this study is an investigation of the mathematics teacher efficacy beliefs of elementary education preservice teachers during student teaching. This study will compare the mathematics teaching efficacy beliefs of preservice teachers before and at the completion of the student teaching internship then investigate what may have aided in the formation of these beliefs and describe any similarities in beliefs. It is my hope that this work will be an addendum to the limited knowledge about mathematics teaching efficacy. Furthermore, it will aid institutes of higher education in developing teachers who are more efficacious toward the teaching of mathematics. Thereby, these future teachers will be more willing to embrace the challenges put forth in the CCSSI, the recommendations from the NCTM, and the demands of various stakeholders.

Theoretical Framework

The theoretical framework for this study is Bandura's (1977, 1986, 1997) self-efficacy theory, which is a central part of social learning theory. Researchers usually assign Bandura's (1977) self-efficacy theory as the theoretical framework for teacher efficacy (Coladarci, 1992). However, historical records show that the conceptualization of teacher efficacy begun from

Rotter's (1966) theory of learning. (More information about the historical development of teacher efficacy beliefs is provided in Chapter 2.)

According to Bandura (1997), social learning theory involves the belief that the conceptualization of all human action begins in thought. Before any personal action, there is a cognitive process that envisions the act, the necessary components needed and one's ability in performing the task. Self-efficacy is the belief that a person has about their abilities to perform a particular task (Bandura, 1977, 1997). It is important to note that self-efficacy is a self-perception of one's competence (Tschannen-Moran, et al., 1998). It is not concerned about the actual execution of task or performance. Because self-efficacy beliefs are a perception, they influence which activity we choose to engage, how long we choose to engage in the activity, and the amount of persistence in performing an activity (Bandura,1977, 1997). Therefore, to be effective at completing a task, a person needs more than skill or knowledge; the belief in their abilities to perform the required actions is also important (Bandura, 1997). Doubt in one's capabilities can cripple the most knowledgeable person (Bandura, 1997). Hence, in terms of teaching, there is considerable need for more than mastery of content knowledge in order to be an effective teacher.

Self-efficacy is comprised of two components: efficacy expectation and outcome expectation. Efficacy expectation is the belief that a person has in their abilities to successfully perform the actions that are necessary to produce a particular outcome (Bandura, 1977, 1997). Outcome expectation is the belief that by performing specific acts this will bring a particular outcome regardless of any external factors (Bandura, 1977, 1997). In terms of teaching, efficacy expectation is a teacher who possesses the belief that she or he has the necessary skills that will

foster student learning. While outcome expectation is a teacher's belief that her or his teaching skills can overcome any impediment to learning, even negative home environment.

According to Bandura (1977, 1986, 1997), the influence on self-efficacy development is from four sources; mastery experiences, vicarious experiences, social persuasion and physiological experiences. Mastery experiences are situations that result from the successful completion of a task. Vicarious experiences refer to situations in which a person witnesses a peer perform a task. Social persuasion, also known as verbal persuasion, is a "pep talk" or words of encouragement. Physiological experiences are the feelings or stress that occurs when a person completes a task. To some degree, all four sources will influence the development of a person's self-efficacy beliefs. However, mastery experiences tend to have the most powerful influence on efficacy beliefs (Bandura, 1997).

Efficacy beliefs vary in level, generality, and strength (Bandura, 1997). The level of one's efficacy beliefs refers to whether or not a person feels efficacious in the performance of executing simple task or tasks that are more demanding. The generality of one's belief is the applicability of this belief to a variety of activities. Lastly, the strength of efficacy is the power of the belief to be resilient in the face of difficult or taxing situations. A weak strength will not survive a challenging situation. Once a challenging situation or task confronts a person with a weak level of efficacy, their belief is quenched (Bandura, 1977, 1997). However, a person with a more powerful sense of efficacy belief will find herself or himself more persistent when participating in a difficult activity.

Self-efficacy beliefs are context and subject-matter specific (Bandura, 1997). A person can be more efficacious at performing one activity and less efficacious at performing another. For example, a person may be more efficacious about speaking in front of her or his peers, but

less efficacious about speaking in front of strangers. Efficacy beliefs are very predictive of behavior (Pajares & Kranzler, 1995). Importantly, efficacy beliefs are most malleable early in learning (Bandura, 1977).

Using self-efficacy theory as a basis, teacher efficacy is a teacher's "judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" (Tschannen-Moran & Woolfolk Hoy, 2001, p. 783). Teacher efficacy is a type of self-efficacy that has two factors as well. Gibson and Dembo (1984) called the factors personal teaching efficacy (PTE) and general teaching efficacy (GTE). Because it is a form of self-efficacy, teacher efficacy affects a teacher's effort, goals and aspirations (Tschannen-Moran, et al., 1998).

Overview of Methodology

This research involves qualitative and quantitative methods. Previous research (see, e.g., Swars, 2004; Wenta, 2000) has used a similar methodological approach in the study of mathematics teacher efficacy of preservice teachers. Bogdan and Biklen (2007) defines qualitative research as an approach "that emphasizes collecting descriptive data in natural settings, uses inductive thinking, and emphasizes understanding the subjects point of view" (p. 274). The second and third sub-questions (previously listed) will utilize qualitative methods.

The purpose of these second and third sub-questions is to describe the characteristics of preservice teachers with various levels of mathematics teaching efficacy beliefs and to ascertain what experiences may have influenced one's beliefs. According to Creswell (2007), qualitative research provides an investigative follow up to quantitative research. The result is "a complex detailed understanding of the issue" investigated (p. 40). Quantitative research focuses on addressing questions about how many or how much, has a deductive mode of analysis, and

produces numerical findings (Merriam, 2009). The first sub-question for this research will be a quantitative investigation.

The purpose of this first sub-question will be to determine whether the mathematics teaching efficacy beliefs of the preservice teachers changed from the beginning to the end of the student teaching experience. The Mathematics Teaching Efficacy Beliefs Instrument (MTEBI)[12] will measure the beliefs using a repeated-measures design[13]. In addition, an analysis of the scores from the MTEBI will aide in the investigation of the existence of a change in beliefs for the group as well as individual preservice teachers. Both of these research paradigms address the multifaceted components of this research project.

This study is a basic qualitative study (Merriam, 2009) that includes a combination of qualitative and quantitative research methods. This approach is useful to researchers who are "interested in (1) how people interpret their experiences, (2) how they construct their worlds, and (3) what meaning they attribute to their experiences" (p. 23). Hence, the basis for this methodological approach is constructionism[14] (Merriam, 2009). Constructionism is an epistemology concerned about how people create their own knowledge and understanding from their current knowledge and experiences (Crotty, 1998). This theory complements Bandura's (1977) self-efficacy component and the standards and mathematical practices put forth by the

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[12] The Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) is an instrument designed to measure the mathematics teaching beliefs of preservice teachers (Enochs, Smith & Huinker, 2000). See the Definition of Terms section for more information.

[13] Repeated measures design is a statistical analytical technique where some characteristic of the same participants is measured several times. The purpose is to determine whether there is a change in the characteristic over time.

[14] According to Crotty (1998), the terms constructionism and constructivism are commonly used interchangeably. However, the two terms have distinct meanings. In this research the term constructionism will be used.

NCTM (1989, 1991; 1995; 2000; 2006; 2014), which are concerned with students constructing mathematical knowledge from experiences and practices.

Furthermore, this study is a bounded case study methodology to examine the *student teaching experience* and its effect on the mathematics teaching efficacy beliefs of preservice teachers. This research examined the student teaching experience in its entirety from the beginning, middle, and end. This case study will be interpretive (Merriam, 1998) because it provided very descriptive information about the student teaching experiences of several participants and offered an interpretation of what happened. Using Stake's (1995) method of classifying case studies, this study has aspects of both intrinsic and instrumental. It is intrinsic, because the researcher is interested in the notion that the student teaching experience will have a positive impact on efficacy beliefs. In addition, it is instrumental in the sense that the research is interested in what happens to efficacy beliefs during the student teaching experience. (More information about the methodology of this study is provided in Chapter 3.).

Participants in this study were elementary preservice teachers enrolled in their final year of studies and participating in a student teaching experience. A small state university in the southeastern United States provided the course of study, which led to a bachelor's degree in early childhood and special education to teach grades kindergarten to fifth. The participants completed the MTEBI three times during their student teaching experience: beginning, middle and end. To determine whether there was a difference in mathematics teaching efficacy beliefs, the research performed an analysis of the results of the MTEBI. Based on the results from the MTEBI, purposeful sampling (Bogdan & Biklen, 2007) will be used to select individuals for interviews and further analysis. The purpose is to explore and provide additional information concerning the

impact of the student teaching experience on mathematics teaching efficacy beliefs of preservice teachers.

Definition of Terms

Cooperating teachers – refers to an experienced, practicing teacher assigned a student teacher to supervise and train to be a teacher.

Effective teachers – refers to a perception that a preservice or inservice teacher possesses about their teaching performance. More specifically, it is the views held by preservice or in-service teachers concerning their skills to bring about learning. It includes the comfort of utilizing a variety of instructional methods and approaches to bring about student learning.

In-service teachers – teachers who have current classroom experience. They have sole responsibility for the teaching and learning of students. They have completed a program of study that has led to employment by a teaching institution. Here, an in-service teacher is an educator who currently has sole responsibility for the teaching and learning of students. These educators are current employees of a school or school system and have credentials to teach.

Mathematics teaching efficacy beliefs – one's beliefs in their ability to teach mathematics effectively (Enochs, et al., 2000). A form of teacher efficacy belief that is content specific to the area of teaching mathematics. Here, mathematics teaching efficacy beliefs are the opinions, feelings, and thoughts that preservice teachers have about their abilities and skills to mathematics to elementary school children.

Mathematics teacher educator – is a mathematics educator who works with the development of preservice and in-service teachers. A mathematics teacher educator may be located in the Colleges of Education and/or Colleges of Arts and Sciences of various institutions of higher learning. My appointment is in the College of Arts and Sciences, but I work closely

with colleagues in the College of Education. These educators instruct preservice teachers on mathematical content and/or pedagogy.

Mathematics teacher efficacy belief instrument (MTEBI) **–** An instrument derived from the Science Teacher Efficacy Belief Instrument, which was based on the Teacher Efficacy Scale (TES) by Gibson and Dembo (1984), that is used to measure the mathematics teacher efficacy beliefs of preservice teachers (Enochs, et al., 2000). The instrument is composed of two subscales: Personal Mathematics Teaching Efficacy (PMTE) and the Mathematics Teaching Outcome Expectancy (MTOE). The design of this instrument is specifically for use with preservice teachers and the area of mathematics.

Preservice teachers – are students enrolled in a teacher education preparation program to earn teaching credentials to become teachers. In order to earn their teaching credentials, these students have content and education coursework and practicum experiences. Generally, the term applies to all students enrolled in a teacher preparation program whether the student has just started the program or about to complete it. Here, the term refers to students in their last year of teacher preparation and enrolled in their final internship experience, commonly known as student teaching.

Self-efficacy – Bandura (1997) defined self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). Bandura (1986, 1993, 1997) stated that self-efficacy is not about what one can presently do, but about the expectation that one feels she or he can do on a future task. Self-efficacy beliefs involve how we think and feel about a task and that these thoughts and feelings dictate how we act on a particular task (Bandura, 1993). Furthermore, self-efficacy is a theoretical framework used "for analyzing changes achieved in fearful and avoidant behavior" (Bandura, 1977, p. 193).

Both teacher efficacy and mathematics teacher efficacy are forms of self-efficacy. Self-efficacy is about how one feels about their abilities to conduct any task, such as teaching or more specifically the teaching of mathematics.

Student teaching experience – is an internship for preservice teachers completed during the last year before the student graduates. Preservice teachers may be involved in other "real" teaching experiences during their teacher training. Some teacher education programs provide such experiences throughout the final year of training. Here, the student teaching experience refers to the internship experiences that occur during a preservice teacher's final year before graduation.

Teacher efficacy – Ross and Bruce (2007) defines teacher efficacy as "a teacher's expectation that he or she will be able to bring about student learning" (p. 50). As with self-efficacy (Bandura, 1977), the emphasis is on the expectation of the behavior, not the actual performance of the behavior. Tschannen-Moran and Woolfolk Hoy (2001) define teacher efficacy as a "teacher's judgement of his or her capabilities to bring about desired outcomes of student engagements and learning, even among those students who may be difficult or unmotivated" (p. 783). Teacher efficacy encompasses the belief in one's abilities to perform the duties of teaching and effectively bring about student learning. Gibson and Dembo (1984) state that teacher efficacy is comprised of two components: Personal Teacher Efficacy and General Teacher Outcome Efficacy. Teacher efficacy is derived from self-efficacy theory, which is a component of Bandura's (1977, 1986) social cognitive theory.

CHAPTER 2

REVIEW OF THE LITERATURE

Teacher efficacy: capturing an elusive construct.

–Tschannen-Moran and Woolfolk Hoy, 2001, p. 783

The purpose of this study is to investigate the changes in the mathematics teaching efficacy beliefs of preservice teachers during their student teaching experience. This period of teacher development, also known as internship or fieldwork, is an important time for future teachers. It is during this course of pre-service training where future teachers get the opportunity to apply all of the concepts, content, and theories, previously learned, into a "real" practical experience (Hoy & Woolfolk, 1990).

The student teaching experience provides a critical source of efficacy information, which warrants a closer look (Knoblauch & Woolfolk Hoy, 2008). Research has shown that teacher efficacy beliefs increase during the student teaching experience (Fortman & Pontius, 2000; Hoy & Woolfolk, 1990; Woolfolk Hoy & Burke Spero, 2005). Mulholland and Wallace (2001) noted the most influential experiences that affect the development of teachers' efficacy are the mastery experiences that occur during student teaching. It is during student teacher training that efficacy beliefs may change. However, once these beliefs develop, they are resistant to change (Woolfolk Hoy & Burke Spero, 2005). Therefore, it is important to examine factors, which may affect teacher efficacy beliefs early. In addition, reflecting on what is known about teacher efficacy and building upon it is just as important.

The history of the research and subsequent findings concerning teacher efficacy is like the growth of a tree. First, the awareness and study of teacher efficacy, the roots of the tree, emerged from two major theories: Rotter's (1966) locus of control theory and Bandura's (1997)

social cognitive theory. Research findings from these two theoretical perspectives were later analyzed and eventually brought together to form the trunk of this tree in a study conducted by Gibson and Dembo (1984) and the work of Tschannen-Moran and Woolfolk Hoy (2001). After the contributions of these researchers, especially Gibson and Dembo's (1984) work, much research occurred in teacher efficacy as this tree began to blossom. There seems to have been much interest and research in teacher efficacy during this period. Tschannen-Moran, Woolfolk Hoy and Hoy (1998) describes this stage of teacher efficacy development as a period in which teacher efficacy "enjoyed a celebrated childhood" (p. 202) with many activities and much interest. Yet, as with many trees, there are slow periods of growth. The study of teacher efficacy did experience times of little to no growth, but eventually renewed interest appeared and growth in research continued.

As the tree of teacher efficacy grew, branches of more specialized areas of research and interest developed. One of these branches is mathematics teaching efficacy, which are beliefs directed toward the teaching of mathematics. Even smaller branches of this tree appeared such as the mathematics teaching efficacy beliefs of preservice teachers.

In this chapter, I present some of the major findings and research about teacher efficacy during three major periods of research. Using the analogy of a developing tree, one can envision the research development concerning teacher efficacy as three stages of development. First, teacher efficacy emerges from a good foundation or roots. Then to continue to grow and be fruitful, the tree requires a solid trunk. Lastly, as the tree survives, branches of new development appear. Therefore, I have labeled the three major periods of teacher efficacy development: emergence of teacher efficacy, trunk of the tree of teacher efficacy, and mathematics teaching efficacy—one branch of the tree. Within each of these major periods, I discuss instruments

developed to measure teacher efficacy as well as the research findings. I conclude this chapter with a summary, reviewing the major developments of teacher efficacy.

Emergence of Teacher Efficacy

From the research, it appears the construct of teacher efficacy began with a simple hunch that no one expected would have such a powerful influence on the effectiveness of teachers (Tschannen-Moran, Woolfolk Hoy & Hoy, 1998). This unexpected hunch illustrates the simplicity in which early researchers became cognizant of the construct and the short, straightforward instruments that were used to measure teacher efficacy. In this section, I examine the early development of teacher efficacy. More specifically, I discuss the theoretical underpinnings of teacher efficacy followed by the instruments used to measure the construct and the research findings.

Rotter's Locus of Control Theory

The beginnings of teacher efficacy have its theoretical underpinnings in Rotter's (1966) locus of control theory. In this theory, Rotter (1966) stated people have an internal or external locus of control that motivates them to act. An external locus of control is when a person feels there are things outside of their control that may impede the outcome. Alternately, an internal locus of control is when a person feels they have the ability to affect the outcome, regardless of other factors that may exist and seem prohibitive.

Using Rotter's (1966) locus of control theory as a lens to examine teachers, an external locus of control would be a teacher who feels there are some outside obstacles that may stymie or impede their efforts to promote student learning. Teachers with an external locus of control may think that a child's home environment or parental influence may either promote or impede any efforts made by them in the classroom. Furthermore, teachers with an internal locus of

control would think it is within them and their abilities to motive and guide students to learn. If a student does not grasp a concept, then a teacher with an internal locus of control may feel they may not have the necessary skills or ability to promote learning of the concept.

Measures developed based on Rotter's locus of control theory. Using Rotter's (1966) theory, two groundbreaking studies introduced the construct of teacher efficacy to the world and launched a plethora of future research. These works became the RAND[15] studies because the RAND Corporation supported them. The first RAND study, conducted by Armor and colleagues (1976), investigated the effectiveness of the Los Angeles School Preferred Reading Program and intervention in 20 minority elementary schools. The authors of the second RAND study, Berman and colleagues (1977), surveyed 100 Title III projects[16] that continued after federal funding ended to investigate why these programs continued. In addition, the second RAND study conducted to determine the level of continued use of materials and methods sponsored by the Title III projects.

Both research studies incorporated two simple statements in their survey data based on Rotter's theory (1966):

1. When it comes right down to it, a teacher really can't do much because most of a student's motivation and performance depends on his or her home environment.
2. If I really try hard, I can get through to even the most difficult or unmotivated students.

The first statement reflects a belief in an external locus of control, while the second represents an internal locus of control. According to Tschannen-Moran and Woolfolk Hoy

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[15] The term RAND is an acronym for research and development.

[16] Title III projects were federally funded grants to school districts for textbooks and library books to improve the quality of elementary and secondary education. The program was initially started by the 1965 Elementary and Secondary Education Act (ESEA).

(2001), the first statement labeled as general teaching efficacy (GTE) and the second is referred to as personal teaching efficacy (PTE). The two statements were a part of a larger survey that used a 5-point Likert scale, 1 representing "Strongly Disagree" and 5 as "Strongly Agree." The sum of the scores from these statements produces a teacher efficacy score (Tschannen-Moran & Woolfolk Hoy, 2001).

As I discuss in the next section, these studies produced some powerful results, but there were doubts about the reliability (Tschannen-Moran et al., 1998) of information gleamed from such a simple instrument (Tschannen-Moran & Woolfolk Hoy, 2001). According to Tschannen-Moran and her colleagues (Tschannen-Moran et al., 1998), researchers developed other instruments to address these doubts and create "longer, more comprehensive measures" (p. 205).

Following the RAND studies, subsequent studies created more extensive instruments to measure teacher efficacy in an effort to dig deeper and learn more about this new construct. Rose and Medwey (1981) developed a 28-item instrument, known as the Teacher Locus of Control (TLC) to determine how teachers assigned the responsibility for student successes and failures. In other words, was the explanation for the student success or failure due to some internal factor caused by the teacher or external factor outside the teacher's control?

About the same time that the TLC was developed, Guskey (1981) created a 30-item instrument, known as the Response Student Assessment (RSA), to measure a teacher's sense of internal responsibility for student success. Similar to the TLC, the RSA was based on Rotter's (1966) theory of locus of control. Other instruments were developed such as the Webb scale (Webb et al., 1982) and Teacher Efficacy Scale (TES) (Gibson & Dembo, 1984) (discussed in more detail later).

Each of the instruments developed after the RAND studies had some similarities. Foremost, the purpose of all of the instruments created was to seek more understanding about the power of teacher efficacy and to add accuracy in measuring the new construct. Each of these instruments tried to capture this elusive construct (Tschannen-Moran & Woolfolk Hoy, 2001) of teacher efficacy, an objective that has continued for approximately forty years. Furthermore, the instruments followed the example established by the RAND studies in that they all utilized a survey format; this tradition has dominated the study of teacher efficacy ever since (Tschannen-Moran et al., 1998).

Findings from studies that utilized Rotter's locus of control theory. There were some powerful results about teacher efficacy from studies utilizing Rotter's (1966) theory. In the annals of teacher efficacy, researchers almost universally noted the RAND studies as the genesis or birth of the construct (Tschannen-Moran et al., 1998). Using Rotter's (1966) locus of control theory, teacher efficacy was seen "as the extent to which teachers believed that they could control the reinforcement of their actions, that is, whether control of reinforcement lay within themselves or in the environment" (Tschannen-Moran et al., 1998, p. 202).

In the first RAND study (Armor et al., 1976), the researchers sought to identify the school and classroom policies and other factors that had been most successful in raising reading scores. They constructed the two-item instrument described previously. Using this instrument, the researchers found a greater sense of teacher efficacy correlated with more students advancing in reading (Armor et al., 1976; Tschannen-Moran et al., 1998).

The next RAND study (Berman et al., 1977) was sponsored by the U.S. Office of Education. This research project was a multi-year, two-phase study of 100 Title III projects in 20 states. One phase of the study was to examine what happened to federally funded, innovative

projects after the initial federal funding stopped. Using the instrument developed by the previous RAND study, the researchers found that teacher efficacy had "major positive effects on the percentage of project goals achieved, improved student performance, teacher change, and student improvement" (Berman et al., 1977, p. xi).

After the RAND studies, Rose and Medway (1981) designed the Teacher Locus of Control (TLC) Scale. They found that their instrument was better at predicting a teacher's behavior than the theory of internal versus external control presented by Rotter's (1966) work. According to Tschannen-Moran and Woolfolk Hoy (2001), this finding may be due to the fact that the TLC was more aligned to a teaching context.

As previously stated, at about the same time as researchers were creating the TLC, Guskey (1981) developed the Responsibility for Student Achievement (RSA) instrument. This study focused more on the internal aspect of Rotter's (1966) locus of control theory by measuring a teacher's sense of internal responsibility for student achievement. The RSA reported a general score for teachers assuming responsibility for student performance and two subscales: responsibility for student success and student failure. Guskey "found significant positive correlations between teacher efficacy [as measured by the RAND items] and responsibility for both student success and student failure" (Tschannen-Moran & Woolfolk Hoy, 2001, p. 785) as measured by the RSA.

Similar studies, which used Rotter's (1966) locus of control theory, were conducted and produced scales to measure teacher efficacy. A couple of instruments that I discuss later in this review are the Teacher Efficacy Scale (TES) (Gibson & Dembo, 1984) and the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) (Enochs et al., 2000). Other research studies examined the reliability and validity (e.g. Coladarci & Fink, 1995; Guskey & Passaro, 1994) of

the instruments designed based on Rotter's (1966) theory. However, there were some studies designed to development instruments for measuring teacher efficacy that were not based on Rotter's (1966) theory. In the next section, I discuss some of these instruments.

Bandura's Social Cognitive Theory

Shortly after the RAND studies, another theory was developed and began to be applied to teacher efficacy research. Bandura (1977) explained, "a theoretical framework, in which the concept of self-efficacy is assigned a central role, for analyzing changes achieved in fearful and avoidant behavior" (p. 193). This framework is comprised of two components: self-efficacy beliefs and outcome expectancy. According to Bandura (1977), a person may believe that certain actions will lead to a particular outcome, but still may have doubts about their ability to perform the necessary actions. Self-efficacy beliefs are judgements one has in their abilities to perform a particular task (Bandura, 1982). Outcome expectancy is "a person's estimate that a given behavior will lead to certain outcomes" (Bandura, 1977, p. 193). According to Gibson and Dembo (1984)—

> if we apply Bandura's theory to the construct of teacher efficacy, outcome expectancy would essentially reflect the degree to which teachers believed the environment could be controlled, that is, the extent to which students can be taught given such factors as family background, IQ, and school conditions. Self-efficacy beliefs would indicate teachers' evaluation of their abilities to bring about positive student change. (p. 570)

Bandura (1997) noted self-efficacy beliefs are different from the beliefs involved in Rotter's locus of control theory. Recall from Chapter 1, that self-efficacy beliefs are perceptions about a future-oriented scenario (Bandura, 1977, 1997). These beliefs are not about executing the task. Instead, these beliefs are about whether or not a person feels he or she can perform certain actions that will produce a desired outcome. The action is not attempted, but contemplated within one's mind. For example, a teacher's belief on whether or not she or he can perform the

necessary actions to teach mathematics. However, the beliefs involved in the locus of control theory are whether or not a person believes certain actions will affect the outcome. In other words, a teacher's belief concerning what she or he does in the classroom will lead to student learning or is it impeded by things outside the control of the classroom. Although both theories concern beliefs, Rotter's (1966) theory focuses on actions or activities and Bandura's theory focuses on one's belief in their potential. Bandura (1997) referred to locus of control theory as "beliefs about whether actions affect outcomes" (p. 20). In other words, the beliefs as to whether or not actions performed by a teacher will lead to student learning or the beliefs that such action will be impeded by things in the student's environment.

Applying Bandura's (1977) theory to teachers, teacher efficacy was viewed as a cognitive process whereby a teacher formulates beliefs about their abilities to perform at a certain level. These beliefs affect the level of effort put forth, persistence during challenging situations, stress management in coping with a demanding job, and resiliency in the face of unsuccessful experiences (Bandura, 1997). To be a successful teacher, a person needs more than factual fluency, because self-doubt can undermine this knowledge. According to Bandura (1993), "effective intellectual functioning requires much more than simply understanding the factual knowledge" (p. 117). Two teachers may have similar levels of content knowledge, but may perform differently when it comes to utilizing the content knowledge due to their efficacy beliefs.

Based on Bandura's (1977) self-efficacy component, instruments were developed to measure teacher efficacy. Similar to instruments developed using Rotter's (1966) theory, some of these instruments survived and were often used, while others were not regularly utilized (Tschannen-Moran & Woolfolk Hoy 2001).

Measures developed based on Bandura's self-efficacy theory. Bandura created an instrument, based on his self-efficacy theory, to measure teacher efficacy. The instrument is undated and not published (Swackhamer, 2009). The instrument is comprised of 30-items distributed across seven subscales that represent tasks and aspects of teaching: influence on decision making, influence on school resources, instructional efficacy, disciplinary efficacy, enlisting parental involvement, enlisting community involvement, and creating a positive school climate (Tschannen-Moran & Woolfolk Hoy, 2001). Similar to the locus of control instruments, each item on Bandura's scale utilized a 9-point Likert scale. Limited research is available about Bandura's teacher self-efficacy scale (Woolfolk Hoy & Burke Spero, 2005). One of the purposes of Bandura's efficacy scale was to "provide a multi-faceted picture of teachers' efficacy beliefs without becoming too narrow or specific" (Tschannen-Moran & Woolfolk Hoy, 2001, p. 791). This objective has been commonplace as far back as some of the early instruments that were designed after the RAND studies. Researchers were focused on creating an instrument that was able to capture more about teacher efficacy; therefore, longer and more comprehensive measures were sought (Tschannen-Moran & Woolfolk Hoy, 2001).

Another instrument, based on Bandura's theory, was Ashton vignettes (Ashton, Buhr, & Crocker, 1984). The format of this instrument was a series of scenarios that describe a potential teaching situation. Teachers were asked to make a judgement about their handling of the situation presented in the vignettes. Another version of this instrument asked teachers to make comparison to other teachers. The Ashton vignettes scale was based on the notion that teacher efficacy is context specific (Tschannen-Moran et al., 1998). The instrument has been rarely used (Tschannen-Moran et al., 1998).

"Trunk" of the Tree of Teacher Efficacy

After the emergence of teacher efficacy and the early application of both Rotter's (1966) and Bandura's (1977) theories to the research and instrument development, there was a need to bring the various research findings and instrumentations together to support future growth of this "tree." With any tree, a good root system and a strong trunk is important to its survival. The development of the Teacher Efficacy Scale (TES) (Gibson & Dembo, 1984) and Teacher Sense of Efficacy Scale (TSES) (Tschannen-Moran & Woolfolk Hoy, 2001) propelled teacher efficacy research from the early stage of development to the present. The TES has been the most popular used instrument in teacher efficacy research (Tschannen-Moran & Woolfolk Hoy, 2001). Therefore, in the upcoming sections, I focus much attention discussing the TES and TSES and some important research that utilized these instruments.

Development of Gibson and Dembo's Teacher Efficacy Scale

Gibson and Dembo's (1984) work pulled together research findings based on either Rotter's or Bandura's theories. Yet, some researchers (e.g., Swackhamer, 2009) classify their work as being based on Rotter's (1966) locus of control theory, while others (e.g., Tschannen-Moran, Woolfolk Hoy & Hoy, 1998) ascribe the foundation of this work being grounded in Bandura's (1977) self-efficacy component.

As previously noted, some researchers were applying Rotter's (1966) locus of control theory and others utilizing Bandura's (1977, 1997) self-efficacy theory to understand teacher efficacy. The juxtaposition of these two theories in the exploration of teacher efficacy lead to further debate and research including the reliability and validity of instruments to measure teacher efficacy, and whether or not the results from these frameworks led to different or similar constructs (Tschannen-Moran & Woolfolk Hoy, 2001). Based on my assessment of the research,

one of the most influential pieces of research on teacher efficacy has been the work of Gibson and Dembo (1984). This research addressed the issues and debates concerning teacher efficacy.

Gibson and Dembo's (1984) project was a multi-purpose study conducted in three phrases. Phase 1 was what are the dimensions of teacher efficacy? How do these dimensions relate to Bandura's theory of self-efficacy? What is the internal consistency of the teacher efficacy measure? Phase 2 was does evidence of teacher efficacy gathered from different sources in different ways converge? Can teacher efficacy be differentiated from other constructs? Phase 3 was do high- and low-efficacy teachers exhibit differential patterns of teacher behaviors in the classroom related to academic focus, feedback, and persistence in failure situations? One of the major outcomes of this research was the development of the Teacher Efficacy Scale (TES). The TES is comprised of 30-items with a 6-point Likert scale rating for each item. A short form of the TES, which has 16-items, is sometimes used.

The TES is the most heavily utilized instrument in the study of teacher efficacy. It has been directly used or a variation of it has been used in numerous research studies (e.g. Fortman & Pontius, 2000; Hoy & Woolfolk, 1993; Ross, 1992; Woolfolk Hoy & Burke Spero, 2005). According to Gibson and Dembo (1984), "although the importance of teachers' sense of efficacy has been identified, researchers are not certain how to conceptualize and adequately measure the construct" (p. 569) which is why the TES was developed. (This fact is evident by the previous attempts to measure it by the other several instruments mentioned in the previous sections of this chapter.) Attempts to measure teacher efficacy, however, did not end with the creation of the TES. Currently, research and instrument development continues.

Other findings from Gibson and Dembo's work. The results from the research of Gibson and Dembo (1984) showed teacher efficacy was comprised of two components. The first

component has become known as personal teaching efficacy (PTE). PTE represents a teacher's "belief that one has the skills and abilities to bring about student learning" (Gibson & Dembo, 1984, p. 573). According to Gibson and Dembo (1984), this aspect corresponds to the second question used in the RAND studies. Recall the second RAND statement involved the belief that through hard work a teacher can reach the most difficult or unmotivated student. Furthermore, this component corresponds to Bandura's (1977) self-efficacy theory. The second component of teacher efficacy, which has become known as teaching efficacy or general teaching efficacy (GTE), represents the "belief that any teacher's ability to bring about change is significantly limited by factors external to the teacher, such as the home environment, family background, and parental influences" (Gibson & Dembo, 1984, p. 574). This component clearly corresponds to the first statement used in the RAND studies, which referred to the belief that efforts of a teacher to foster student learning is stymied by a student's environment or external factors, and Bandura's (1977) outcome expectancy component. The sum of scores from the two components of the TES (i.e., the PTE and the GTE) represented teacher efficacy.

Basically, the work of Gibson and Dembo (1984) linked the RAND studies, which were based on Rotter's (1966) locus of control theory and Bandura's (1977) self-efficacy theory to teacher efficacy. In the words of Gibson and Dembo (1984):

> Teacher efficacy is multidimensional, consisting of at least two dimensions that correspond to Bandura's two-component model of self-efficacy. The measures of teacher efficacy identified through different methods converge. (p. 579)

These findings tended to spur on the application of self-efficacy theory in the study of teacher efficacy.

Furthermore, Gibson and Dembo's (1984) work showed that information gathered from various sources came together. They found similar results that supported earlier research

findings. Their research highlighted characteristic differences between high and low efficacious teachers. High efficacious teachers spent more time in preparing lessons. They were less flustered by student interruptions than low efficacious teachers and were able to re-direct students who were off task or who had questions. High efficacious teachers were more persistent. Low efficacious teachers were more likely to "give up" on a student who did not know the answer to a question. Low efficacious teachers used criticism more often as feedback to students.

Impact of Gibson and Dembo's research. As previously mentioned, the work of Gibson and Dembo (1984) and the development of the TES propelled further research concerning teacher efficacy (Tschannen-Moran & Woolfolk Hoy, 2001). Many subsequent studies used the TES. Hoy and Woolfolk (1990) examined the efficacy beliefs of preservice teachers during student teaching. They used 20 items of the TES and the RAND statements to measure efficacy beliefs. The findings showed that general sense of teaching efficacy (GTE) for student teachers declined after the student teaching experience, but personal teaching efficacy (PTE) showed a significant increase after the student teaching experience. (Recall, GTE is the belief that factors such as environment or family background may limit the efforts of a teacher to foster learning, and PTE is the personal belief that a teacher has in her or his abilities to bring about student leaning.)

In a similar study, Fortman and Pontius (2000) examined the changes in teacher efficacy during student teaching using a modified version of the TES. Using a pre- and post-test design, the researchers found a significant gain in personal teaching efficacy as a result of student teaching. However, general teaching efficacy did decline, but it was not significant. By disaggregating the data, the researchers found that elementary preservice teachers had higher

levels of personal teaching efficacy than secondary preservice teachers. Fortman and Pontius suggested that this difference could be due to preparation programs for the two groups.

In a study that incorporated several instruments, Woolfolk Hoy and Burke Spero (2005) examined the change in teacher efficacy from preservice teachers' entrance into a teacher preparation program through the first year of actual teaching. Several instruments were used in the study to measure teacher efficacy. Among the used instruments were the TES, Bandura's, which was unpublished and not dated (Swackhamer, 2009) teacher efficacy scale, and the researchers' own designed instrument. According to the researchers "efficacy, however assessed, rose during teacher preparation and student teaching, but fell with actual experience as a teacher" (Woolfolk Hoy & Burke Spero, 2005, p. 352). Surprisingly, the researchers found that GTE increased after the student teaching experience, which was contrary to the findings in other studies (Fortman & Pontius, 2000; Hoy & Woolfolk, 1990). Woolfolk Hoy and Burke Spero (2005) hypothesized the reason that GTE rose may be because the preservice teachers in their study were involved in a yearlong student teaching experience and gradually introduced to teaching responsibilities. In the two previously mentioned studies, the student teaching experience was one semester long. This semester long experience was the first opportunity that these preservice teachers were introduced to real teaching responsibilities.

Development of Tschannen-Moran and Woolfolk Hoy's Teachers' Sense of Efficacy Scale

The most popular instrument designed based on Bandura's theory was the Teachers' Sense of Efficacy Scale[17] (TSES) (Tschannen-Moran & Woolfolk Hoy, 2001). In line with many researchers who have preceded them, Tschannen-Moran and Woolfolk Hoy noted there have

[17] The TSES is sometimes referred to as the Ohio State Teacher Efficacy Scale (OSTES); the authors of the instrument, however, prefer the name TSES.

been persistent problems in trying to measure teacher efficacy. The TSES is based on a model first envisioned by Tschannen-Moran, Woolfolk Hoy, and Hoy (1998) who felt there was a need "to examine the conceptual underpinnings of teacher efficacy and the tools used to measure it with an eye toward clarifying the construct and improving its measurement" (p. 203). This model, similar to Bandura's instrument assumes teacher efficacy is both context and subject-matter specific (Bandura, 1997; Tschannen-Moran & Woolfolk Hoy, 2001; Tschannen-Moran et al., 1998).

Similar to the TES, the TSES (Tschannen-Moran & Woolfolk Hoy, 2001) has two versions. The long version consists of 24 items and the short version has 12 items. For each item on either form, a respondent is given a 9-point Likert scale to rate their response, which is similar to Bandura's unpublished teacher efficacy instrument. Another similarity with the TES and more obvious with Bandura's teacher efficacy instrument, the TSES is comprised of sub-components. On the TSES, there are three sub-components: efficacy for instructional strategies, efficacy for student engagement, and efficacy for classroom management. Recall the TES has two sections or factors (i.e., PTE and GTE) and Bandura's efficacy instrument has seven sections. However, unlike the TES and more like Bandura's scale, the subcategories on the TSES are situations related to authentic responsibilities performed by teachers. For preservice teachers, Tschannen-Moran and Woolfolk Hoy (2001) noted that examining the results of the subcategories, instead of the results as a whole, "may have little meaning for prospective teachers who have yet to assume real teaching responsibilities" (p. 801). Therefore, the long form or short form in their entirety should be used with preservice teachers.

An analysis of the TSES revealed a reliability of alpha equal to 0.94 for the long form and alpha equal to 0.94 for the short form. An analysis of the construct validity of the TSES

showed that it positively related to both RAND items and each factor of the TES. This positive relation is true for the long and short forms of the TSES. Tschannen-Moran and Woolfolk Hoy (2001) stated the strongest correlation was with instruments that measure PTE.

Impact of Tschannen-Moran and Woolfolk Hoy's work. After the development of the TSES, several studies used this instrument. In one of these studies, Knoblauch and Woolfolk Hoy (2008) examined the efficacy of preservice teachers before and after student teaching. Among other purposes, this study investigated the relationship between efficacy beliefs and school setting (i.e., rural, suburban, and urban).

Grounded in Bandura's self-efficacy theory, this study administered the TSES to participants to measure teaching efficacy beliefs. Knoblauch and Woolfolk (2008) found a significant increase in teacher efficacy beliefs after student teaching for all three school settings. Additionally, they found that "the student teachers' perceived cooperating teachers' sense of efficacy was moderately and positively correlated with the student teachers' efficacy beliefs" (p. 175). The researchers noted if the student teachers perceived their cooperating teacher, whom they were learning the art of teaching, as efficacious then this increased the efficacy level of the student teacher. Recall from Chapter 1 two sources of efficacy information, as outlined by Bandura (1997), were vicarious experiences and verbal persuasion or words of encouragement. The researchers stated these experiences and words of support are valuable in developing the efficacy beliefs of student teachers.

Also grounded in Bandura's self-efficacy theory was a study conducted by Poulou (2007). A few of the purposes for this study were to examine student teachers' perceptions of the sources of PTE and the relationship between the sources of PTE and beliefs for instructional strategies, classroom management, and student engagement. Interviews were conducted with 32

student teachers and the TSES was administered to measure efficacy beliefs. The study found a student teacher's motivation and capabilities were the strongest source of teaching efficacy.

Mathematics Teaching Efficacy – One Branch of the Tree

According to Bandura (1997) and Tschannen-Moran, Woolfolk Hoy, and Hoy (1998), teacher efficacy is both context and subject-matter specific. Bandura (1997) stated:

> Teachers' sense of instructional efficacy is not necessarily uniform across different subjects. Thus, teachers who judge themselves highly efficacious in mathematical or science instruction may be much less assured of their efficacy in language instruction and vice versa. (p. 243)

Although there was much research conducted concerning teacher efficacy after the development of the TES and the TSES, it did experience a period in which it "struggled through the difficult, if inevitable, identity crisis of adolescence" (Tschannen-Moran et al., 1998, p. 202). However, throughout its maturation, teacher efficacy research has continued and revealed numerous correlations with teaching and student learning.

One of the fruitful branches of teacher efficacy has been to examine in more depth the notion that teacher efficacy is subject-matter specific (Bandura, 1997; Tschannen-Moran et al., 1998). From this line of investigation, additional instruments have been developed or previous ones have been adapted. Also, due to the fact that efficacy beliefs form early and once formed are malleable to change (Bandura, 1997), research has started to examine the efficacy beliefs of preservice teachers. In the upcoming sections, I discuss some of these instruments and the results from these studies, particularly those dealing with the mathematics teaching efficacy of preservice teachers.

Mathematics Teaching Efficacy Scales based on the Teacher Efficacy Scale (TES)

The Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) (Enochs et al., 2000) is utilized often to measure the mathematics teaching efficacy beliefs of preservice teachers. The MTEBI is based on the TES; therefore, it can be traced back to Rotter's (1966) theory.

The MTEBI, similar to several of its predecessors, derived from a modification of the Science Teaching Efficacy Belief Instrument (STEBI) (Riggs & Enochs, 1990). The STEBI was based on the TES and had two forms: STEBI-A and STEBI-B. The difference between the two instruments is that one form was applicable to inservice teachers (STEBI-A) and the other (STEBI-B) (Enochs & Riggs, 1990) was used to measure efficacy beliefs toward teaching science among preservice teachers. For several years, the custom of modifying the STEBI to measure subject-specific teaching beliefs was utilized (Enochs et al., 2000).

The MTEBI is a 21-item instrument whereby respondents are presented a 5-point Likert scale for each item. There are two subscales: personal mathematics teaching efficacy (PMTE) and mathematics teaching outcome expectancy (MTOE). Because technically the MTEBI eventually derived from the TES via the STEBI, one can see the connections to Bandura's (1977) work given that Gibson and Dembo (1984) brought together the research based on Rotter's (1966) and Bandura's (1977) theories.

Findings from studies using MTEBI. In developing the MTEBI, Enochs, Smith and Huinker (2000) used a sample of 324 elementary preservice teachers. A reliability analysis revealed an alpha coefficient of 0.88 for PTME and 0.77 for MTOE subscales. A confirmatory factor analysis showed that the two components (i.e., PTME and MTOE) are independent. Hence, the MTEBI showed to be reliable and valid for measuring the mathematics teaching efficacy beliefs of preservice teachers.

Using the MTEBI and STEBI, Utley, Moseley, and Bryant (2005) investigated the change in teacher efficacy beliefs towards mathematics and science teaching during a methods course and student teaching. In addition, the researchers examined the relationship between mathematics and science teaching efficacy. They administered the MTEBI and STEBI at the beginning of mathematics and science methods courses and at the end of these courses and student teaching. The results of this study showed that PTME significantly rose during the methods courses, but dropped slightly after the student teaching experience. Yet, the level of PTME was still higher after the student teaching experience than compared to the beginning of the methods course. Interestingly, MTOE rose from the beginning of the methods courses to the end and from the start of the methods course to the end of the student teaching experience. The authors noted further research is needed to explain the factors that affected causing a change in teacher efficacy.

In a study that examined the perceptions of mathematics teaching effectiveness among elementary preservice teachers with various levels of mathematics teacher efficacy (i.e., high and low), Swars (2005) identified three themes using a sample of preservice teachers who had just completed a methods course. Using the MTEBI and interviews, the Swars found past experiences with mathematics was related to mathematics teacher efficacy beliefs. In other words, the participants with the lowest level of mathematics teacher efficacy beliefs had negative past experiences with mathematics. While the participants with the highest level of mathematics teaching efficacy had either a positive past experience or realized they struggled with mathematics and had to focus more. Another thematic finding from this research was the preservice teachers with the lowest level of mathematics teaching efficacy beliefs felt they would have to work harder, provide more time and effort in order to be effective mathematics teachers.

The preservice teachers with the highest level of beliefs felt they would be effective mathematics teachers due either to their comfort or struggle with math. Lastly, the notion that it was important to motivate students to learn mathematics by using authentic, real-world applications was also a finding. However, the preservice teachers differ on whether or not manipulatives should be used as an instructional strategy. The participants with the lowest level of beliefs did not agree on the use of manipulatives. Yet, the preservice teachers with the highest levels of beliefs enthusiastically embraced the use of manipulatives because manipulatives added to a student's understanding of mathematics.

Mathematics teaching efficacy beliefs have been associated with other characteristics. Gresham (2009) examined the relationship between mathematics teacher efficacy and mathematics anxiety.[18] In a sample of preservice teachers enrolled in a mathematics methods course, Gresham found a significant, negative relationship between mathematics teaching efficacy and mathematics anxiety. Those preservice teachers with the highest level of mathematics teaching efficacy processed the lowest level of anxiety. Gresham used the MTEBI to measure mathematics teaching efficacy and the Mathematics Anxiety Rating Scale (MARS) to assess anxiety levels. In addition, interviews were conducted with the preservice teachers. The interviews showed it is beneficial that preservice teachers are provided "opportunities to address their past mathematical experiences" (Gresham, 2009, p. 32).

There have been other studies (e.g., Swars et al., 2006; Wenta, 2000) that investigated the relationship between mathematics teaching efficacy beliefs and mathematics anxiety. Wenta (2000) examined the effects of a methods course and its corresponding field experience on the

[18] Mathematics anxiety is a fear of mathematics that hinders or negatively affects a person's ability to perform mathematics in a variety of settings including basic everyday functions (Vinson, 2001).

teaching efficacy beliefs of elementary preservice teachers. Wenta found changes in the level of teacher efficacy, personal teaching efficacy, (PTE) and general teaching efficacy (GTE). These changes, however, varied depending on how the preservice teachers dealt with their past fear experiences with mathematics. The preservice teachers who were not negatively influenced by past mathematics fears showed an increase in PTE, and those preservice teachers who were negatively influenced by past mathematics fears, displayed a decrease in teacher efficacy and PTE. Overall, the findings showed that PTE increased over the course of the methods course. However, there was not significant change in GTE and teacher efficacy as a whole.

Swars, Daane, and Giesen (2006) examined the relationship between mathematics anxiety and mathematics teaching efficacy beliefs among elementary preservice teachers. Similar to the participants in Wenta's (2000) study, the participants in their study were enrolled in a methods course. The researchers found there was a moderate negative relationship between mathematics anxiety and mathematics teaching efficacy beliefs.

Mathematics Teaching Efficacy Scales based on Teacher Sense of Efficacy Scale (TSES)

The STEBI and MTEBI were two popular instruments used to measure teacher efficacy for a specific content. In some cases, the TES was adapted for use in similar context. When it comes to measures that were based on Bandura's (1997) work, as mentioned previously, the TSES was rather popular. Several studies used the TSES to measure teacher efficacy in a subject specific situation. In the literature, I did not find an instrument, based on Bandura's theory, developed specifically for measuring mathematics teaching efficacy. Again, the TSES was adapted as needed.

Findings from studies using TSES. Using a translated and modified version of the TSES, Charalambous, Philippou, and Kyriakides (2008) studied the mathematics teaching efficacy

beliefs after the student teaching experience of a group of preservice teachers in Cyprus. There were 89 participants in the study who were administered the modified TSES at the beginning, middle, and end of their last course of fieldwork. The researchers acknowledged their study was the first to undertake such an investigation.

Using an exploratory factor analysis, two factors emerged from the data: efficacy for mathematics instruction and efficacy in mathematics classroom management. In addition, the researchers found teacher efficacy was open to change during the student teaching experience and it did increase during student teaching, but the increase was not uniform. Because of this non-uniformity in change, the Charalambous and colleagues (2008) cautioned it is important that future researchers look beyond just the mean change in efficacy.

When the researchers examined what factors influence teacher efficacy, they found results similar to what Bandura (1997) purposes about efficacy beliefs. Charalambous and colleagues (2008) found that mastery experiences, vicarious experiences, and social persuasion during the student teaching experience caused an increase in teacher efficacy. However, the mastery experiences from being in the schools all day during the student teaching experience was the most influential impact on teacher efficacy beliefs among the preservice teachers. Further attention should be given to mentors and the influence that they may have on the development of the teacher efficacy beliefs of preservice teachers.

In another study using the TSES, Swackhamer (2009) studied the influences on mathematics teaching efficacy as well. However, contrary to Charalambous and his colleagues' work (2008), this study involved inservice teachers instead of preservice teachers. Similar to the work of Gresham (2008, 2009) and Swars (2005), this study examined mathematics anxiety as

well. The study used the shorten version of the TSES (Tschannen-Moran & Woolfolk Hoy, 2001)[19] and adapted it for use concerning mathematics content.

Using a sample of 86 teachers from either an urban or suburban school districts, Swackhamer (2009) found mathematics content knowledge, years of teaching, and teacher support influenced mathematics teaching efficacy. It was noted that having a high level of mathematics teaching efficacy produced teachers who were more willing to embrace innovative practices, appreciated the benefits of all curriculum materials, were able to differentiate instructions to benefit all learners, and possessed a high level of perceived effectiveness as mathematics teachers. These are all characteristics embraced by National Council of Teachers of Mathematics (NCTM) and other stakeholders in the teaching of mathematics. These teachers, with a higher level of efficacy, felt a strong need to be experts in all content areas that they taught.

Interestingly, Swackhamer (2009) found mathematics anxiety was only a predictor of efficacy for teachers whose TSES score reflected a low efficacy. Similar to other studies (e.g., Charalambous et al., 2008; Swars, 2005), teachers with low efficacy had issues about past negative experiences with mathematics and they had problems seeking a deeper level of understanding of mathematical concepts. In support for the need to create content-specific instruments to measure teacher efficacy, Swackhamer (2009) found that the majority of the low efficacious teachers had a higher level of efficacy for literacy than mathematics. In addition, low efficacious teachers were unsure about teaching some mathematical concepts.

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[19] The shorten version of the TSES is comprised of 12 items instead of the standard 24 items found on the original version.

Summary

Throughout the history and research concerning teacher efficacy, researchers have been investigating the power of this construct. Yet, as I have presented in this chapter, researchers have struggled with developing an instrument that could adequately measure teacher efficacy. I have presented a pathway from the earliest revelation about teacher efficacy to its present state. Clearly, you can see the struggles and trials of researchers; evidenced by the various attempts to develop an instrument to measure teacher efficacy.

There has been no doubt about the power of teacher efficacy. As presented earlier in this chapter, teacher efficacy has been shown to affect teacher and student behavior. Poulou (2007) stated, "Teachers' confidence in their ability to perform the actions that lead to student learning is one of the few individual characteristics that predicts teacher practice and student outcomes" (p. 192). Level of teacher efficacy affects the involvement of parents in their children's learning. According to Hoover-Dempsey, Bassler, and Brissie (1987), efficacious teachers are more willing to invite and encourage parental involvement and in return the parents are more willing to seek out these more efficacious teachers and get involved.

As the research on teacher efficacy matured, questions arose concerning the specificity and content on the level of a teacher's efficacy beliefs. In addition, researchers questioned an appropriate time to explain one's level of efficacy in order to make an impact. More research has been examining the development of efficacy beliefs among preservice teachers, especially during the student teaching experience when preservice teachers are presented authentic teaching situations. A strong sense of efficacy in a student teacher is important because this in turn impacts the level of student achievement and desirable teacher characteristics (Mulholland & Wallace, 2001). In terms of mathematics, Swars (2005) concluded the characters exhibited by

more efficacious teachers toward the teaching of mathematics are in line with the standards espoused by NCTM.

Yet, many researchers have cautioned that early in the investigation of teacher efficacy, quantitative measures have been the primary tool used. This trend continued in subsequent teacher efficacy research. In the studies present in this review of the literature, it is evident that a majority of the research studies utilized quantitative methods. According to Henson (2002), further examination of teacher efficacy requires more qualitative investigations. The use of more qualitative methods of research concerning teacher efficacy "will provide an understanding of how teacher efficacy beliefs are formed and hence support the investigation of interventions that enhance teacher efficacy" (Labone, 2004, p. 357). The results of such investigations can be used in teacher preparation programs to produce more efficacious teachers and hence more effective teachers. Sadly, teacher efficacy research has neglected qualitative methods (Tschannen-Moran et al., 1998).

CHAPTER 3

METHODOLOGY

> …the researcher as the primary instrument of data collection and analysis, an inductive investigative strategy, and the end product being richly descriptive.
>
> –Merriam, 2009, p. 39

The development of effective teachers of mathematics has been a national issue for decades as exemplified by the various movements and initiatives during the 20th and continues into the 21st century (e.g., Back to Basics, NCTM Standards, NCLB Act, and Common Core State Standards Initiative). Numerous stakeholders (e.g., presidents, national organizations, and school and community leaders) have proffered suggestions to improve the teaching and learning of mathematics.

Research (e.g., Ashton, 1985; Bandura, 1997; Lin & Gorrell, 2001) has shown that teacher efficacy has a positive impact on teacher effectiveness, student achievement, teacher retention, and teacher practice. It is important to note, however, "that efficacy may be most malleable early in learning, thus the first years of teaching could be critical to the long-term development of teacher efficacy" (Woolfolk Hoy & Burke Spero, 2005, p. 344). Furthermore, much of the research on teacher efficacy (e.g., Fortman & Pontius, 2000; Gibson & Dembo, 1984; Ross, 1992) has been quantitative studies performed on current teachers, instead of future teachers. Therefore, there is a need for more qualitative studies concerning teacher efficacy, especially involving pre-service teachers during student teaching experiences. The advantages of more qualitative studies will help in understanding the development of teacher efficacy beliefs (Labone, 2000).

There exists far less research concerning the mathematics teaching efficacy beliefs of preservice teachers (Briley, 2012). The results of the few studies on the teacher efficacy of pre-

service teachers have identified teacher efficacy of preservice teachers increased during the student teaching experience (e.g., Fortman & Pontius, 2000; Hoy & Woolfolk, 1990; Woolfolk Hoy & Burke Spero, 2005). Therefore, to address these deficiencies in teacher efficacy research and the needs of various stakeholders, the purpose of this qualitative study is to investigate what happens to the mathematics teaching efficacy beliefs of preservice teachers during the student teaching experience.

Research Questions

What happens to the mathematics teaching efficacy beliefs of preservice teachers during the student teaching experience? The three sub-questions are:

1. During the student teaching experience, what happens to the level of mathematics teaching efficacy beliefs of the preservice teachers?
2. What are the characteristics of preservice teachers with low and high levels of mathematics teaching efficacy beliefs[20] after the student teaching experience?
3. What factors from the student teaching experience influenced the mathematics teaching efficacy beliefs of preservice teachers?

Design of Study

This study is a basic qualitative study (Merriam, 2009) with a quantitative component. This type of study is "probably the most common form of qualitative research found in education" (Merriam, 2009, p. 23). This design is preferred when a researcher is interested in the following things:

1. How people interpret their experiences;

[20] Preservice teachers whose mathematics teaching efficacy score, as determined by the MTEBI (Enoch, Smith & Huinker (2000), is approximately at least one standard deviation below the cohort mean MTEBI score is considered as possessing a low level of mathematics teaching efficacy belief. Similarly, a high level of mathematics teaching efficacy belief is approximately a score of at least one standard deviation above the cohort mean score.

2. How they construct their world, and
3. What meaning they attribute to their experiences? (p. 23)

According to Bogdan and Biklen (2007), qualitative research is very descriptive and involves an inductive approach, with a focus on uncovering meaning from the point of view of the participants. Therefore, a qualitative researcher tries to determine "how people interpret their experiences, how they construct their worlds, what meaning they attribute to their experiences" (Merriam, 2009, p. 14). Because efficacy beliefs are formed from how individuals interpret their experiences and construct meaning, it seems appropriate for this study to utilize a basic qualitative design.

In this study, I am interested in how preservice teachers interpret their experiences from student teaching to develop their beliefs about teaching mathematics. Like all qualitative researchers, I am attempting to better understand the behavior and experiences (Bogdan and Biklen, 2007) of these future teachers. As qualitative researchers, our goal is to attempt to understand the process in which people construct meaning and to describe these meanings (p. 43). Therefore, constructionism is the underlying philosophy of this study (Merriam, 2009).

Because this study is exploring the impact of the student teaching experience on the mathematics teaching efficacy beliefs of preservice teachers, a case study methodology seems most appropriate. Yin (2009) noted a case study method is used when the researcher wants "to understand a real life phenomenon in depth, but such understanding encompassed important contextual conditions" (p. 18). According to Merriam (1988), this methodology is used when a researcher seeks "insight, discovery, and interpretation" (p. 10). Furthermore, when researchers seek "an in-depth understanding of the situation and its meaning for those involved" (Merriam, 1988, p.xii), this methodology is appropriate. Each of these rationales for using a case study

methodology addresses the purpose of this research, which is to understand how the student teaching experience affects the mathematics teaching efficacy beliefs of preservice elementary teachers.

A case study researcher's role is very similar to a police detective conducting an investigation (Merriam, 1988). The detective gathers information (i.e., data) pertaining to the investigation about a crime, a situation, a phenomenon, or a "case." The information is assembled from a multitude of sources. There are in-depth interviews with eyewitnesses. Usually, the interview is fluid (i.e., somewhat unstructured). In other words, the detective has some questions in mind that she or he would like to ask the eyewitnesses, but depending of the information received from the witness other questions are formulate on the spot. The detective relies upon the witness' accounts, experiences, and interpretation of these events. Furthermore, the information gathered from one witness may shape the questions asked of the next witness. Information is gathered in the natural setting of the situation. Hence, the term natural inquiry (Guba & Lincoln, 1985) is another phrase used to refer to qualitative research, because the inquiry occurs in "the field" where the phenomenon lies. Usually, the detective has to revisit the field gathering more information. In addition, information is gathered from various documents and artifacts. All of these sources of information are brought together to view the phenomenon in its entirety and valid the information received. This process is similar to a detective who is constantly gathering information to define a phenomenon or understand his or her case.

Several researchers (see, e.g., Tschannen-Moran & Woolfolk Hoy, 2001) have recommended the need for more research about teacher efficacy to provide insight on how future teachers create their beliefs. Furthermore, this methodology supports the theory of efficacy beliefs as purported by Bandura (1997) that acknowledges "different people with similar skills,

or the same person under different circumstances, may perform poorly, adequately, or extraordinarily, depending on fluctuations in their beliefs" (p. 37). I, however, found a limited amount of knowledge, especially qualitative information, surrounding the effect of the student teaching experience on the mathematical teaching beliefs of preservice teachers. The use of case studies, an approach used in education to extend our current knowledge (Merriam, 1988), can add to this shortage. However, the phrase case study can be vague, because it is used in a multitude of ways, jobs, and disciplines with different meanings; hence, the phrase can be confusing (Merriam, 1998).

Several experts on case study methodology have proffered a variety of definitions of this methodology. Cresswell (2007) defines case study as "a qualitative approach in which the investigator explores a bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information (e.g., observations, interviews, audiovisual material, and documents and reports), and reports a case description and case-based themes" (p. 73). Merriam (1988) views a case study as "an intensive, holistic description and analysis of a bounded phenomenon such as a program, an institution, a person, a process, or a social unit" (p. xiv). Miles, Huberman and Saldana (2014) explains a case study as "a phenomenon of some sort occurring in a bounded context" (p. 28). Lastly, Yin (2009) views a case study as "an empirical inquiry that investigate a contemporary phenomenon in depth and within real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (p. 18).

Each of the aforementioned definitions or descriptions express the notion that a case study investigates some phenomenon or case that may be an individual, several individuals, a program, or some event (Merriam, 1998). For this study, an analysis of the student teaching

experience was performed. The goal is to explore (Creswell, 2007), make discoveries (Merriam, 1988), and "to understand a real-life phenomenon" (Yin, 2009, p. 18) about how these preservice teachers use their experiences from student teaching to develop a system of beliefs that motivates their behavior as teachers of mathematics. Although the process in which a case study is conducted is not delineated, there is an emphasis on gathering as much information as possible to present the phenomenon in its entirety by having a variety of data sources—again, similar to what a detective does. The final product is "an in-depth description and analysis of a bounded system (Merriam, 1998, p. 40).

In addition, several of the case study experts (Cresswell, 2007; Merriam, 1988, 1998; and Miles et al., 2014) explicitly mentioned that a case study is bounded when the phenomenon is contained. The examination of the phenomenon occurs within a determined limits or boundaries. In other words, bounded means the researcher can fence in what is being studied (Merriam, 2009). In this research, the student teaching experience is bounded. It can be enclosed. There is a beginning, middle, and an end.

Regardless of the definition used, case studies have four, essential characters: particularistic, descriptive, heuristic, and inductive (Merriam, 1988). The particularistic character is that all case studies focus on a particular happening and the way people confront problems. This research is focused on mathematics teaching efficacy beliefs of future teachers and how they dealt with their experiences of teaching and learning of mathematics. A case study is descriptive because the result is "a rich, thick description" (Merriam, 1988, p. 11). Because this research examined the entire student teaching experience and gather data from several sources, the goal is to produce a descriptive account of the experience for these preservice teachers. Case studies provide understanding of the phenomenon and can extend our knowledge of the

phenomenon. They provide understanding and promote further investigation. As with the detective, one piece of discovered evidence leads to further enquiry. This process is the characteristic of heuristic. Lastly, case studies research allows for discovery. In this journey of discovery, the researcher does not have a predetermined notions or hypotheses and thereby seeking verification of the hypotheses. A piece of information may lead to more information or may influence the direction of the investigation. Hence, the journey is inductive. All qualitative research involves an inductive process (Bogdan & Biklen, 2007; Merriam, 2009).

In case study research, the researcher is the detective (Merriam, 1988, 1998), conducting an investigation. As previously mentioned the researcher has no predetermined ideas. Therefore, she or he does not know where the journey of discovery will lead. Furthermore, "the researcher is the primary instrument of data collection and analysis" (Merriam, 1998, p. 52). All of the information is filtered through the researcher and her or his interpretation and understanding. Yin (2009) compares the researcher in a case study to that of a fisherman. The researcher casts out a wide net in hopes of gathering as much information as possible. Again, the notion that data are gathered from a variety of sources and much data are needed similar to a fisherman catching a variety of fish. Thus, the multitude of data collection methods is one of the advantages and benefits of using case studies (Merriam, 1988; Yin, 2001); it provides a more detailed account of the case and the multitude of sources are used to validate the information gathered.

According to researchers there are many types of case studies (e.g., Merriam, 1988; Stake, 1995; Yin, 2009). Merriam (1988, 1998) classifies case studies based on the final report from the study. She states that the final report may be descriptive, interpretive, or evaluative. A descriptive case study presents a description of the phenomenon being studied. There is no theorizing or evaluating of the situation. In an interpretive case study, which will be descriptive

as well, the end result is to theorize or make interpretations about the phenomenon. Combining the characteristics of both descriptive and interpretive case studies with the notion of making a judgment, the case study becomes an evaluative case study. This study will involve both descriptive and some interpretive characteristics.

Instead of focusing on the end report as a means of labeling the case study, Stake (1995) uses the intent or the interest of the researcher as a means in naming the various types of case studies. He refers to case studies as intrinsic, instrumental, and collective. An intrinsic case study results when a research has an interest in a problem or entity. For example, a local citizen may be concerned or interested in the number of homeless individual in their community. The concerned citizen conducts a case study to investigate the problem. This type of case study is designed to explore an issue or situation. In an instrumental case study, the researcher is focused on gaining knowledge about an issue or innovative program. The actual case is not primary. Lastly, collective case study, also known as multiple case study, involves several cases to investigate. This study is somewhat instrumental in that the purpose is to gain more knowledge about the mathematics teaching efficacy beliefs of preservice teachers. Yin (2009) use a different, but somewhat similar classification system for case studies.

Although there are various types and approaches to case studies research, eventually, the goal is

> to understand how the actors, the people being studied, see things. Ultimately, the interpretations of the researcher are likely to be emphasized more than the interpretations of those people studied, but the qualitative case researcher tries to preserve the multiple realities, the different and even contradictory views of what is happening. (Stake, 1995, p. 12)

Similarly, Merriam (2009) states that all case studies seek "meaning and understanding, the researcher as the primary instrument of data collection and analysis, an inductive investigative

strategy, and the end product being richly descriptive" (p. 39). The utmost determination goes into executing and reporting a case study.

Sample

Because this study utilized a case study methodology, two levels of sampling were necessary (Merriam, 2009). First, all participants enrolled in the student teaching experience at a particular small state university in the southeastern United States were invited to participate in the first level of this study. These participants were enrolled in a cohort model[21] for teacher preparation, where the final year of their Program of Study to become certified teachers was a two-semester student teaching experience. The first semester of student teaching was a 15-week placement in a K–5 classroom, followed by a semester in a Special Education (SPED) setting. Upon completing this Program of Study, the students graduated with a bachelor's degree in early childhood education and special education.

There were initially 30 members of the cohort. All of the members of the cohort where female, ranging in age at the beginning of this study from 20 to 56 years of age. There were 23 European Americans, six African Americans, and one Hispanic American in the cohort invited to participate in this study.

The participants in the study were invited to complete three administrations of the survey Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) (Enochs et al., 2000). The survey was given at the beginning, middle, and end of the student teaching experience by the researcher. Of the preservice teachers invited to participate in this study, only 25 completed all three administrations of the MTEBI. Of the 25 who completed all administrations of the survey, 20 were European Americans, four were African Americans, and one was Hispanic American. For

[21] A cohort model is where the students enrolled in the program participate together in the same courses.

this research, only their surveys were used in the first level of this research. The reason for the reduction in number of participants is due to various reasons such some preservice teachers withdrew from the teacher preparation programs or missed taking the survey due to illness.

During the second level of sampling, purposeful sampling was used to determine which preservice teachers would be invited for a semi-structured interview and provide additional documents for this study. In purposeful sampling, criteria are established to determine which participants would be invited to be a part of the next level of the study. Because a criterion is created, some researchers (LeCompte & Preissle, 1993) use the term criterion-based selection instead of purposeful sampling. This technique is a procedure that does not involve a probabilistic process to select the participants. In fact, probabilistic sampling is not justified in qualitative research (Merriam, 2009). Instead the sample is specifically chosen to provide information that will address the research purpose. In qualitative research, it is important to select a sample from which the researcher can learn the most concerning the case being studied (Merriam, 1988, 1998, 2009).

The criteria used for this study was to invite preservice teachers who scored above the average MTEBI score on the final administration of the MTEBI and those who scored below the average score. The preservice teachers whose MTEBI score was above the average MTEBI score were identified as possessing a high level of teaching efficacy. Similarly, the preservice teachers whose MTEBI score was below the mean MTEBI score were designated as having a low level of teaching efficacy beliefs. Utilizing these criteria, seven preservice teachers agreed to participate further in this research. Four of these future teachers had high levels of mathematics teaching efficacy beliefs and three had low levels based on their total MTEBI scores after the student teaching experience. Of the four preservice teachers who scored above

the mean on the final MTEBI and selected for further participation in this research, one was European American, two were African Americans, and one was Hispanic American. Of the remaining three preservice teachers selected to participate further in this study, two were European Americans and one was African American. At this point in the research, the participants had graduated from the teacher preparation program and were preparing to start their first year as teachers.

Data Collection

The data collected for this study is qualitative and quantitative. Surveys, semi-structured interviews, and documents (e.g. biographical data sheets and autobiographical mathematics history) were the sources for data. It is rather common in case study methodology and qualitative research to have several data collection techniques to provide a detailed account of the phenomenon being studied from various aspects (Merriam, 1988, 1988, 2009). This multiple sourcing adds to the richness and completeness of the data in the study. Furthermore, case studies do "not claim any particular methods for data collection or data analysis. Any and all methods of gathering data, from testing to interviewing can be used in a case study (Merriam, 2009, p. 42). What is being studied will influence the types of techniques employed to collect the data. As in all forms of qualitative research, the emphasis is on "the search for meaning and understanding, the researcher as the primary instrument of data collection and analysis, an inductive investigative strategy, and the end product being richly descriptive" (Merriam, 2009, p. 39). Each of the data collection methods is discussed in the following subsections.

Surveys. The MTEBI (Enochs et al., 2000) was given to all preservice teachers during their final year of teacher preparation. The survey was administered before the beginning of the student teaching experience, middle of the experience, and after the completion of the

experience. The results from the MTEBI were used to support findings from the qualitative data gathered during this study (cf. Merriam, 1988).

As mentioned in chapter two, the MTEBI was designed based on the Science Teaching Efficacy Belief Instrument (Enochs & Riggs, 1990). Both instruments were based on the Teacher Efficacy Scale (Gibson & Dembo, 1984). The MTEBI has a total of 21items. It is divided into two subscales, the Personal Teaching Mathematics Efficacy (PTME) which is 13 items and the Mathematics Teaching Outcome Efficacy (MTOE) which has 8 items.

All items on the MTEBI are accompanied by a 5-point Likert Scale ranging from strongly disagree to strongly agree. The highest possible total score on the MTEBI is 105. Scores on the PTME subscale can range from 13 to 65, and 8 to 40 on the MTOE. The reliability of the MTEBI has an alpha coefficient of 0.88 for the PTME and 0.75 for the MTOE (n = 324). Based on confirmatory factor analysis, the two subscales are independent (Enochs et al., 2000). See Appendix C for a copy of the MTEBI used in this study.

Interviews. The interviews were conversations with the participants in an attempt to gather their "thoughts, opinions, perspectives, or descriptions" (de Marrais & Lapan, 2004, p. 54) of how they felt about teaching mathematics and to gleam information about their student teaching experience. There are various types of interviews that can be conducted such as highly structured, semi-structured, and unstructured (Merriam, 2009).

In highly structured interviews, the questions and order of the questions are planned in advance of the interview. By comparison in an unstructured interview, the questions are open-ended, the order is more flexible, and the interview is more of a conversation. A semi-structured interview is somewhat in the middle of the two. In a semi-structured interview, the questions are somewhat outlined, yet there is some of the freedom to have a conversation as indicated in the

unstructured interview. This approach allows for some follow up or probing during the interview. In this current study, I used semi-structured interviews.

Each interview was conducted, in person, in a public but somewhat quiet, private location, using the interview protocol found in Appendix F. The interviews were approximately one hour in length; they were audio recorded and transcribed. I conducted the interviews shortly after the participant had graduated from the university and completed all of both student teaching experiences.

Biographical data information. The participants selected for the interviews completed a biographical data information sheet. The purpose of the biographical data sheet was to gather some general background information about the participants such as age, race, and education (see Appendix E).

Autobiographical mathematics history. The participants selected for the interview provided a history of their educational experience in learning mathematics from grade school to the present (see Appendix G). This document included the opinions, feelings, and thoughts of the former preservice teachers as they experienced learning mathematics. This document, along with the biographical data information, "do not explore the depth of meaning that interviews do, but can complete the picture" (de Marris & Lapan, 2004, p. 242) that developed of each participant as she journeyed from student to a new elementary teacher.

Data Analysis

Before the analysis of any data, each participant was assigned a random number using an electronic random number generator found on a graphing calculator. The random numbers were used instead of the participants' names to protect the participants and as a means of unbiased treatment in analyzing the data. The assigned random numbers were used for individual MTEBI

scores, interviews, biographical data sheets, and autobiographical mathematics histories. The randomly assigned numbers, the participants' names, and the actual data were stored separately to prevent the identification of the participants. As an additional step to protect the participants from identification, pseudonyms were used to reference the seven participants who were involved in the qualitative portion of this study. In the next two sections, a presentation of how the quantitative data and qualitative data were analyzed is presented.

Quantitative data. Each participant completed the MTEBI on three separate time intervals during her or his student teaching experience. Therefore, in analyzing the results of the MTEBI, a quantitative analysis known as a repeated measures analysis of variance (ANOVA) (Green & Salkind, 2011) was most appropriate. A repeated measures ANOVA is very similar to a dependent *t*-test (Bluman, 2008) that is used to determine whether or not a difference occurs between information gathered at two points in time. A dependent samples *t*-test is used because the samples are related (Bluman, 2008). In this study, each score of the MTEBI at the beginning of the student teaching experience can be matched or paired with each score after the student teaching experience. In each administration of the MTEBI, the same participants are used. Therefore, a participant will have several MTEBI scores. Hence the samples are dependent. Simply stated, a repeated measures ANOVA is extending the *t*-test procedure to more than two measures (Green & Salkind, 2011).

The repeated measures ANOVA was conducted on all of the MTEBI scores to determine if a significant change in beliefs has occurred over the course of the student teaching experience. More specifically, a repeated measures ANOVA was used to seek whether a difference existed between mean MTEBI scores after each administration. After the data from the MTEBI were entered into a spreadsheet, a computerized software known as Statistical Package for the Social

Sciences (SPSS)[22] was used to perform the repeated measures ANOVA. Once the repeated measures ANOVA was completed and a difference was detected, a follow-up analysis was performed in order to detect where the difference or change occurred. In other words, did the change occur from the beginning of the student teaching experience to the middle, from the middle of the experience to the end or from the beginning to the end of the experience?

Qualitative data. Because the data in a qualitative study comes from several sources, the amount of data can be a bit overwhelming (Merriam, 1988, 1998; Stake, 1995; Yin, 2001). Therefore, maintaining and organizing the data was paramount. In addition, analyzing the data in a qualitative study is an iterative process that can be a bit overwhelming and rather taxing to manage. Also, "there are no set procedures or protocols that one follows step by step" (Merriam, 1988, p. 37). To assist with managing and analyzing the wealth of data generated by any type of qualitative research, it is now common to use some kind of computer software to assist with these various tasks (Merriam, 2009). An electronic software program known an NVIVO[23] was used in this research. NVIVO, and similar types of software known as Computer Assisted Qualitative Data Analysis Software (CAQDAS) (Merriam, 2009), is useful in that it allows the researcher to bring together data from different sources and assist in the analytic process.

In qualitative research, the researcher's discernment of the data is "the key instrument for analysis" (Bogdan & Biklen, 2007, p.4). During this process, the researcher "combs" the various pieces of data, seeking out patterns or common themes (Merriam, 1988, 1998, 2009). The researcher is constantly comparing various pieces of data. From this process, the data is coded

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[22] SPSS is a software package designed to perform statistical analysis. It was purchased by IBM in 2009. Currently, it is officially known as IBM SPSS Statistics.

[23] NVIVO is a software package used for working with qualitative data from various sources. For more information, see http://www.qsrinternational.com/what-is-nvivo.

and themes or patterns are identified as the researcher continues to revisit the data. For all types of qualitative research, including case study research, the basic analytical strategy is "inductive and comparative" (Merriam, 2009, p. 197). Ultimately, this process guides the researcher in interpreting meaningful patterns or themes (Miles & Huberman, 1984) that identified in the data.

In this research and all qualitative research, the analysis of the data is a recursive and iterative process whereby the researcher is constantly collecting data, analyzing data, seeking patterns, and repeating the process (Merriam, 2009). This analytic investigation is similar to a "loop" in computer programming. The patterns or themes that are identified from the data are the results of the study (Merriam, 2009). Strauss and Corbin (1998) labeled this procedure as the constant comparative method. This procedure can be used in research where data has been collected from several difference sources (Bogdan & Biklen, 2007).

Validity and Reliability

Before analyzing the data from the MTEBI, each participant was assigned a number that was used in lieu of their name. Each participant's number was then re-assigned a new number. This process ensured that the participants' identity was unknown during the analysis of the MTEBI scores. Additionally, for the participants in the interview portion of this study, pseudonyms were used.

In validating the interview data, member checking was used. In member checking, the preliminary summaries of the interviews and findings were presented to the participants to ensure that the appropriate understanding of the participant's information was gleamed correctly. If not, this process provides an opportunity for corrections or further clarifications. In qualitative studies, generalizations of the results and information are not possible (Merriam, 2009).

Because the data for this research and in any case study is gathered from several different sources, validity and reliability is strengthened. This process is known as triangulation: "Triangulation is similar to the modus operandi approach used by detectives" (Miles, Huberman, & Saldana, 2014, p. 299), where data is collected from various sources and different analyses are conducted in order to reach the same conclusion. In this study, qualitative and quantitative analyses were performed and several qualitative methods (e.g. interviews and documents) were utilized. All of these efforts were done to provide "repeated verification" (Miles, Huberman, & Saldana, 2014, p. 299) of the results.

Summary

This research was a qualitative study employing a case study methodology in the examination of the effect of the student teaching experience on the mathematics teaching efficacy beliefs of preservice teachers. This study contained both descriptive and interpretive case study characteristics in an effort to produce a "rich, thick description" (Merriam, 1988, p. 11) of the experiences of preservice teachers during the student teaching experience as they encounter the various activities and responsibilities of teaching mathematics. Both qualitative and quantitative analyses were utilized.

All of the preservice teachers involved in a student teaching experience at a small university in the southeastern United States during the 2015–2016 academic year were invited to participate. These participants completed three administrations of the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) (Enochs et al., 2000). The results of the surveys were analyzed using a repeated measures statistical analysis. From this analysis, seven future teachers were invited to participate in the qualitative portion of this study that involved a semi-structured interview and some personal documents (e.g. personal mathematics history and background

biographical information). The computer software NVIVO aided in the management, sorting, and analyzing of the qualitative data. The purpose of several data collection methods and analyses was to aide in the triangulation of the data, strengthening the validity and reliability of the findings.

CHAPTER IV

PRESENTATION OF DATA AND ANALYSIS

"**…**depending on my teachers. It all just depends on them."

–Ana

This study examined what happened to the mathematics teaching efficacy beliefs of preservice teachers during the student teaching experience, which is traditionally an internship experience in elementary classrooms during the final year of teacher preparation for future teachers. There were three sub-questions:

1. During the student teaching experience, what happens to the level of mathematics teaching efficacy beliefs of the preservice teachers?
2. What are the characteristics of preservice teachers with low or high levels of mathematics teaching efficacy beliefs after the student teaching experience?
3. What factors from the student teaching influenced the mathematics teaching efficacy beliefs of preservice teacher?

Data were gathered from the results of three administrations of the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) (Enochs et al., 2000), transcriptions of semi-structured interviews, autobiographical mathematics histories, and personal demographic information. In this study, the analytical techniques used to analyze the data were both qualitative and quantitative methods. This chapter includes both the data presentation and the data analyses, because collecting and analyzing data in a case study methodology (and all qualitative research) occurs concurrently (Merriam, 1988, 1998, 2009).

The chapter is divided into six sections. In the first section, the first research question is answered using quantitative analysis of the total MTEBI scores and the scores for each subscale (i.e., PMTE and MTOE). The next two sections present the qualitative data that were used to

answer research questions two and three. The first of these two sections introduces the four preservice teachers: Adriana, Marisol, Ana, and Maria, who possessed high levels of mathematics teaching efficacy and their experiences. This section is following by a similar section discussing the experiences of preservice teachers Sofia, Christina, and Isabella, who possessed low levels of teaching efficacy. The information from these two sections, along with the results of the MTEBI, are used to address the second research question; presented in the fourth section. The fifth section provides a reaction to the third research question. Finally, the chapter is concluded with a summary of study findings.

Research Sub-Question 1

The first sub-question is *During the student teaching experience, what happens to the level of mathematics teaching efficacy beliefs of the preservice teachers?* A quantitative analysis of the results from the MTEBI (Enochs et al., 2000) was used to address this question. According to Brodgan and Biklen (2007): "[Quantitative data] can have conventional uses in qualitative research. It can suggest trends" (p. 154). Recall, the MTEBI consisted of 21 items using a 5-point Likert scale. Furthermore, the MTEBI had two subscales: personal mathematics teaching efficacy (PMTE) and mathematics teaching outcome expectancy (MTOE). There were 13 items on the PMTE subscale and 8 items on the MTOE subscale. Results from the MTEBI produced a total mathematics teaching efficacy score with a possible range from 5 to 105, the PMTE scores may range from 13 to 65, and the MTOE scores may vary from 8 to 40. The results of the MTEBI, which produced a total mathematics teaching efficacy score, was analyzed followed by an analysis of the PMTE and MTOE scores.

Total MTEBI Scores

For the participants in this study, the total MTEBI scores ranged from 65 to 98 at the beginning of the student teaching experience and 68 to 96 at the end of the student teaching experience. These ranges did not suggest much of a variation in the total MTEBI scores. However, the range was a slight decrease, which suggested less variability in the scores. The total MTEBI scores from each administration are presented in boxplots in Figure 1. Visually, the boxplots illustrated the slight decrease in the range of the total MTEBI scores from the beginning of the student teaching experience to the end. A couple of outliners are indicated in the total MTEBI middle scores. Further examination of the total MTEBI scores was performed.

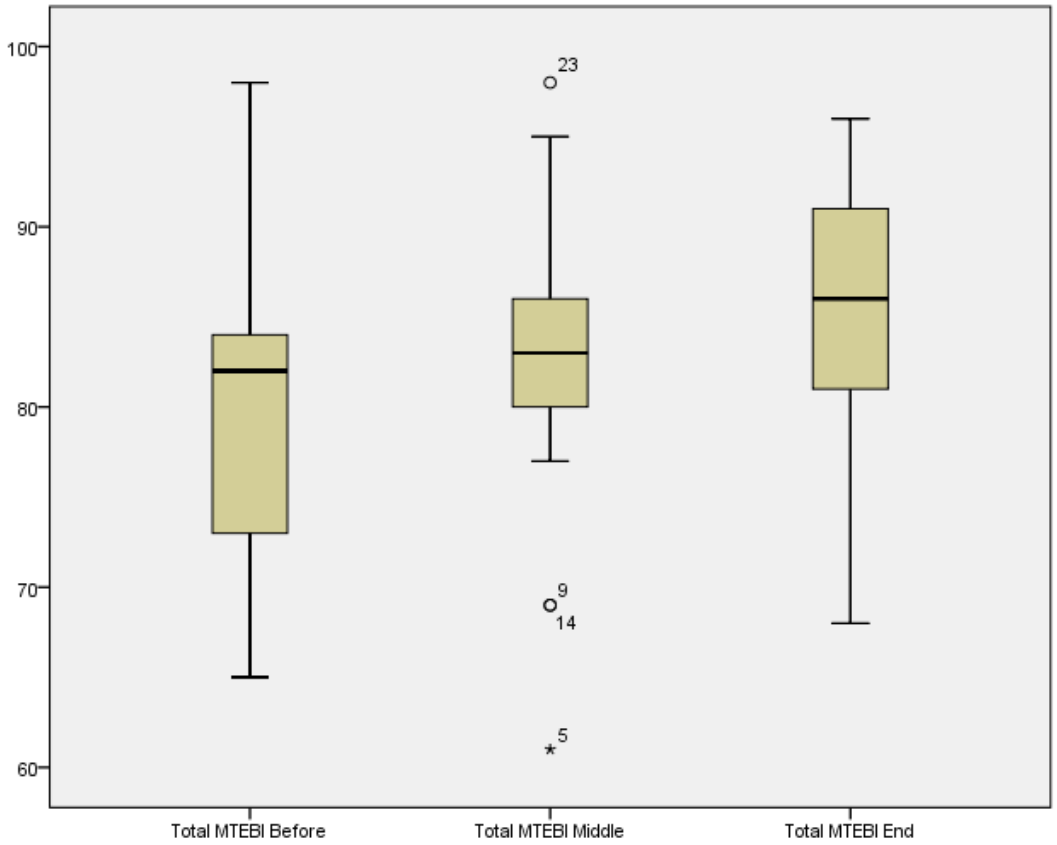

Figure 1.
Boxplot display of all total MTEBI scores.

I conducted several statistical analyses on the total MTEBI scores and the subscale scores. Because the participants in this study completed the MTEBI several times to measure teaching efficacy, I selected a repeated measures analysis of variance (ANOVA) to analyze the total MTEBI scores, PMTE subscale scores and MTOE subscale scores. The ANOVA was used to see whether or not there was a significant difference between the scores over time. In other words, did the mathematics teaching beliefs of the preservice teachers change over the course of the student teaching experience. In addition, I conducted a follow-up analysis of the scores to determine the time interval where the change occurred.

Table 1 is a presentation of the means and standard deviation for the total MTEBI scores. Over time, the mean total MTEBI score increased from 80.16, at the beginning of the student teaching experience, to 82.24, in the middle of the experience, to 85.24, at the end. Additionally, as displayed in Table 1, the standard deviation of the scores decreased, which indicates that the scores became closer together. The scores coming closer together confirm the observation mention above that the scores varied less from each other. To summarize the average of the scores increased and the individual scores came closer together.

Table 1
Mean, Standard Deviation, and Sample Size (n) for the Total Mathematics Teaching Efficacy Scores Beginning, Middle, and End of the Student Teaching Experience

Total MTEBI	**Mean**	**Standard Deviation**	**Sample Size (n)**
Beginning	80.16	9.012	25
Middle	82.24	7.790	25
End	85.24	7.350	25

An ANOVA was conducted with the factor being time in the student teaching experience and the dependent variable being the total MTEBI scores to determine whether the change in the mean total MTEBI scores was significant. The results from the ANOVA indicated a significant

time effect, Wilk's $\Lambda = 0.544$, $F(2, 23) = 9.628$, $p < 0.01$, multivariate $\eta^2 = 0.456$. These results indicated that there was a significant change in the total MTEBI scores during the student teaching experience.

A follow-up analysis was conducted to pinpoint where the change in total MTEBI scores lie. The results are presented in Table 2. The change in the mean total MTEBI scores between beginning of the student teaching experience and the middle was not significant. However, there was a significant change in the mean total MTEBI scores from the beginning of the student teaching experience to the end and from the middle to the end. These results suggest that preservice teachers' mathematics teaching efficacy changed over the course of the entire student teaching experience with the greatest effect occurring during the second half of the student teaching experience.

Table 2
Results from ANOVA with Significance Levels for Total MTEBI Scores

Time (I)	Time (J)	Mean Difference (I - J)	Standard Error	Significant[b]
Beginning	Middle	-2.080	1.28	0.118
	End	-5.080*	1.27	0.001
Middle	Beginning	2.080	1.28	0.118
	End	-3.000*	0.906	0.003
End	Beginning	5.080*	1.27	0.001
	Middle	3.000*	0.906	0.003

* The mean difference is significant at the .05 level.
b Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

PMTE Scores

Furthermore, in order to address thoroughly the first sub-question, I conducted one-way within-subjects ANOVA with the factor being time in the student teaching experience and the dependent variable being the PTME scores. Table 3 is a presentation of the means and standard deviation for the PTME scores. Similar to the total MTEBI scores, the mean PMTE scores

increased from 52 at the beginning of the student teaching experience to 52.76 during the middle and finally to 55.28 at the end. The standard deviations of the PMTE scores were not a constant change. The standard deviations decreased from 5.299 at the beginning of the experience to 4.675 at the middle and then it increased to 5.013 at the end of the student teaching experience. The standard deviation for the PMTE scores at the end of student teaching, however, was less than the standard deviation at the beginning.

Table 3
Mean, Standard Deviation, and Sample Size (n) for the PMTE Subscale Scores Beginning, Middle, and End of the Student Teaching Experience

PMTE Scores	**Mean**	**Standard Deviation**	**Sample Size (n)**
Beginning	52.00	5.299	25
Middle	52.76	4.675	25
End	55.28	5.013	25

An ANOVA was conducted with the factor being time in the student teaching experience and the dependent variable being the PMTE scores to determine whether the change in the PMTE scores was significant. The results for the ANOVA indicated a significant time effect, Wilk's $\Lambda = .567$, $F(2, 23) = 8.779$, $p < .01$, multivariate $\eta^2 = .433$. In other words, the PMTE scores significantly changed during the student teaching experience. Table 4 presents the results of a follow-up analysis of the PMTE scores to determine where the change in PMTE scores occurred. Follow-up polynomial contrasts indicated a significant linear effect with means increasing over time, $F(1, 24) = 12.781$, $p < 0.01$, partial $\eta^2 = 0.347$. There was not a significant change between beginning of the student teaching experience and middle of PMTE scores. However, there was a significant change in PMTE scores from the beginning of the student teaching experience to the end and the middle to the end. These results suggest that preservice

teachers' personal mathematics teaching efficacy (i.e., PMTE) changed over the course of the entire student teaching experience.

Table 4
Results from ANOVA with Significance Levels for PMTE Scores

Time (I)	Time (J)	Mean Difference (I - J)	Standard Error	Significant[b]
Beginning	Middle	-0.760	0.719	0.301
	End	-3.280*	0.917	0.002
Middle	Beginning	0.760	0.719	0.301
	End	-2.520*	0.619	0.000
End	Beginning	3.280*	0.917	0.002
	Middle	2.520*	0.619	0.000

Based on estimated marginal means
*The mean difference is significant at the 0.05 level.
b Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

MTOE scores

Lastly, the researcher performed a one-way within-subject ANOVA to analyze the MTOE with the factor being time in student teaching and the dependent variable being the MTOE scores. Table 5 shows a report of the means and standard deviations for the MTOE scores. Similar to the total MTEBI and PMTE scores, the mean MTOE scores increased from 28.16 at the beginning of student teaching to 29.48 during the middle and finally to 29.96 at the end. In addition, similar to the total MTEBI scores, the standard deviations of the MTOE scores decreased throughout the student teaching experience. At the beginning of student teaching, the standard deviation of the MTOE scores was 5.257, decreased to 4.331 at the middle, and continued to decrease to 3.553 at the end. Similar to the total MTEBI scores, the averages of the MTOE scores increased, but the scores became less variable.

Table 5
Mean, Standard Deviation, and Sample Size (n) for the MTOE Subscale Scores Beginning, Middle, and End of Student Teaching Experience

MTOE Scores	**Mean**	**Standard Deviation**	**Sample Size (n)**
Beginning	28.16	5.257	25
Middle	29.48	4.331	25
End	29.96	3.553	25

An ANOVA was conducted with the factor being time in student teaching and the dependent variable being the MTOE scores to determine whether the change in the MTOE scores was significant. The results for the ANOVA indicated not a significant time effect, Wilk's Λ= .838, $F(2, 23) = 2.231$, $p > .01$, multivariate $\eta^2 = .162$.

Follow-up polynomial contrasts indicated not a significant linear effect with the means increasing over time, $F(1, 24) = 4.607$, $p > 0.01$, partial $\eta^2 = 0.161$. Table 6 is a presentation of this analysis. There was a slight increase in MTOE scores between beginning of student teaching and middle of student teaching MTOE scores and from Middle to End of student teaching. A significant trend due to changes from the beginning of student teaching to the end in terms of MTOE scores. These results suggest that preservice teachers' personal mathematics teaching outcome expectancy (i.e. MTOE) changed slightly over the course of the entire student teaching experience.

Table 6
Results from ANOVA with Significance Levels for MTOE Scores

Time (I)	Time (J)	Mean Difference (I - J)	Standard Error	Significant[b]
Beginning	Middle	-1.320	0.719	0.301
	End	-1.800*	0.917	0.002
Middle	Beginning	1.320	0.719	0.301
	End	-0.480	0.619	0.000
End	Beginning	1.800*	0.917	0.002
	Middle	0.480	0.619	0.000

Based on estimated marginal means
*The mean difference is significant at the 0.05 level.

Preservice teachers with high levels of mathematics teaching efficacy beliefs: The definition for high level of mathematics teaching efficacy beliefs for this study is those preservice teachers with a total MTEBI score greater than the mean total MTEBI score. This resulted in four preservice teachers, Adriana, Marisol, Ana, and Maria, with high levels of efficacy beliefs selected. Each of these preservice teachers began the student teaching experience with high levels of mathematics teaching beliefs. This is rather common among preservice elementary teachers, because they have high levels of expectations in their abilities before having actual teaching experience (Woolfolk Hoy & Burke Spero, 2005). A closer examination of these preservice teachers with high levels of mathematics teaching efficacy beliefs revealed the following analysis.

Both Marisol and Ana levels of mathematics teaching efficacy beliefs increased throughout the entire student teaching experience as indicated by an increase in each of their total MTEBI score. In comparison, Adriana's total MTEBI score rose after the first placement and slightly decreased by the end of student teaching. Yet, her total MTEBI score remained high. Maria's total MTEBI score remained high, but relatively almost the same throughout student teaching. Both Adriana and Maria had total MTEBI scores at the end of student teaching that

were more than one standard deviation above the mean total MTEBI score. Maria's total MTEBI score at the end of student teaching was the highest of all preservice teachers in this study.

Drilling deeper into the MTEBI scores by examining the sub components of the MTEBI scores, PMTE scores and MTOE scores, the data revealed somewhat of a different pattern. The PMTE scores increased, significantly. The MTOE scores had a slight increase. For all four preservice teachers with high levels of mathematics teaching efficacy beliefs, their PMTE scores increased during student teaching. However, the same is not true concerning their MTOE scores. Of the four preservice teachers with high levels of mathematics teaching efficacy beliefs as indicated by their total MTEBI results, Adriana's MTOE scores were the only one that increased during student teaching. Her MTOE scores increased from the beginning of student teaching to the middle and then from the middle to the end of student teaching. She had the highest MTOE score by the end of student teaching of all preservice teachers in this study. For Marisol, Ana and Maria, their MTOE scores remained somewhat the same throughout student teaching. Maria experienced a slight decrease in her MTOE scores during student teaching, while Marisol had a slight increase and then a slight decrease in MTOE by the end of student teaching.

Preservice teachers with low levels of mathematics teaching efficacy beliefs: For this study, the definition of low level of teaching efficacy beliefs is a total MTEBI score less than the mean total MTEBI score at the end of student teaching. This resulted in three preservice teachers, Isabella, Christina, and Sofia, with low levels of mathematics teaching efficacy beliefs selected for further inspection of their math teaching efficacy beliefs. Both Christina and Sofia had a final total MTEBI score more than one standard deviation below the mean. In fact, Sofia's total MTEBI score at the end of student teaching was the lowest of those in this study.

Further investigation of the total MTEBI scores of these preservice teachers revealed that their total MTEBI score fluctuated somewhat during the course of student teaching. Isabella's total MTEBI score declined after her first teaching placement and remained about the same at the end of student teaching. Over the course of student teaching, Isabella's total MTEBI score declined. Christina's total MTEBI score rose a little after her first placement and then decreased slight after her second placement. After her first teaching experience, Sofia's total MTEBI score decreased substantially and then increased. By the end of the student teaching experience, Sofia's total MTEBI score had rebounded to a level barely above the original value at the start of student teaching.

Investigating the sub components of the MTEBI scores, PMTE and MTOE, showed a similar pattern of little or no increase or decrease. Isabella's PMTE scores showed very little change during student teaching. There was a very slight declined in her PMTE score after the first semester of student teaching and then a small increase by the end of the entire student teaching experience. As for Christina, her PMTE scores revealed a very small increase throughout student teaching. Sofia's PMTE followed a pattern similar to Isabella, but the final PMTE at the end of student teaching was less than the score at the beginning of student teaching.

As for the MTOE scores, with the exception of Sofia, the MTOE scores of the preservice teachers with low levels of mathematics teaching efficacy beliefs declined during student teaching. Sofia's MTOE scores rose during student teaching. However, all of Sofia's MTOE scores were very low. Her MTOE scores were consistently the lowest throughout the student teaching experience.

Experiences of Preservice Teachers with High Levels of Efficacy

This section is divided into four sections to highlight the experiences of each preservice teacher with high efficacy beliefs after student teaching; Adriana, Marisol, Ana, and Maria. The basis for their experiences is information gathered from the MTEBI, semi-structured interviews, personal histories, and personal biographical information. In this section and the subsequent section, there is an emphasis on the preservice teachers' experiences as well, as how these experiences made them feel. The emphasis on both is important, because in Bandura's (1997) social cognitive theory concerning efficacy beliefs there is an importance placed on one's experiences, interpretation of these experiences, feelings during the experiences, and interaction with others during the experiences.

Adriana's experiences. Adriana was no different from the other members of her preservice teachers' cohort. Except, she was slightly older than other members of the group were. Yet, she was comfortable about her age compared to her peers. Unlike most of her peers, before attending the small state university during this study, Adriana attended private schools for all of her formal education. Despite the minor differences, Adriana, like her fellow preservice teachers, was able to develop a close and supportive friendship with her peers during the teacher education program at the university.

Similar to many of her peers in the program, the teaching profession, especially teaching elementary students, was not Adriana's first major at the university. The first time the notion of becoming a teacher entered her thoughts was when Adriana was in high school. However, at the university, she first pursued a degree in nursing and dreamt of becoming a nurse. Later, during the early years of her university studies, Adriana recalled going "back and forth between

teaching and a few other careers" (Adriana's interview). Finally, she decided to pursue a degree in elementary education.

In analyzing Adriana's MTEBI scores at the end of student teaching, she displayed a strong belief in her abilities to teach mathematics. Her total MTEBI result was more than one standard deviation above the mean score, her PMTE score was approximately one standard deviation above the mean, and her MTOE score was the highest among all of the preservice teachers in the cohort. Based on these scores, Adriana felt confident she could teach mathematics by the end of the student teaching experience. As she spoke during the interview, she was confident and certain about her beliefs in her abilities. Where did these beliefs come? They could have originated somewhere in her formal education and then were strengthened by experiences from her student teaching experiences.

During her junior and senior year of high school, the same mathematics teacher who she referred to as her favorite teacher, instructed Adriana. This teacher had a significant effect on Adriana's decision to become a teacher. It was during these two years of high school that Adriana realized that mathematics was her favorite subject and she "liked working problems and finding different ways of solving the problems" (Adriana's interview). For Adriana, mathematics was a little bit of a challenge and allowed her to find more than one way to solve a problem.

Adriana recalled taking advance mathematics courses in high school such as geometry, algebra, precalculus and advanced placement calculus (AP Calculus). She remembered that her high school mathematics teacher "allowed students to work on their own and was there to support them. As well, the teacher presented different approaches to solve a problem. She provided her own experiences about learning and a lot of hands-on things" (Adriana's interview) during her classes. Out of her enjoyment for mathematics and the success with the subject,

Adriana began to tutor students and "felt enjoyment from tutoring people" (Adriana's interview). Adriana developed some fond memories of learning mathematics from her high school experience.

One of Adriana's most memorable learning experience about mathematics occurred when her favorite teacher was on maternity leave. The teacher resorted to teach the class remotely from home via various technologies. Adriana recalled being amazed how the teacher used the technology to instruct the class. Furthermore, the class members worked together as a group to figure things out and support each other. Adriana was impressed how the teacher remotely taught the class and the students support each other's learning. Without the teacher being physically in the room, the classroom environment was motivating and engaging to Adriana. This experience made a memorable impression on her. One in which Adriana recalled with enamored gratitude and admiration.

As she worked toward becoming a teacher, there were some challenges Adriana faced. Some of these challenges occurred during Adriana's student teaching experience. For example, during the first half of her student teaching experience, Adriana's assignment was a fourth grade class at a local elementary school in a nearby county, which was a short commute from the university. As Adriana reflected on this experience, she emphatically stated it was not the best situation for several reasons. First, early during her student teaching experience, Adriana felt her cooperating teacher did not like her. It appeared to Adriana the teacher did not want to spend time with her during free time in order to develop a supportive, collegial relationship. Adriana sought a relationship of mentorship and encouragement. Instead, the cooperating teacher spent her free time with professional colleagues, the other fourth grade teachers at the school. Adriana

felt little time was devoted to nurturing her, a future teacher. Sadly, this poor relationship between Adriana and her cooperating teacher may have begun well before the two met.

According to Adriana, the cooperating teacher was not given a choice whether or not to have a student teacher. It was a decision made by school leadership. Regardless of what caused the poor relationship between Adriana and her cooperating teacher, the experience had a negative effect on Adriana's psyche. She recalled feeling "outcast and not welcome" (Adriana's interview). Therefore, she withdrew into herself and did not try to get the cooperating teacher to like her, because the teacher "did not appear to care" (Adriana's interview). To add to this new, strained relationship, Adriana said she felt rushed by her cooperating teacher to complete her required teaching assessment, also known as the Teacher Performance Assessment (edTPA)[24].

The cooperating teacher instructed Adriana to complete the edTPA requirements at the beginning of the student teaching experience. In Adriana's words, she was told, "let's go ahead and get that out of the way" (Adriana's interview). To stress the relationship further, Adriana noted that after the edTPA task was completed, she spent most of her time observing and assisting her cooperating teacher and the students for the remainder of her placement in this fourth grade classroom. Adriana felt that she did not get "any real experience" during this placement (Adriana's interview) due to a lack of support and encouragement from the cooperating teacher and limited teaching opportunities.

In addition, Adriana felt that this experience was not the best, because the assignment was with one teacher in a cross-curriculum collaborative team with a few other fourth grade teachers. In this environment, one teacher is usually responsible for teaching one or two of the

[24] edTPA is a performance-based, subject-specific assessment used by many teacher preparation programs to measure the skills of preservice teachers. For more information, see http://edtpa.aacte.org/faq#51

content areas. Her cooperating teacher's assignment was to teach mathematics and writing. Although, mathematics is Adriana's favorite subject, she felt that her student teaching experience was disadvantaged in that she was not in a situation where she could teach all of the subjects like most traditional elementary educators. Adriana assumed the other preservice teachers in her cohort were having this experience. Therefore, Adriana felt she was not getting the full experience of being an elementary school teacher. In spite of a rather disappointing first experience, things changed drastically for Adriana during the next half of her student teaching experience.

When she talked about the second half of her student teaching experience, Adriana entire demeanor changed. She smiled and her whole disposition brightened. The melancholy sadness, which Adriana displayed while talking about her first semester experiences, disappeared. During this portion of her student teaching experience, Adriana's assignment was a special education (SPED) placement where the emphasis was, once again, on mathematics and it included reading. Once again, Adriana felt that she did not get the experience of teaching all of the subjects in an elementary school curriculum. This placement involved students in kindergarten through third grade. During this experience, Adriana and her cooperating teacher would go into another teacher's classroom and either co-teach or remove small groups of students and work with them. Adriana noted this experience was very different from what she experienced during her first placement.

First, Adriana said she really enjoyed working with this cooperating teacher. In Adriana's words, "this teacher was nice and very supportive. She tried to tell me everything she knew and tried to get me to have as much experience as I could. She let me have the freedom to work with students as much as I could. She was very helpful with giving advice and telling me I could do

this better" (Adriana's interview). In comparison, Adriana commented the cooperating teaching during the first part of student teaching "just didn't seem willing to help or help me learn or get any real experience" (Adriana's interview). The second student teaching experience had a positive impact on Adriana. It was from this experience Adriana concluded that she would like to be a SPED teacher.

As she reflected on teaching mathematics during her entire student teaching experience, Adriana commented on a few difficult moments. During the first part of student teaching, Adriana noted that she had to adjust to the Common Core[25] strategies of presenting some of the mathematical content. She recalled having to review a lot and sometimes learn from her cooperating teacher as she observed her teaching. She discussed the challenges of teaching a lesson on place value and getting the students to understand how important it was to use the number zero appropriately. After she concluded a lesson about place value, Adriana noted, she had to go back and lead the students in a re-teaching of this lesson. The reason for re-teaching the lesson was the difficulty the students had in understanding the material. Eventually, Adriana said most of the students understood place value. This experience made a very important impression on Adriana. She was surprised the students had such difficulty with the concepts in the lesson. During the interview, Adriana was able to laugh about some of the misunderstandings the students had.

Another challenging situation for Adriana occurred during the last part of her student teaching experience. While observing the cooperating teacher instructing the class on how to solve some type of word problem, Adriana noticed both she and the students were confused,

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[25] Common Core is a set of standards for teaching in grades kindergarten to 12th grade in the areas of English Language Arts/Literacy and mathematics. For more information see www.corestandards.org

because the teacher omitted writing some steps on the board for the class. According to Adriana, the students were puzzled and simply resorted to mimicking on their papers what the teacher wrote on the board. They did not understand what the teacher was teaching. Furthermore, the students were not engaged in the lesson. Adriana said she did not know what to do. Finally, the teacher realized that the students were having difficulty and adjusted the lesson.

Yet, in spite of this last challenge, Adriana reiterated she really liked working with the students and teacher during the last half of her placement. She noted many of the students in this field placement were weak concerning basic multiplication facts. In order to assist the students with their learning of multiplication facts, Adriana created flash cards and taught strategies to help the students to recall these facts. Adriana and her cooperating teacher used a variety of manipulatives to help the students learn or re-learn concepts that they had forgotten. Although the class used manipulatives a lot, Adriana and her cooperating teachers would supplement the use of manipulatives with the drawing of pictures. They used pictures or drawings to get the students to demonstrate their understanding of the concepts from a lesson. Adriana said it was so important during this student teaching experience to get the students to recall multiplication facts and perform their mathematics proficiently, because there was a big emphasis on preparing the students for the upcoming milestones test[26]. Adriana commented, "there was a lot of mathematical review to prepare the students for the upcoming milestones" (Adriana's interview).

Reflecting on her teaching of mathematics experiences, Adriana restated on some of the challenges she faced. As previously mentioned, she had difficulty teaching a lesson on place value during her first semester of student teaching. Therefore, she had to reteach the lesson. Now

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[26] The Georgia Milestones Assessment, commonly known as milestones testing, is a comprehensive summative assessment program ranging from third grade to twelfth grade in various content areas such as mathematics, science social studies and English language arts. For additional information see www.gadoe.org

with laughter, Adriana fondly reflected on this challenge. In addition, during this same semester, Adriana recalled she tried to emulate the teaching style and classroom management of her cooperating teacher. This style involved using the textbook often in teaching the students. Adriana said, "I tried to stay with her strategy of using the book and stuff presented in the book" (Adriana's interview). Adriana soon realized this teaching approach did not work for her, because "the book had so much stuff in it and the students weren't engaged. I should have done my own lessons to go along with the book" (Adriana' interview). Therefore, Adriana slowly adapted a teaching style she felt more comfortable.

Although there were challenges during her second semester of student teaching, Adriana seemed to have enjoyed this experience far more than the previous semester. In spite of the fact, the students needed assistance that is more individual and they challenged Adriana's skills in conveying mathematical concepts to them, Adriana said she really enjoyed working with these students. There was a lot of using manipulatives and hands on activities to assist student learning. Adriana and her cooperative teacher had to be very creative. However, after all of her efforts during student teaching, Adriana felt the students were learning from her. She felt proud.

Marisol's experiences: Similar to Adriana, Marisol was slightly older than the traditional age students were in her cohort of preservice teachers and she too did not decide to become a teacher until after pursuing studies in an area other than education. In addition, Marisol's total MTEBI was higher than the mean, but not has high as Adriana. Both of her PMTE and MTOE scores were higher than the mean. Originally, Marisol received training in fashion, photography and Spanish before she considered pursuing a career in education.

Marisol recalled when she was very young she noticed she was good at mathematics. In fact, Marisol's mathematics skills were ahead of her classmates when she was in elementary

school. Marisol explained therefore she was on the school math team, which competed in state competitions during her last two years of elementary school. Marisol's love for mathematics continued throughout middle and high school. During her senior year of high school, Marisol enrolled in high school and college courses, because she had completed all of the mathematics courses her high school offered.

Marisol credited her early success and love with mathematics to her parents. She said her parents really showed her how fun and important math was to them. They passed their joy of mathematics to her by encouraging and cultivating a love for the subject in her. Furthermore, she had teachers who motivated and challenged her love for mathematics as she progressed through elementary, middle and high schools. Surprisingly, Marisol shared her favorite subject in high school was not mathematics. Instead, it was psychology. Although during her student teaching experience, mathematics was Marisol's favorite subject to teach.

What brought Marisol to teaching was an experience from a part-time job at a daycare where she taught Spanish to the children and an early love of mathematics. To finance her college studies in fashion and photography, Marisol took a job teaching at a daycare center. The joy she received from this teaching experience led Marisol to decide teaching is what she really wanted to do. Therefore, Marisol applied for admission at the state university with the intent to pursue a degree in early childhood education. Marisol completed a year of prerequisite coursework before her admission to the teacher preparation program.

When explaining her love and success with mathematics, Marisol said she has "always been really good at it. I pick it up faster and I remember the concepts better than other subjects and it's easier for me to explain" (Marisol's interview). In second grade, Marisol loved the multiplication drills where students competed against each other to see who was the fastest.

During this grade, Marisol met her favorite teacher. Because of this teacher, Marisol wanted to go to school every day. According to Marisol, this teacher "made school fun. She rather made the classroom like a game room. Everything we did was based around games, competitions and we would have a leader board posted in the classroom. And that was the first year we started with multiplication and that was my strong suit" (Marisol's interview). Marisol was very excited as she reflected on the memories of the games and activities she participated in during second grade. Marisol expressed rather fond memories and admiration for this teacher.

As Marisol matured and went off to college, she was able to reconnect with her favorite teacher. Marisol said this teacher "kind of treated us like we were her actual kids. So, I really, really, really liked her" (Marisol's interview). According to Marisol, this teacher made her love to go to school. In her class, all of the students were well mannered, not because the teacher was mean and extremely strict, but because she respected her students and their parents.

During the first semester of student teaching, Marisol's placement was in a kindergarten classroom. Marisol commented how she felt like the teacher, because this was the first time she had the opportunity to teach, fully. She designed the lessons, the activities, and taught the entire thing. Marisol said she loved it. Based on Marisol's account, her teaching demonstrated a high level of organization and preparedness. She knew what was going on, because she had the schedule and the lesson plans for the day. She was in charge. Because the students were kindergarteners, everything was new and exciting to them. The school rules of conduct and being in a learning environment added to the children's excitement and willingness to please the teacher. Marisol talked about how much fun it was to work with these excited children.

However, in spite of the fun and joy, this first semester of student teaching was a stressful time for Marisol because she had to complete the requirements for edTPA. Furthermore, this was

the first time Marisol had to deal with problems most teachers face each school year. Marisol confronted student absenteeism, students moving away, and new students arriving. Although there were 29 students enrolled in the class, there were times when students would be absent for two weeks. In addition, it seemed like new students were arriving every day. Marisol witnessed firsthand the juggling act teachers perform each day as they try to be a stable and supportive presence in the lives of young children.

Marisol's second semester of student teaching was a special education placement where she taught math to third, fourth and fifth graders. However, this experience became more of a co-teaching situation. According to Marisol, there was supposed to be a general teacher, a special education teacher, and her, the student teacher in the classroom. However, the general teacher was absent from school often. Therefore, Marisol would teach the whole class lesson which the general teacher planned. Marisol welcomed the challenge of this second experience.

Her face 'lit up' with excitement as she described the enjoyment she received from this experience. She took some time to describe the various mathematics lessons she taught either in small group settings or with the entire class. Marisol discussed the different activities she used in her lessons and the challenges she faced as the teachers prepared the students for the milestones test. To her, Marisol felt that the lessons during this placement focused too much on workbook practice and materials from the textbook.

During this teaching experience, Marisol had to interact more with the parents of her students. This was stressful for her and caused some doubt about her career choice. She started to question whether she would want to teach special education. Marisol explained there was so much paperwork and too many rules about what to do and what not to do. She felt, "the kind of

freedom of teaching is not really there like it was in kindergarten even though I had so many students; it felt like a bigger responsibility" (Marisol's interview).

Since math was her favorite subject and she felt comfortable with the content, Marisol stated she was excited and at ease while teaching math. In her words, "I feel like I can, I'm a better teacher the more comfortable I am with the material and so just the fact that I was so, I am, so comfortable with math concepts, especially in elementary. If someone tell me I might have to go teach this class in 30 minutes, they're doing this. I can do it, because I know what is going on in elementary math" (Marisol's interview). However, Marisol did mention there was one concept she had difficulty in teaching.

Marisol found trying to teach a group of students during her special education placement how to tell the current or elapsed time from an analog clock was a huge challenge for her. According to Marisol, the students were on various reading levels. Many of the students had never seen an analog clock. They were accustomed to a digit clock. Therefore, if the students were familiar with telling time, they read the numbers off the clock screen. As a result, Marisol had to present an analog clock to the students and teach them how to use it to determine time. She commented on how difficult these tasks were. In addition, the students had difficulty with concepts such as quarter and half past the hour. Marisol commented the ability of telling time and elapsed time were important skills for the standardized tests the students will have to take. Therefore, there was some pressure on her to get her students to maser this skill.

When asked about her favorite subject to teach during student teaching, as expected, Marisol said mathematics, but, surprisingly, she included English. However, she clarified by saying that she liked teaching the writing component of English. To clarify further, Marisol made the point about how teaching the two subjects brings about completely different rewards. With

writing, the reward is gradual and slow. With mathematics, it is like a surprise. In Marisol's words,

> "with math there are so many lightbulb moments. English is a gradual, slowly learn how to write complete sentences, and slowly learn how to write paragraphs. But math is like you can see it [she snaps her fingers for emphasis] when it happens, when they get that concept. You just like yes! Finally! [Marisol laughed with excitement]" (Marisol's interview).

More evidence of her love to teach mathematics, Marisol noted most of the lessons she taught during the both semesters of student teaching involved mathematics. When asked about a rationale for her choice to focus so much on mathematics in student teaching, Marisol responded, "that's where I was connecting with the students. That's where I wanted to show off!" (Marisol's interview) She ended her statement with laughter. As Marisol reflected on her student teaching experience, it is rather hard for her to contain her exuberance. At certain points in her reflection, Marisol voice got louder. She laughed a lot as she enjoyed her stories. The once quiet room where the interview occurred echoed with her voice and laughter. One point during the interview, a security personnel came by the room and asked us to lower our voices and laughter.

When asked about her cooperating teachers during her student teaching experience, Marisol quickly responded. She said it is weird to explain her first cooperating teacher, because the teacher "was reluctant to kind of give me that control [of the classroom] but at the same time wanted me to take it all" (Marisol's interview). There were times when Marisol was not sure whether to step in and help or not. She was rather unsure of her role as the student teacher in the classroom and the expectations of the cooperating teacher for her. Marisol stated this teacher had been a teacher for a long time and had a rather ridged belief about student behavior. In Marisol's view, she was very strict with the children. However, Marisol was more forgiving and allowed the students to wiggle in their seats or talk during class. There were times when Marisol and the

cooperating teacher disagreed about what the students could or could not do. Marisol recounted an incident where she allowed a student to do a particular activity and the cooperating teacher contradicted her judgment. Therefore, the students were confused about who was really in control of the classroom. Therefore, there was a bit of a strained dynamics between Marisol and the cooperating teacher during this first placement. However, Marisol did not want to upset this teacher.

During her second placement, Marisol's assignment was a special education placement, where she worked with a general teacher and a special education teacher. Marisol was not quite sure which teacher she should report. Therefore, she had to get this cleared up early during this placement. However, Marisol commented that both cooperating teachers were nice and taught her a lot. The teachers prepared, provided support, and encouragement to Marisol to do well. Marisol said these cooperating teachers wanted her to be a good teacher. One of these cooperating teachers noted to Marisol that she graduated from the same teacher preparation program as Marisol's current enrollment. Therefore, this cooperating teacher provided guidance and support in the classroom and she was eager to support her through the requirements at the university. These cooperating teachers welcomed Marisol and went out of their way to support Marisol on her journey to become a good teacher.

Marisol commented that the teachers from her two student teaching placements were so different. The cooperating teachers from the second placement made her feel like a colleague, a fellow teacher. They would ask her about her weekends and share stories about their lives with her. The teacher from the first experience was far less engaging. Marisol felt uncomfortable around her. Marisol felt forced upon this cooperating teacher. Marisol explained that the principal made student teaching assignments and this teacher, regardless of her input, had a

student teacher, Marisol. The feeling Marisol felt was somewhat similar to Adriana's feelings, but were not as extreme.

Throughout her entire student teaching experience, Marisol felt that she was prepared to teach the mathematics. She commented that if the content or the task was difficult, "I kind of researched first to see what works best with students learning in different ways and I would have, made sure I had everything in a row before I got there to kind of plan it out". (Marisol's interview). For Marisol, it was important to plan and be prepared each day and this led to success in the classroom. She commented that her biggest challenge during student teaching was planning and being prepared for any kind of questions the student may have. During both of her placements, Marisol confidently said she was prepared and comfortable with teaching mathematics.

Without any doubt or hesitation, Marisol felt that her students learned from her mathematics lessons. She tried to make sure her students were engaged in their learning. After every lesson, Marisol gave the students an assessment to determine what they learned. Furthermore, Marisol liked to include writing activities after each lesson, which allowed the students an opportunity to write down what they learned. It was an opportunity for the students to reflect on the day and for her to evaluate what learning had occurred. This inclusion of writing goes back to Marisol's love of teaching writing. During the student teaching experience with the kindergarteners, Marisol used a lot of songs, dance, and games. With the older students, she had many hands on activities and games such as using the game Battleship as a means to introduce the coordinate plane. With the special education placement, Marisol and fellow cooperating teachers conducted weekly progress reports. From these reports, Marisol said that she could see that the students were learning.

After completing student teaching, Marisol said she has no concerns about teaching any mathematical concept. She stated her concerns are more about relating to the students. She has secured a job for the near future where she will be teaching in an environment that is far different from what she is accustomed. She has accepted this challenge in order to apply her life skills and previous trainings. She is excited and looks forward to the challenge. She loved her student teaching experiences and reflected upon it with great joy and delight.

Ana's experiences. Unlike Adriana and Marisol, Ana is more of a traditional age university student. English was not Ana's first language. Although her total MTEBI score was higher than the mean, Ana's PMTE score was slightly less than the mean and her MTOE was one standard deviation higher than the mean. Yet, the most striking difference between Ana and the previously mentioned preservice teachers was the fact that Ana was not a fan of mathematics in elementary and middle schools. She was somewhat drawn to the subject during the latter part of middle school and in high school.

For the most part, Ana remembered having to struggle with mathematics early in her education. There was a brief time in elementary school when Ana liked division. During middle school, there were several instances when Ana had to receive tutoring in mathematics. In high school, she survived mathematics due to the assistance of her friends. It was not her 'game' as Marisol passionately refers to mathematics. During middle school, there were several times when Ana had to receive tutoring in mathematics. Occasionally, there were a few brief moments in high school when Ana liked math. During these brief moments, Ana recalled her mathematics teachers were very engaging in their teaching.

One of these moments occurred during a summer program where Ana received extra assistance with her studies in math. Another moment happened during high school when Ana

outperformed the class on a mathematical concept. During the instruction of this concept, Ana's high school teacher would use real world situations and walk around the classroom to assist students. Ana recalled the teacher of the summer program and the previously mentioned high school teacher were the reasons why she briefly liked mathematics. However, for the most part, Ana recalled she first started liking math while taking mathematics courses at the university. She attributed this change in her attitude toward mathematics was because she had good mathematics instructors at the university.

Initially during her interview, Ana was adamant she never had a favorite subject. She commented, "I changed my mind every year depending on my teachers. It all just depends on them" (Ana's interview). However, she stressed the fact she did not like science in high school. Ana took the necessary mathematics courses in the high school college prep curriculum. Yet, Ana's coursework in mathematics was not as advanced as Adriana's and Marisol's. Surprisingly, at the end of Ana's interview, she stated mathematics was her favorite subject to teach during student teaching.

Somewhere during the course of her college education and student teaching, Ana came to the realization she liked mathematics and enjoyed teaching the subject. She said, "I think I like math more than anything else, because I could find different ways to approach one thing" (Ana's interview). She mentioned there are various manipulatives and hands-on things she could use to get students to understand a mathematical concept. Although Ana was rather reluctant to admit her love for mathematics, she was rather quick to express her distain for teaching English language arts during student teaching.

Despite the difficulties, Ana had early in her formal education, she knew she wanted to be a teacher at an early age. As a child, she would practice being a teacher with her younger

cousins and friends. Ana said this was due to the fact she was one of the first members of her family and friends to learn English. Therefore, she would assist others with learning the language. She commented she wanted to be a teacher because she always had bad ones, except for the teacher she had in fourth grade.

Of all of her previous teachers, the fourth grade teacher was one of the few teachers Ana had some positive things to say. Ana recalled this teacher was patient, held high standards, strict, but nice. It was this teacher Ana credits for pushing her to make great advances in learning English. While being a student in her class, Ana commented she was able to move up three reading levels to catch up with the other students in the class.

As previously mentioned, Ana had a dislike for science. She stated that as a young child she received very little science education. For Ana, science education involved sitting at your desk and completing a bunch of worksheets. There were never fun activities in science class. Surprisingly, Ana's view of science changed to a positive one. She admitted she liked teaching science during student teaching, because of the experiments. She admitted she would look forward to teaching science in the future. She had developed several science activities to use with her future students.

During student teaching, Ana's first placement was in a kindergarten classroom. This experience had a profound effect on Ana. Because of this experience, Ana sought either a kindergarten or first grade teaching position as her first job after graduation. Eventually, Ana selected a job as a first grade teacher, because she felt being a new teacher and the students being new to the school environment were too many new things to balance during her first year of teaching. However, she admitted she has not given up on teaching kindergarten, because of the wonderful experience she had during student teaching. Also during this placement, Ana

discovered she enjoyed teaching math “because of the manipulatives” (Ana’s interview). Also, she “loved how they [students] would get excited about everything specifically the math, because they got to count, they got to play with things, and just learning” (Ana’s interview). It was very motivating to Ana to have an experience where the students were so excited about learning.

As Ana reflected on her student teaching experiences, she felt that it was successful and she learned a lot. Like most student teachers, Ana commented she was scared at the beginning. Her biggest fear was she lacked the classroom management skills and would not have the respect of the students. Ana’s cooperating teaching during the kindergarten placement was instrumental in dispelling this notion of Ana. She modeled for Ana how a teacher could be nice and demand the respect of the students. The teacher knew when to be firm and strict with the students and when to be a bit easygoing and nice. Ana stated how much she admired this cooperating teacher by saying she “wants to be like her” (Ana’s interview) when she becomes a teacher.

The last portion of Ana’s student teaching assignment was in a special education placement. Although Ana felt she had a good experience during this part of student teaching, it was not as enjoyable as the first placement. Ana stated there was so many problems with student behavior during this placement. In Ana’s words, “I did learn a lot but it was difficult” (Ana’s interview). Ana’s lackluster feeling toward this experience may relate back to Ana’s initial fear about managing student behaviors during student teaching.

When asked about her abilities to manage the disruptive behavior of some students, Ana noted she was able to control the behavioral problems “because I always listened to them [the students], always motivated them, praised them a lot, and they started respecting me. When a student didn’t listen, I would send them to the back and then talk to them and explained why I sent them to the back.” (Ana’s interview). Ana commented this approach usually worked and the

disruptive student would usually apologize to her. Ana noted when a student was misbehaving in class, especially during a math lesson; it was because the student was having difficulty with the content of the lesson taught.

One of Ana's proudest moment during student teaching occurred during her kindergarten placement. Ana was responsible for designing and instructing an entire mathematics lesson to the class. This lesson would be the first math lesson that Ana will teach during her placement. Ana admitted she was nervous and concerned about the appropriateness of the lesson for the class. For this lesson, Ana created what she called The Shapes Game. The lesson involved pre-assessment, songs, dancing, and hands on activities to assist the students in learning various shapes and terminology. Ana was so proud of this lesson that she brought a copy of the game to her interview to demonstrate. Ana considered this lesson to be the best math lesson she taught throughout her student teaching experience. She is planning to use this lesson and activities in her future teaching.

More importantly, Ana was impressed with the class performance on the concepts and ideas that she was trying to convey from the lesson on shapes. She said on the summative evaluation at the end of the lesson, the class did very well. Every member of the class improved in performance from the pre-assessment to the final assessment except for one student. In an attempt to meet the needs of all students, Ana commented she has been reflecting on how to improve the lesson.

When asked about her content knowledge to teach mathematics, Ana responded, with a lot of confidence, that all of her education, both content and pedagogy, has prepared her to perform quite well in the classroom. Without a doubt, Ana felt she could teach mathematics. She noted, "you always have to get to know students and see if you know this student likes to sing,

this student likes hands-on activities, try to implement all their interest into one lesson. I think that is what I did" (Ana's interview) with the lesson on shapes. For Ana, it was very important that students be engaged in the lesson taught. For math lessons, Ana felt it was important to use manipulatives and activities to motivate learning. It was at this point, with a surprisingly big smile, Ana admitted she liked teaching math during student teaching more than any other subject. The reason was "because of the manipulatives and all the ideas you can make" (Ana's interview).

Often, Ana mentioned the use of manipulatives during her interview. To her, manipulatives were very important in the teaching of mathematics. She felt that children were able to recall things and develop understanding if they had some kind of hands-on, tactile thing to manipulate as they developed understanding. During student teaching, Ana commented her cooperating teachers used manipulates very often during their math lessons. Students were encouraged to use manipulatives to solve problems. This made a very positive impression on Ana. She felt manipulatives and hands-on activities assisted students to become independent learners. Ana felt it was very important to encourage kindergarteners to be more independent, because they need to be "in the habit of doing things on their own. I'm going to be teaching first grade so they have to be more independent" (Ana's interview). With a look of uncertainty upon her face, Ana did not recall using manipulatives as a child when she was learning mathematics. Most of her memories of her childhood education was about learning English, because of its importance and immediate need during her formal education.

However, as previously mentioned, Ana did recall being good at division and determining time as a child. Furthermore, Ana remembered her classmates had difficulty with both concepts. Smiling, Ana fondly recalled her teacher bragging about her performance on tests

involving division or time. She made the highest grade in the class. Her teacher would use praise to encourage and motivate Ana. Therefore, Ana has incorporated this notion in her philosophy of teaching. Ana stated, "I feel like students will enjoy doing things when they think they are good at it. So, I want to praise them a lot, even though, they are not doing good" (Ana's interview), but are working hard and improving.

Finally, Ana stated she really enjoyed her student teaching experience, because she learned a lot. She commented she learn a lot from her college professors who prepared her to be successful during student teaching and for the upcoming school year when she will be the teacher. However, Ana noted, regardless how much your college professors teach you, it is different when you are in the actual classroom. The professors might "teach you in these certain situations you have to do this and that, but when you are in there [classroom] it depends on the students. You have to know your students and what works for them" (Ana's interview).

Maria's experiences. Similar to Ana, Maria was a traditional age university student, who enjoyed 'teaching' her younger sibling and friends when she was a child. Maria's total MTEBI and PMTE scores were the highest scores among the cohort of preservice teachers in this study. Both scores were more than one standard deviation above the mean. Maria's MTOE score was higher than the mean.

Maria's early attitude toward mathematics was more similar to Marisol than the other three preservice teachers who had high levels of mathematics teaching efficacy. Maria possessed a love and joy for mathematics at an early age. Maria said, "as a student learning mathematics, I have learned to thoroughly enjoy the process" (Maria's interview). She recalled having teachers as far back as elementary school who made her "excited about learning and wanting to go to school" (Maria's interview). In high school, Maria took all of the mathematics courses designed

for college bound students. Maria loved her mathematics courses and all of her math teachers. However, it was her fourth grade teacher who impressed Maria the most.

According to Maria, this teacher was not one of those teachers who instructed the class from a seat behind her desk. Instead, this teacher interacted with each student. She was very patient with the class and was able to teach to each student's level. Maria credited this teacher as the one who really encouraged her interest in mathematics. Maria noted,

> "I already had an interest in math but she helped to cultivate that interest" (Maria's interview). This teacher has become a role model for Maria. When she becomes a teacher, Maria said, "I want to be a teacher like my fourth grade teacher" (Maria's interview).

When Maria reflected on her student teaching experience, she was extremely excited about the first semester placement compared to the second. During the first semester of her student teaching experience, Maria worked with a second grade teacher, where the "students in her classroom were in a gifted talented education program" (Maria's interview). Maria said the placement was a good experience, because she had an opportunity to teach all of the subjects, unlike her second semester placement.

During this placement, Maria had several opportunities to teach mathematics. According to Maria, her teaching was a fun and successful experience. She described her math lessons as fun, active and filled with the use of many manipulatives. The students were encouraged to get out of their seats to demonstrate mathematical understanding by using hand movements. In addition, the students were required to use manipulatives such as base ten blocks to develop and show understanding. During the interview, Maria described how she used manipulatives in a lesson on place value, which she labeled as one of the best lessons she taught. Maria encouraged her students to present their work on the classroom boards. Furthermore, students had to engage in a version of 'think-pair-share' where they were presented a problem, thought about how to

solve it, got in a small group with a neighbor to discuss how to solve the problem, and finally share with the class how they solved the problem. While discussing her lessons taught during the first half of her student teaching experience, Maria continuously stressed the importance of using manipulatives in the teaching of mathematics.

When asked about the emphasis placed on the use of manipulatives, Maria responded,

> "I love manipulatives. I love it, I love it! I feel like, especially with students, they can be used to prove things and help the students see. I'm a very visual, kinesthetic and tactile learner. I like to touch things in order to prove it to be true. So, I love manipulatives. It shows their [students'] critical thinking." (Maria's interview)

She recalled when she was a young student in elementary school; her teachers used various manipulatives in math classes. Maria noted there were many types of manipulatives in her second-grade placement classroom. Frequently, she and her cooperating teacher used manipulatives.

At the beginning of her student teaching experience, Maria felt prepared to teach math, but noted that she was rather scared to teach and somewhat unsure of her abilities. Maria credited her university studies from both the content and education courses for providing her with the skills to be very prepared before teaching a lesson. However, it was Maria's cooperating teacher, during this placement, who motivated and encouraged her. Maria said,

> "she [cooperating teacher] just helped out, as far as just, making sure I was equipped and prepared. I was really scared about teaching subjects in general, just because you don't want to overstep your bounds when it is some else's classroom. But she said, you are going to go out there. She threw me out there. So, it helped! At first I was nervous, but it helped." (Maria's interview)

According to Maria, this cooperating teacher was very straightforward in providing real and helpful comments about her teaching. The cooperating teacher provided advise about student learning, the pace of their learning, and about being patient with the students. Maria noted, she is rather critical of her work and is very eager to improve. Therefore, after each lesson Maria

taught, she sought immediate feedback from her cooperating teacher. Her cooperating teacher would say,

> "you did fine. I wouldn't ask you to teach my kids if I didn't actual trust that you would be able to do it. If I were to change anything, I would do this particular thing. She [cooperating teacher] would give me little pieces of advice. She was very supportive." (Maria's interview).

Maria and her cooperating teacher developed a comfortable relationship, which allowed for honest, supportive discussions about teaching. For Maria, this teacher was a great resource for her and the two remain in contact with each other.

Maria's second semester assignment was a special education placement where she helped students with reading. Although Maria admitted she learned a lot, it was not as enjoyable as the previous placement. The cooperating teaching during this experience was supportive and encouraging; however, Maria did not like teaching reading. Throughout the school day during this placement, students came to her in small groups of about four students. Maria's dislike from this experience was "teaching that one subject all day long and having to sit there in that small group. And maybe because we were only in the book the whole time. I just don't like sitting in one place for that whole hour or whatever doing the same thing. There just has to be some kind of change." (Maria's interview)

Before the end of the student teaching experience, Maria received and accepted a first grade teaching position. Maria said she looks forward to teaching mathematics to her future first graders. With much confidence, she felt prepared to teacher. Maria credited the student teaching experience for her level of confidence about her future career. Her experience was very successful and prepared her well for her own classroom. Maria noted, "I have those resources such as the manipulatives, videos, and other teachers that I can collaborate with. I feel great about it." (Maria's interview)

Experiences of Preservice Teachers with Low Levels of Efficacy

In this section, there are three subsections to present the experiences of the three preservice teachers with low levels of efficacy beliefs: Sofia, Christina, and Isabella. Because all three preservice teachers with low levels of efficacy beliefs refused to participate in the interview phase of this study, less information is available from this group of preservice teachers. Therefore, the MTEBI, autobiographical math histories and biographical information provided by these preservice teachers generated the information for the snapshots of their experiences.

Sofia's experiences: At the end of the student teaching experience, Sofia had the lowest total MTEBI score and the lowest MTOE score of the cohort of preservice teachers in this study. Throughout the student teaching experience, her total MTEBI scores were the lowest or almost the lowest among the preservice teachers. At the beginning of student teaching, her PMTE result was about average for the cohort of preservice teachers, but as the student teaching experience progressed, her PMTE score decreased while the majority of the cohort PMTE scores increased. Similar to her total MTEBI score, Sofia's MTOE scores over the course of the student teaching experience were among the lowest in the cohort. However, her MTOE scores always improved.

Not surprising, Sofia said, "I hated math. It was never fun. We always just did problems and solved them. I was a visual learner and manipulatives were never used" (Sofia's math history). After student teaching, Sofia appeared to be opened to the wonders of mathematics. When she began her experience, she had a strong dislike for mathematics. She was unsure and uncomfortable with mathematics, because she felt unsuccessful with the subject. She felt during her formal mathematical education her style of learning was never addressed. Student teaching made her more aware of this omission. However, Sofia was very reluctant in sharing any of her feelings or experiences from the student teaching experience.

Christina's experiences: Christina's total MTEBI score at the end of student teaching was more than one standard deviation below the mean. She and Sofia had the lowest MTOE scores of all the preservice teachers in this study. Christina's MTOE score was more than two standard deviations below the mean. Her PMTE score was about a half of standard deviation below the mean. However, unlike Sofia, Christina's total MTEBI, PMTE, and MTOE showed some increases with a slight fluctuation downward in her total MTEBI and MTOE scores at the end of student teaching. Her PMTE scores continued to increase throughout the student teaching experience.

Like Sofia, Christina noted that she struggled with math as a child. She does not recall much about studying mathematics during her elementary and middle school years. Christina noted a problem might have been that her family moved a lot. Hence, she changed schools often. Thus, not having an opportunity to develop a supportive relationship with teachers during her early grades in school. This is different from Sofia who indicated her difficulty with math was due to her learning style not aligning with her teachers' teaching style.

Finally, Christina's home situation changed. Her family no longer moved a lot. Therefore, she had the opportunity to attend one school during high school. During which time she started to like math, especially geometry and trigonometry. Yet, unlike most of the preservice teachers in the cohort, Christina took a huge break from education after high school and before starting college.

During her coursework at the university, Christina said, "I felt very comfortable in my college math courses. It just sort of comes naturally to me. I hope to one day teach math" (Christina's Math history). Such a comment about hoping to teach math was surprising. This indicated Christina's attitude toward mathematics has changed and she was very optimistic and

somewhat comfortable with the notion of teaching math. Again different from Sofia, who continued to feel apprehensive about mathematics and the idea of teaching mathematics.

Isabella's experience: Similar to Sofia and Christina, Isabella's total MTEBI score at the end of the student teaching experience was below the mean score for the cohort of preservice teachers. However, her initial total MTEBI score started out rather high, but it continued to decrease during student teaching with a very slight increase at the end of student teaching. Isabella's total MTEBI score took a dramatic decrease after the first semester of student teaching. It really did not recover from such a huge decline by the end of the second semester of student teaching experience. Although Isabella's PMTE score was slightly below the mean, it was somewhat flat throughout student teaching. Her final MTOE score was more than one standard deviation below the mean. Similar to her total MTEBI scores, Isabella's MTOE dropped drastically after the first semester of student teaching and never truly recovered.

In terms of mathematics, Isabella said, "math is actually one of my favorite subjects. I can't say that it has always been, however, over time, I learned to love it" (Isabella's math history). Isabella liked the fact math is practical; problems have one answer, although there are more than one way to reach the answer. During her schooling, Isabella said she was successful at math and it was easy until her second year of high school when she was taking a course in geometry. She had to receive tutoring for this course and was barely successful in passing the course. During the remainder of high school, Isabella studied advanced algebra and precalculus. She noted her love for mathematics started to return after completing the geometry course. In comparison to Sofia and Christina, Isabella appeared to have a good experience learning math with somewhat of a challenge occurring with a geometry course, but she overcame this challenge. Unlike Sofia, both Christina and Isabella never had a strong distain for mathematics.

During her student teaching experience, Isabella loved teaching math. She said, "teaching math was fun and exciting" (Isabella's math history). Isabella said she is hopeful that she will be teaching math during her new job with fourth graders. Similar to Christina, Isabella enjoyed teaching math during student teaching and look forward to teaching it in the future. What is unknown is what occurred during student teaching to cause her MTEBI scores to decline. Was it the familiarity with the complexity of the duties of a teacher that Isabella became more aware as she gained knowledge and insight during the student teaching experience?

Research Sub-Question 2

What are the characteristics of preservice teachers with low or high levels of mathematics teaching efficacy after student teaching? To address this question, the researcher used the information presented in the two previous sections and the results from the MTEBI. After examining the data, four characteristics emerged, which appeared to be paramount. They were attitude toward mathematics, use of manipulatives and hands-on activities, motivation to teach mathematics, and persistence. The subsequent four sections addressed these characteristics.

Attitude toward Mathematics. The attitude toward mathematics, especially as it evolved during the student teaching experience, contributed to the mathematics teaching efficacy beliefs of these future teachers. The preservice teachers with a high level of mathematics teaching efficacy beliefs possessed a very positive attitude toward mathematics. While the other preservice teachers had either an indifference or less than favorable attitude toward mathematics. However, after student teaching, all of the preservice teachers felt they could teach mathematics to elementary school children.

Ana was one of the preservice teachers who was initially adamant at the beginning of her interview that she really was not exactly thrilled about mathematics. She said mathematics was a

subject she struggled with in high school. In addition, Ana was adamant she never really had a favorite subject. However, after the student teaching experience, Ana noted, "so far I've liked math. I really enjoyed teaching math" (Ana's interview). A big smile broke out across Ana's face as she made this surprising revelation and was able to admit to herself that she liked mathematics. Immediately, she began to discuss the many ideas she had about teaching mathematics in her future classroom. Then, she referred to her favorite lesson she taught during student teaching, which was a lesson that involved students recognizing various geometric shapes and their parts. Ana looked forward to teaching mathematics and mentioned ideas she had about how to incorporate the lessons from her student teaching experience in to her future teaching.

As for Marisol, there was no doubt she had a strong propensity toward mathematics. Her positive attitude toward started as a child when her parents shared their love and joy of mathematics with her. She enthusiastically looked forward to teaching mathematics. She admitted she purposefully solo taught quite a few more lessons on mathematics than what was required, because "that's where I wanted to show off!" (Marisol's interview). Math was her strong suit. It was where she felt comfortable and her student teaching experience provided the arena for her to show it and perfect it. She noted if you gave her about thirty minutes advanced notice, then she could walk into any elementary classroom and teach mathematics. Marisol said she felt comfortable teaching mathematics. To her, "I feel like I'm a better teacher the more comfortable I am with the material" (Marisol's interview). Marisol's attitude toward mathematics was very strong and positive.

Although Adriana felt mathematics was her favorite subject, it was not her favorite subject to teach. She preferred to teach writing. Initially, she thought this was contradictory,

because she does not like English Language Arts and reading. Then, she explained she could probably incorporate writing into other subjects such as math. She explained by saying it is important for students to explain their thoughts and work, instead of just arriving at an answer. Students should be able to write out and explain how they came up with their solution. For Adriana, this rationale seemed to validate in her mind that loving to teach writing was not contradictory to her love for mathematics. It seemed as if it was okay for her to embrace both, her love for teaching writing and mathematics. Then, Adriana restated and justified her love for mathematics. She said she liked math, because "I'm able to find the different approaches to solve problems and it's just a little bit of a challenge" (Adriana's interview). Adriana felt writing can be used to develop critical thinking skills in mathematics. In spite of the challenges Adriana faced during student teaching, her attitude toward mathematics and belief in her abilities to teach mathematics did not suffer.

Maria was very enthusiastic when she talked about mathematics and teaching mathematics. She displayed a joy and confidence toward mathematics, which was very similar to Marisol. However, she felt her love of mathematics was due to her style of learning. Maria described herself as a "very kinesthetic, tactile learner who like to touch things" (Maria's interview). Mathematics was Maria's favorite subject to teach during student teaching. When teaching math, Maria said she made the students "get up and interact with things" (Maria's interview). The students were required to provide an answer to a problem and explained their work. She encouraged various approaches to solving problems. She felt showing one's work with explanation encouraged critical thinking. Maria's philosophy about showing their work was similar to Adriana's belief.

Among the three preservice teachers who had low mathematics teaching efficacy beliefs at the end of student, their attitudes towards mathematics was different. It was very clear that Sofia's attitude toward mathematics was very negative. In her math history reflection written after student teaching, Sofia said, "I hated math" (Sofia's autobiographical history). However, Sofia did try to explain her feelings by saying, "I did not conceptually understand math" (Sofia's autobiographical history). In contrast, both Christina and Isabella expressed some difficulty with math, but for the most part expressed a rather positive attitude toward mathematics. After their student teaching experience, both preservice teachers expressed a desire to "one day teach math" (Christina and Isabella's autobiographical history). Although their attitude toward mathematics was not as enthusiastic as Adriana, Ana, Marisol and Maria's, it was more positive than Sofia's attitude. Although Christina and Isabella may have had some challenges with mathematics, they experienced some moments of success and joy. Some of these moments occurred during student teaching, because they looked forward to teaching math in the future. However, this did not appear to be true for Sofia.

Use of manipulatives and hands-on activities. The use of manipulatives and hands-on activities generated the most excitement among the four preservice teachers with high level of teacher efficacy beliefs, especially Maria. When asked, her opinion concerning manipulatives in the teaching of mathematics, Maria enthusiastically responded, "I love manipulatives. Yes! I love manipulatives. I love it! I love it!" (Maria's interview). She felt manipulatives were crucial to students' understanding of mathematical concepts. For her, "students can visualize, understand, and prove mathematical concepts" (Maria's interview) with the assistance of manipulatives. Maria commented "how important it is to incorporate manipulatives into math,

especially at those foundational years [elementary grades] and just what manipulatives worked with certain students and with certain skills" (Maria's interview).

With a somewhat similar attitude toward manipulatives as Maria, Ana fervently supported the use of manipulatives in the teaching of mathematics. She admitted she enjoyed "math because of the manipulatives and the various things students can do with them. They [manipulatives] make students excited and engaged about learning math. They help with their motor skills." (Ana's interview). Most importantly, Ana felt manipulatives fostered independent learning and recall of mathematical concepts. She said, "they remember things. I [student] remember doing this or using an activity to figure this out. If I'm not there, I feel like they [students] can remember how to solve a problem and can do it on their own" (Ana's interview)

Maria, Ana, and Adriana stated they used manipulatives a lot in the teaching of mathematics during their student teaching experience. According to Ana, "they [cooperating teachers] had a lot of shapes and manipulatives" (Ana's interview) in their classrooms. All three preservice teachers noted they would use manipulatives in the future to teach their students, because they saw students learning mathematics during student teaching experience.

Interestingly, Marisol did not mention manipulatives as direct and forceful as Maria, Ana, and Adriana did. However, she stressed on several occasions the importance of using games and other activities to engage students and foster learning. In the teaching of mathematics, Marisol felt the students needed something tangible to connect their world to the mathematical concepts. She mentioned the challenge of teaching the students how to tell time and their unfamiliarity with clocks.

However, Maria stressed best the sentiments of all four preservice teachers and their attitude toward teaching math and the importance of using manipulatives and hands-on activities.

"Elementary school, those are the foundational years. Of course, we teach them the way or the way they learn certain things. It determines their motivation or excitement about math in general, from then on" (Maria's interview). Maria implied that it is very important for students to get a very good understanding of mathematics at an early age. Furthermore, it is just as important for students to see mathematics as fun and enjoyable. If not, a teacher could turn students off to mathematics throughout their education.

The teachers with low levels of mathematics teaching efficacy shared very little about their thoughts concerning manipulatives and hands-on activities. Sofia mentioned manipulatives. When she was a young student in elementary school and trying to learn mathematics, Sofia commented that they did not use manipulatives. She suggested the incorporation of manipulatives would have helped her to understand math due to her learning style.

Motivation to teach mathematics. Among the preservice teachers who had a high level of mathematics teaching efficacy (i.e. Adriana, Marisol, Ana and Maria), initially, they were all excited about teaching mathematics at the beginning of the student teaching experience. Their high MTEBI scores are a reflection of their high level of motivation to teach mathematics. It appeared this excitement continued throughout the first and second semesters of student teaching for all of them except for Adriana.

Sadly, Adriana initial excitement was somewhat diminished during the first semester. Adriana remarked she spent a good bit of time during the first semester observing the class and assisting them. This squashed Adriana's original zeal for teaching, because she did not have the opportunity to express it as a practicing teacher. In her words, the first semester was not a "real experience" (Adriana's interview) because her opportunities to teach were limited, not encouraged, and not supported. Because of this lack of support, Adriana admitted she simply

shut down and withdrew. Thereby, the level of motivation suffered. In addition, it was during this period when she tried to adjust her natural style of teaching to match that of the cooperating teacher by relying on the textbook to dictate her lessons. Yet, the lull in her level of motivation rebounded and increased during her second semester of student teaching. During this period, Adriana had more opportunities to teach and work with students. Furthermore, she received the support of her cooperating teacher and positive encouragement from students.

However, for Marisol, Ana and Maria, their level of motivation appeared to increase during the first semester. Unlike Adriana, Marisol met resistance to her teaching with determination. Marisol said, she felt some reluctance from her cooperating teacher about allowing her to teach, but she felt she had to takeover. With each passing day of teaching, Marisol appeared to be more motivated and excited. She loved being the person in charge of the classroom who knew the class lesson. Even student absenteeism did not deter her excitement.

As for Ana's motivation, it improved as she saw the students' level of excitement for learning increase. Ana noted she enjoyed teaching mathematics because she "loved how they [students] would get excited about everything specifically the math" (Ana's interview). It was this experience, which lead Ana to the revelation that math is her favorite subject and she enjoyed teaching the subject. Her excitement and motivation about mathematics continued after the student teaching experience. As Ana talked during the interview, she revealed ideas for teaching math to her future classroom of students.

Maria's motivation to teach math was obvious. During her interview, she had difficulty trying to contain her enthusiasm for teaching math. As she noted in her experiences, all Maria needed was the initial push to go and teach the children mathematics. According to Maria, her

cooperating teacher told her "you are going to go out there and she threw me out there. So, it helped! At first I was nervous, but it helped" (Maria's interview)

Surprisingly, none of the four preservice teachers with high levels of math teaching efficacy expressed concerns about being unprepared to teach math or their content knowledge was deficient. In Marisol's words, "I felt prepared during the whole year [student teaching experience] to teach math." (Marisol's interview). Both Adriana and Maria noted that in the upper grades, they may have to review some content, but their training in the teacher education program re-enforced the importance to be proactive and to make sure to be prepared before each class meeting. Without any doubt, all four preservice teachers were motivated and ready to teach mathematics. Each one had items and ideas from their student teaching experience about teaching mathematics, which they want to use in the near future.

The level of motivation to teach mathematics among Sofia, Christina and Isabella, preservice teachers with low levels of teacher efficacy, appeared to be somewhat mixed. First, Sofia did not comment or display any signs of her motivation to teach math. She appeared to focus more on what she missed as a young student. Her low MTEBI scores are indicative of a lack of motivation toward teaching mathematics.

Although Christina had low MTEBI scores, she commented that she would like "to one day teach math" (Christina's autobiographical history). Furthermore, Christina's PMTE scores, which started low, continued to increase throughout the student teaching experience. This meant her beliefs in her abilities to teach mathematics became more positive.

Isabella said, "teaching math was fun and exciting" (Isabella's autobiographical history). She appeared to be motivated to teach math. Her initial MTEBI scores reflected this excitement, which was relatively high, but decreased during student teaching and rebounded somewhat

during the second semester of student teaching. It would be interesting to know what happened during the first semester that resulted in a decrease in her MTEBI score. However, by the end of the student teaching experience, Isabella's belief in her abilities to teach mathematics increased.

Persistence. Of the four preservice teachers with high levels of mathematics teaching efficacy, all of them recalled situations, which were not their best performance. Yet, all of them found a means to persevere and not let the situations negatively influence their beliefs to teach mathematics. Adriana shared two situations, which challenged her.

In reference to her first semester of student teaching, Adriana commented that she "wasn't placed with the best teacher" (Adriana's interview). In another situation that occurred during the same semester, Adriana taught a lesson where she relied on the textbook too much and the lesson was unsuccessful. Therefore, she had to re-teach the lesson. Reflecting on this lesson Adriana noted some things she would do differently such as use the textbook less and more as a resource to support lessons created by her. In spite of these setbacks, Adriana' s mathematics teaching efficacy beliefs did not suffer as indicated by her MTEBI scores. During the second semester, Adriana had a very positive experience.

Marisol shared two incidences where she had to be persistent. First, Marisol discussed that her first cooperating teacher seemed somewhat hesitant to relinquish her classroom to Marisol and allow her to teach. However, Marisol was emphatic that she had to practice her teaching and this meant she had to take control of the classroom. Furthermore, she shared that she and her first cooperating teaching had different classroom management styles, which caused some conflict and confusion for the students. Yet, Marisol was persistent that she needed to teach. In addition, Marisol shared the challenge of trying to teach her students how to tell time. She recalled the frustrations she had in trying to get her students to relate to an analog clock

when they were most familiar with a digital clock. She recanted how hard this was, but she did not quit. Marisol noted that when she becomes a teacher there are going to be challenges. However, as she talked about these future challenges, she felt confident and eager to face these challenges. Marisol's MTEBI scores reflected that whatever challenges she faced during student teaching did not negatively influence her beliefs in her abilities to teach mathematics.

Ana seemed to have had no problems during her first semester of student teaching. The success of this semester seemed to have encouraged her and prepared her for future challenges. With each successful and fun experience Ana had during her first student teaching assignment, her confidence and the realization she could teach grew. This made her more persistent. There might be a connection between her determination to learn English and to be success at mathematics as a student and the drive to teach. Excitedly, Ana discussed her persistence and dedication to create activities that would support her student learning. The confidence she developed from her first semester of student teaching equipped her to face the student behavior problems, which occurred during her second semester of student teaching. When a student misbehaved while she was teaching, Ana was persistent in her belief that listening and talking to her students was so important to get a student back on task.

Maria was determined she could teach mathematics. Initially, she needed a little push to get started, but after that, her belief never faltered. Her MTEBI started high at the beginning of student teaching and remained high throughout the experience. She felt challenged while she taught and observed her cooperating teacher conducting a lesson. However, nothing appeared to stop her persistence to teach, especially math. She is confidence about what works and felt she has the necessary resources to succeed.

As for the preservice teachers with low level of efficacy, there is little information about their persistence. However, Sophia's words suggested a struggle and shortage of success with mathematics, which may develop a lack of persistence when it comes to mathematics. Instead, Sophia developed a notion that she was not good with mathematics. However, both Christiana and Isabella learned to preserve during their struggles. Unfortunately, they did not share a lot of the details about the challenges they faced during student teaching. The two of them stated they faced challenges learning mathematics, but overcame them. In fact, after completing student teaching, both Christina and Isabella felt a desire to teach math one day.

Research Sub-Question 3

What factors from student teaching influenced the mathematics teaching efficacy beliefs of preservice teachers? Several factors influenced the beliefs of the preservice teachers in this study. The factors, which were most prevalent in this research, were prior experiences with mathematics, relationship with cooperating teachers, experiences during student teaching, and the students served by the preservice teachers.

Prior experiences with mathematics. The fact Christina and Isabella enjoyed mathematics and had some success with the subject may explain the difference in their level of motivation and Sofia's. Sofia made her feelings concerning mathematics very clear, when she said rather emphatically, "I hated math" (Sofia's interview). To her, mathematics was never a subject that was fun and it appeared she was very uncomfortable with the subject. Probably, Sofia never had a moment where she felt successful with mathematics. This was a sharp contrast with the other two preservice teachers, Christina and Isabella, who had low levels of beliefs toward the teaching of mathematics.

In their prior experiences with math, both preservice teachers appeared to have some success with math. Although, there were some moments when they struggled with the subject. As a young student studying mathematics, Christina admitted she had difficulty with mathematics. However, she noted in her high school and college mathematics courses things changed. While in college, Christina "felt very comfortable" (Christina's autobiographical history) with mathematics. A similar journey occurred for Isabella, who said, "math is actually one of my favorite subjects. I can't say that it has always been; however, over time, I learned to love it" (Isabella's autobiographical history).

As for the preservice teachers with high levels of efficacy beliefs; Adriana, Marisol, Ana and Maria, two different pictures emerged. Marisol and Maria expressed they enjoyed math and was successful with it from a very early age. Math was the subject where they could shine. For Adriana and Ana, their love for mathematics developed slowly and later in life. This is somewhat similar to Christina's and Isabella's experiences. However, unlike Christina and Isabella, Adriana's and Ana's feelings toward mathematics became far more passionate, which is similar to Marisol and Maria's feelings.

Relationship with cooperating teacher. Each of the preservice teachers, who participated in the interview portion of this study (i.e. Ana, Marisol, Adriana, and Maria), addressed their relationship with their cooperating teachers. These relationships had a profound effect on each preservice teacher. Although limited, there is a presentation of the relationship of the three preservice teachers with low math teaching efficacy beliefs (i.e. Sofia, Christina, and Isabella) and their cooperating teacher. Truly, a supportive, encouraging relationship had a very positive effect on the preservice teacher's beliefs about their ability to teach mathematics.

Ana found her cooperating teacher from her kindergarten experience to be "easygoing, nice, but when they [the students] didn't do their work she would put her foot down and she was strict and they respected her for that" (Ana's interview). Ana said she learned a lot from her cooperating teacher and emphasized she learned how to control a classroom of students. This teacher has become a role model for Ana. Someone she would like to emulate. In her words, Ana said, "I want to be like her" (Ana's interview).

Although Ana had no difficulties or concerns working with her cooperating teachers from her student teaching experiences, the teacher from her kindergarten placement had the most profound positive effect on her. Ana had such a wonderful experience working with this teacher that she wanted to teach kindergarten. As a matter of fact, Ana admitted during her interviews for prospective teaching position, she sought kindergarten positions. However, after turning down a kindergarten teaching position, she selected a job teaching first grade, because she was concerned about being a new teacher and having students who were new to the formal learning environment. However, she has not given up on her love for teaching kindergarten. Because of the very positive and supportive experience she received during student teaching, Ana still dreams of teaching kindergarten one day.

Marisol's relationship with her cooperating teachers was more complex than Ana's. However, a good supportive relationship did develop. Marisol felt she worked with very good cooperating teachers and students. According to her, "there were no horror stories, especially nothing like some of the bad things, which she heard could happen during student teaching" (Marisol's interview).

During her first placement, Marisol described the relationship as very guarded. Marisol was rather prudent in which activities she engaged and responsibilities she acquired. In her words, Marisol said her first cooperating teacher

> "was reluctant to kind of give me that control, but at the same time wanted me to take it all. So, it was weird. I didn't know when I should step in and do stuff. I didn't know. I didn't want to upset her and she was very strict with the kids. And so, it made me feel very uncomfortable, because I would be telling them that they could do something and she would go and tell them they couldn't. And it kind of made the dynamics between us strained. I went to school feeling like I was the student every day. Like let me not mess up, because she's going to get mad" (Marisol's interview).

Marisol found herself in a difficult quandary. She did not know who to please and what role she would play (i.e. student or teacher). This battling duality of a student teacher was commonplace for many preservice teachers as they learn and perfect the art of teaching.

However, Marisol's relationship with her cooperating teacher during the second semester placement was very different. Marisol felt as if she was a part of team. Furthermore, Marisol felt as if she was a fellow teacher, not a student. As she described this experience, Marisol reflected with fondness and laughter. This cooperating teaching was more engaging and at ease with working with a student teacher. Marisol and this cooperating teacher developed a relationship that was more of an apprenticeship filled with comradery. They were able to develop more of a connection between them. Marisol appeared to be able to relate more to this teacher. The collegiality of this relationship could be because the cooperating teacher was a young veteran teacher who had graduated from the same university teaching program as Marisol. In Marisol's words, this cooperating teacher "was more welcoming to me. She graduated from this program so she knew exactly what I had to do. It was easier to work with her" (Marisol's interview). Comparatively speaking, the first cooperating teacher had been teaching for quite some time, was entrenched in her way of doing things, and did not want any deviation or disturbance of the

way in which she did things. Marisol felt the first cooperating teacher "had been doing this for a long time and her way is the only way and there is no other way" (Marisol's interview).

Adriana's student teaching experience contained both ends of the spectrum going from a very terrible experience and then rescued by having a very good, supportive experience. During her first student teaching placement, Adriana felt as if she was not wanted. She felt as if her cooperating teacher was not going to assist and guide her as she completed the last step in becoming a teacher. In Adriana's words, "I don't feel like I was placed with the best teacher. She told me in the beginning that she did not want a student teacher. So, I felt kind of out casted" (Adriana's interview). With sadness and bitterness, Adriana recalled this experience as one in which the cooperating teacher rushed her to complete the necessary required solo teaching unit and she spent the remainder of the semester observing and briefly assisting other students in the classroom. "The first teacher [i.e. first cooperating teacher] just didn't seem willing to help or help me learn or get any real experience" (Adriana's interview). Adriana felt the cooperating teacher did not try to create any kind of a relationship with her.

However, the relationship between Adriana and her second cooperating teacher was supportive and very influential. As Adriana reflects on this relationship, her entire demeanor changed. She appeared more relaxed and smiled. According to Adriana, this cooperating teacher "tried to tell me everything she knew and tried to get me to have as much experience as I could. She let me have the freedom to work with students as much as I could. And she was very helpful with giving advice and telling me I could do this better" (Adriana's interview). During the second semester of student teaching, Adriana had a special education classroom placement. Because of the positive impact of her cooperating teacher during this semester, Adriana said, "I would be very willing to work in SPED after that experience" (Adriana's interview).

Unlike Adriana, Maria did not have a poor relationship with any of her cooperating teachers. Her placements were in an environment that was supportive and really helped her to blossom and improve her teaching skills. With this said, it was the relationship with her first cooperating teacher, whom she developed a strong lasting bond, which had the most positive influence on Maria's mathematics teaching efficacy beliefs. According to Maria, "it is a relationship, forged during student teaching, which continues today" (Maria's interview).

Maria described her first cooperating teacher as

> "a great resource. She just helped out as far as just making sure I was equipped and prepared. I was really scared about teaching subjects in general just because you don't want to overstep your bounds when it is someone else's classroom, but she said you're going to go out there. She threw me out there and so it helped!" (Maria's interview)

Maria said this cooperating teacher encouraged her, gave supportive and constructive feedback, and provided many opportunities for her to teach math and the other subjects. Maria noted this teacher "was very open with me. She kept it realistic with me. She told me to be patient and don't be hard on myself" (Maria's interview). Maria admitted she is rather over critical of herself.

What helped Maria was her cooperating teacher's trust and support. Maria commented that her cooperating teacher said, "I wouldn't ask you to teach my kids if I didn't actual trust that you would be able to do it." (Maria's interview). After each lesson Maria taught, she and her cooperating teacher would reflect on the lesson. First, the cooperating teacher would give positive feedback. According to Maria, any constructive critique of her lessons were proceeded by the statement "If I were to change anything I would do this particular thing" (Maria's interview). Although Maria admitted that she had a very good supportive teacher for the second semester of her student teacher, she just did not care for spending the entire school day teaching reading. She missed teaching mathematics and the other subjects.

Unfortunately, Sofia, Christina, and Isabella adamantly refused to participate in the interview portion of this study; therefore, the information about their relationship with their cooperating teachings is limited. However, based on information provided, there is no indication that their relationship with their cooperating teachers were problematic or less than supportive and productive. It appears that their relationships were somewhat encouraging to the point that both Christina and Isabella want to teach mathematics someday.

Student teaching experience. Of the preservice teachers with high levels of mathematics teaching efficacy, all of them had an overall good student teaching experience both semesters, except for Adriana. Recorded in the previous sections are Adriana's trials and eventual joys from her student teaching experiences. It is rather clear she felt she did not have a good student teaching experience during the first semester. However, her second semester was a very good experience. She describes her second semester as one in which she learned a lot, given an opportunity to learn, and felt supported. In her words, Adriana noted, "all of my favorites" (Adriana's interview) about student teaching occurred in the last half of my student teaching experience.

Completely contrary to Adriana's experience, Maria noted she did not have a bad student teaching experience. In her words, she "never had an experience where the teacher did not want her to teach. I felt like the teacher. It was nice. It was great" (Maria's interview). She admitted there were things she did not like such as teaching reading, but she had a good experience and enjoyed her time. She reflected upon her student teaching experience as a period of training in which "I definitely think that I needed it" (Maria's interview).

In a similar vein to Maria's experience, Marisol felt she had a very good experience. From this experience, she realized that she does not want to teach special education due to an

abundance of necessary paperwork. This is contrary to Adriana's thought, which could be due to the support and positive experience she received during the special education portion of her student teaching experience. Yet, Marisol expressed "I really, really liked my senior year" (Marisol's interview) of the teacher preparation program. She highly praised her first semester experience, because it

> "was the first time they let us teach fully. Like the teacher was just there. She did not teach at all. Like every day, I went in and I had the schedule, I knew what we were doing, and I had the activities. I really, really liked being in that classroom and just having the freedom to be like okay today we're going to do this this way." (Marisol's interview)

When Marisol reflected on her experience, her exuberance was hard to control. It outpoured in the volume of her voice as it swelled to chase and capture the joy and excitement she recalled.

Somewhat like Maria and Marisol, Ana mentioned she had a good student teaching experience and the best part occurred during the first semester. Several times, Ana noted "I enjoyed being in kindergarten [for placement]. I loved being in there. It was so much fun. They [the students] get excited over everything" (Ana's interview). Yet, from her second semester placement, Ana admitted she learned how important it was "to keep the students engaged and excited about learning because it helped with classroom management. I did learn a lot, but it was difficult" (Ana's interview). Ana's biggest concerns at the beginning of her student teaching experience was classroom management and if the students would like her.

Students. All of the preservice teachers interviewed commented on how much they loved working with the students and were ecstatic to see their students' excitement for learning. As noted previously, the students' excitement and eagerness for learning in kindergarten won Ana's heart. Because of this experience, Ana has developed a love for teaching kindergarten. Because of her dislike for dealing with behavior issues that arose during her second placement, Ana

decided she did not want to teach the later elementary grades. Similar to Ana, Marisol's first placement was in a kindergarten classroom. In spite of the early tension, she had with her cooperating teacher and the problem with student absenteeism, Marisol enjoyed working with the students. With fond reflection, Marisol referred to the students as "a group of excited little children" (Marisol's interview). Even during her second experience, Marisol felt very excited about working with the students. Her dislike during this experience was the amount of paperwork and working the parents of the students.

Although Adriana felt personally rejected by her cooperating teacher during her first placement, she felt encouraged by her students. During the interview, Ana recounted an exchange between her and a former student from her first placement. The exchanged occurred after Adriana had completed her first semester of student teaching and had moved on to her second placement. Adriana encountered the student in the hallway of the school. The former student informed Adriana that she enjoyed her lesson and wished that she would come back to teach them. As Adriana retold this encounter, she smiled brightly. Adriana commented she tried very hard to make her lessons real to these students. She tried to use real-world things and connect it to the students' current knowledge and world. Adriana said she tried to use things and people that her students were familiar and interested.

Every action Maria took was to engage her students. She motivated them to be active, both physically and mentally, about their learning. Maria was thrilled about her students' eagerness to learn. However, Maria's first placement was somewhat different from the other preservice teachers with high levels of mathematics teaching efficacy beliefs. Maria's students were second graders who "were in a gifted talented education program" (Maria's interview). This group of students were more homogenous in terms of their abilities compared to the

students taught by the other preservice teachers. Regardless of this difference, all four of the preservice teachers commented on their joy of working with the students and the level of excitement the students possessed.

Summary

Based on the survey of twenty-five preservice teachers during student teaching, the mathematics teaching efficacy beliefs of preservice teachers increased. However, a more in-depth analysis revealed there was not a significant change in MTOE. The total MTEBI scores had a significant increase from the beginning of the student teaching experience to the end. This means mathematics teaching efficacy beliefs among the preservice teachers in this study increased over the course of student teaching. In other words, the beliefs of these preservice teachers in their abilities to be effective teachers of mathematics increased by the end of their student teaching experience.

In addition, the PMTE scores had a similar significant increase. The beliefs these preservice teachers had in their capabilities to be effective mathematics teachers increased during the course of student teaching. Again, the change in total MTEBI and PMTE was significant. Unlike the total MTEBI and PMTE scores, there was no significant change in the MTOE scores. The belief, which these preservice teachers possessed concerning the notion that effective mathematics teaching can bring about student learning regardless of external factors, such as student's parental support and other environmental factors, did not have a significant difference. There were some individual changes, both increase and decrease, but nothing significant.

Using interviews, autobiographical histories and biographical information of four preservice teachers with high levels of mathematics teaching efficacy and three preservice teachers with low levels, four characteristics emerged. They were attitude toward mathematics,

the use of manipulatives and hands-on activities, motivation to teach mathematics and persistence.

All of the preservice teachers with high level of teaching possessed a very positive attitude toward mathematics. Among teachers with low levels of math teaching efficacy, there was a mixture of attitudes toward mathematics. Sofia indicated she hated math. Both Christina and Isabella admitted having difficulty with mathematics, but both experienced periods when they liked math and would like to teach it one day.

The preservice teachers with high levels of teaching efficacy expressed the importance of using manipulatives and hands-on activities. Ana and Maria were very strong in their support for manipulatives and hands-on activities. Of the preservice teachers with low levels of efficacy, only Sofia mentioned manipulatives. She gave the impression that they were helpful for student learning. She wished her teachers had used them when she was in elementary school.

As for motivation to teach, all preservice teachers with high levels of teaching efficacy were very motivated to teach mathematics. They were excited and filled with ideas for their future classrooms. Of the preservice teachers with low level of efficacy, Christina and Isabella looked forward to teaching mathematics in spite of the challenges that had learning the subject as students. Sofia did not share an opinion.

In terms of perseverance, all of the preservice teachers, except for Sofia, shared experiences of difficulty, setback, and overcoming the challenges that occurred during the student teaching experience.

There were four factors, which seemed to influence the mathematics teaching efficacy of these preservice teachers. The factors were prior experience with mathematics, relationship with cooperating teacher, student teaching experience, and students.

Two of the preservice teachers, Marisol and Maria, who possessed high levels of mathematics teaching efficacy, seemed to have had a very positive past experience with mathematics. Both of these preservice teachers shared their love and enthusiasm for mathematics. Fellow preservice teachers, Adriana and Ana, who also possessed high levels of mathematics teaching efficacy, had a different prior experience with mathematics. It was not a subject these two preservice teachers embraced enthusiastically and as early as Marisol and Maria did. However, they eventually found joy and success with mathematics.

Similarly, Christina and Isabella, preservice teachers with low levels of efficacy, stated they previously faced challenging experiences with mathematics, but eventually reached a point where they looked forward to teaching the subject. However, Sofia never elaborated about her prior experiences with mathematics.

In reference to the cooperating teachers, the preservice teachers with high level of efficacy all had a good experience with their cooperating teachers during student teacher, except for Adriana. The relationship she had with her first cooperating teacher during the first semester of student teacher was not a good, supportive relationship. Based upon Adriana's interpretation of the experience, it appeared the two had little or no relationship. However, Adriana's relationship with her second cooperating teacher was wonderful and very supportive. As for the relationship between Sofia, Christina, and Isabella and their cooperating teachers, very little is known. Neither of them acknowledged their cooperating teacher, positively or negatively.

All of the preservice teachers, who commented about their student teaching experience, acknowledged they had a good experience. This is true of Adriana as well, in spite of her bad experience during the first half of student teaching. They all admitted the experience was valuable and they learned a lot.

The preservice teachers commented they really enjoyed working with their students during student teaching. Many of them commented about how rewarding and motivating it was to see their students excited about learning. The student teachers noted the students appeared to enjoy their lessons.

CHAPTER V

FINDINGS, CONCLUSIONS, AND IMPLICATIONS

> …effective intellectual functioning requires much more than simply understanding the factual knowledge.
>
> – Bandura, 1993, p. 117

This research project was a qualitative study with a quantitative component that used a case study methodology to examine the mathematics teaching efficacy beliefs of preservice teachers. The main research question was what happened to the mathematics teaching efficacy beliefs of preservice teachers during the student teaching experience. The three sub-questions were:

1. During the student teaching experience, what happens to the level of mathematics teaching efficacy beliefs of the preservice teachers?
2. What are the characteristics of preservice teachers with low and high levels of mathematics teaching efficacy beliefs after the student teaching experience?
3. What factors from the student teaching experience influenced the mathematics teaching efficacy beliefs of preservice teachers?

Teacher efficacy is a form of self-efficacy, defined as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3). More specifically, teacher efficacy is efficacy beliefs directed toward being an effective teacher in order to bring about student learning. According to Bandura (1997), efficacy "beliefs are constructed from four principal sources of information: enactive mastery experiences, vicarious experiences, verbal persuasion and allied types of social influences, and physiological and affective states" (p. 77). The most influential of these four sources of efficacy development is mastery experiences (Bandura, 1977, 1997). The results of this study indicated

that these sources of information had an influence on the mathematics teaching efficacy beliefs of the preservice teachers. The findings of this study noted several things did happen to the mathematics teaching efficacy beliefs of the preservice teachers in this study as they progress through their student teaching experience working with young students, teachers, and parents.

In the next section, divided into three subsections, I present the results of this research project. Each subsection corresponds to one of the research sub-questions. After the last subsection summarizing the findings of this research, I outline some implications. I conclude the chapter with some suggestions for future research on teacher efficacy, especially, mathematics teaching efficacy of preservice teachers.

Findings

Research Sub-Question 1

First, for the cohort of preservice teachers in this study, their mathematics teaching efficacy beliefs significantly increased from the beginning of the student teaching experience to the end of their experience. In other words, the beliefs that these future teachers had in their abilities to teach mathematics and bring about student learning increased. This finding is important because teachers with a strong sense of efficacy tend to spend more class time teaching a subject when they feel more efficacious (Riggs & Enochs, 1990). Teachers avoid subject areas where they feel less efficacious (Riggs, 1995).

A deeper investigation revealed the preservice teachers' personal mathematics teaching efficacy beliefs (PMTE) had a significant increase as well. This finding means the beliefs that these preservice teachers had in their abilities to teach mathematics and bring about student learning significantly increased during the student teaching experience. However, the mathematics teaching outcome expectancy (MTOE) did not show a significant change among

these preservice teachers. Although there was not a significant change in mathematics teaching outcome expectancy beliefs for the preservice teachers in this study, their beliefs did increase. In other words, the preservice teachers' beliefs about effective mathematics teaching overcoming any environmental barriers a student may have that would inhibit learning such as abilities and home environment became more positive.

Recall, Gibson and Dembo (1984) defined teacher efficacy in more general terms as having two components: PTE and GTE. In a study, involving the more general definition of teacher efficacy beliefs of both elementary and secondary preservice teachers, Fortman and Pontius (2000) found personal teaching efficacy (PTE) improved significantly after the student teaching experience. Similar findings resulted from other studies (Hoy & Woolfolk, 1990; Woolfolk Hoy & Burke Spero, 2005). In a study concerning preservice teachers' involvement in mathematics methods course and field experience (i.e. student teaching), the findings were personal teaching efficacy (PTE) and teacher efficacy had a significant increase, but not general teaching efficacy (GTE) (Wenta, 2000). Furthermore, Knoblauch and Woolfolk Hoy (2008) found that teacher efficacy of preservice teachers increased after the student teaching experience, regardless of school setting (i.e. rural, suburban, and urban). Lastly, Utley and her colleagues (Utley, et al., 2005) found that not all aspects of mathematics teaching efficacy increased significantly during coursework and student teaching. The results of this study mirror the findings of these studies.

The results of this study and similar studies are important because the teaching experience that occurs during student teaching may be more influential on personal teaching efficacy (PTE) (Hoy & Woolfolk, 1990), the belief in one's abilities to be an effective teacher (Hoy & Woolfolk, 1990). Furthermore, these findings reverberate Bandura's (1997) self-efficacy

component concerning beliefs. The most influential influence on efficacy beliefs is having successful experiences in student teaching (Mulholland & Wallace, 2001). In addition, during the student teaching experience, preservice teachers receive efficacy information verbally, vicariously, and psychologically from their cooperating teachers, peers, and students. The results of this study show that all of these sources influenced the mathematics teaching efficacy beliefs of these preservice teachers, resulting in an increase. Therefore, due to the changes in mathematics teaching efficacy beliefs, the student teaching experience needs a closer look because of its critical source of information that may impact efficacy (Knoblauch & Woolfolk Hoy, 2008).

Research Sub-Question 2

An analysis of the qualitative data revealed four thematic characteristics about the preservice teachers in this study. The characteristics were attitude toward mathematics, use of manipulatives and hands-on activities, motivation to teach mathematics, and persistence. The preservice teachers with high levels of mathematics teaching efficacy possessed a positive attitude toward mathematics. While, the preservice teachers with lower levels of teaching efficacy beliefs had a much less than enthusiastic positive attitude. Furthermore, there was a mixture of attitudes with some positive feelings by the end of the student teaching experience and some indifference. Basically, attitudes toward mathematics of the preservice teachers with lower efficacy were different from each other. In addition, the attitudes toward mathematics of both groups of preservice teachers were different.

The preservice teachers with a high level of efficacy beliefs began the student teaching experience with a rather high positive attitude toward mathematics and, for the most part, retained this positive attitude by the end of the experience. For the preservice teachers with low

levels of teacher efficacy, all of them experienced an improvement in their attitudes toward mathematics, except for Sofia. She remained a bit unmoved about her attitude toward mathematics. Both Christina and Isabella indicated a more positive attitude toward mathematics as exemplified by their eagerness and willingness to teach mathematics in the future.

Sofia and the other preservice teachers with low levels of mathematics teaching efficacy beliefs may possess some feelings of anxiety toward mathematics. This anxiety toward mathematics is a debilitating dread of mathematics (Vinson, 2001), which affects a disproportionately large percentage of preservice teachers (Gresham, 2004; Swars et al., 2006; Vinson, 2001). There is a proven association between mathematics teaching efficacy levels and mathematics anxiety (Gresham, 2009). Swars (2004) found a significant negative relationship between mathematics teaching efficacy beliefs and mathematics anxiety among preservice teachers. The feelings of anxiety toward the use of manipulatives to aid mathematical understanding could have been alleviated (Thompson, 1992). Both Christina and Isabella expressed some difficulty with studying mathematics.

The use of manipulatives and hands-on activities were another interesting characteristic that emerged from the study. The four preservice teachers with high levels of mathematics teaching efficacy were excited and steadfast in their beliefs about the use of manipulatives and hands-on activities in teaching mathematics. They felt the use of manipulatives and activities were important for the development and understanding of mathematical concepts. Swars (2004, 2005), in her study, found that preservice teachers who possessed the highest level of mathematics teaching efficacy strongly embraced the use of manipulatives in the instruction of mathematics; while preservice teachers with low levels of mathematics teaching efficacy did not agree on the use of manipulatives. Of the preservice teachers with low levels of teaching efficacy

in this study, only Sofia mentioned manipulatives and implied that they would have helped her to understand mathematics. Sofia seems to believe that the use of manipulatives is helpful in the learning of mathematics. Thompson (1992) stated the use of manipulatives in the teaching of mathematics could dispel feelings of anxiety.

Regardless of the level of mathematics teaching efficacy beliefs, all of the preservice teachers in this study appeared to be motivated to teach mathematics with the exception of Sofia. The difference among these preservice teachers was the level of the motivation. The preservice teachers with high levels of efficacy were ecstatic, without a doubt, about teaching mathematics; they had an eagerness to teach the subject. This level of motivation may be linked to their high level of mathematics teaching efficacy. Researchers have shown a link between the level of motivation and level of teaching efficacy beliefs (Tschannen-Moran et al., 1998). Some researchers (Allinder, 1994; Guskey, 1984) found that teachers who possess a high level of teaching efficacy have a high level of enthusiasm to teach. This relationship was observed in all four preservice teachers with high levels of mathematics teaching efficacy.

Although Christina and Isabella, two preservice teachers with low levels of mathematics teaching efficacy, expressed some eagerness to teach mathematics, it was not at the extreme excitement level possessed by the preservice teachers with high levels of efficacy. The other preservice teacher with low level of efficacy, Sofia, did not express a motivation to teach mathematics.

Lastly, the four preservice teachers with high levels of mathematics teaching efficacy possessed a level of persistence that energized and propelled them forward. Ashton (1985) found the level of efficacy is linked to teachers' persistence on a task. In addition, the high level of efficacy may have added to these preservice teachers' level of persistence. Tschannen-Moran

and Woolfolk Hoy (2001) stated the level of efficacy influence teachers' persistence. There were challenges for each of these preservice teachers, which could have easily stymied their actions to become teachers. Instead, they moved forward. Adriana had a difficult first semester during the student teaching experience that could have led her to quit. However, she did not lose faith in her beliefs in her ability to teach.

There is little information about the perseverance of the preservice teachers with low level of mathematics teaching efficacy. It is clear that both Christina and Isabella faced some challenges and they were able to survive them. Recall, Christina and Isabella said they would like to teach mathematics one day, in spite of some of the challenges they had. The limited information concerning Sofia indicated she faced some challenging situations. She completed the student teaching experience, sadly, however, with an unchanged negative attitude toward mathematics and her abilities to teach mathematics.

Research Sub-Question 3

In response to the last sub-question, four factors emerged from this study as an influence on the mathematics teaching efficacy beliefs of these preservice teachers. The factors were prior experience with mathematics, relationship with cooperating teacher, the student teaching experience, and the children taught.

According to Bandura (1997), past experiences are the most influential source of efficacy development. All of the preservice teachers in this study commented on their prior experiences with learning mathematics. The four preservice teachers who had high levels of mathematics teaching efficacy had experienced a high level of success with the study of mathematics. As for the preservice teachers with low levels of efficacy, they admitted that they struggled with subject. Sofia struggled to the point she hated the mathematics. Swars (2005), in a similar study,

found that the preservice teachers who had a low level of teacher efficacy had negative past experiences with mathematics, and the preservice teachers with high levels of efficacy had a far more positive past experience with mathematics.

The findings about the relationship with cooperating teacher being a factor that influenced the efficacy beliefs of preservice teachers is not surprising because preservice teachers spend a huge amount of each day with their cooperating teacher during the student teaching experience. According to Borko and Mayfield (1995), the cooperating teacher is a most influential factor on the teacher efficacy beliefs of future teachers. Cooperating teachers provide verbal feedback and a vicarious experience for preservice teachers; both are important sources of efficacy information (Bandura, 1977, 1997). These sources influenced teacher efficacy beliefs by causing an increase among a group of preservice elementary teachers in Greece (Charalambos, et al., 2008). Therefore, cooperating teachers are crucial to the development of teacher efficacy beliefs among preservice teachers (Knoblauch & Woolfolk Hoy, 2008). Cooperating teachers have a positive or negative affect on the teacher efficacy beliefs of preservice teachers via a variety of means such as teaching style and feedback messages (Philippou & Charalambous, 2005).

During the student teaching experience, some of the most powerful influences on the development of teacher efficacy occur (Mulholland & Wallace, 2001). It was during this experience where these future teachers received real experience about the tasks teachers perform and have an opportunity to execute these tasks. If a preservice teacher experienced some success in executing the teaching task, this may create a profound impact on the preservice teacher's sense of efficacy. Bandura (1977, 1997) stated mastery experiences where a preservice teacher felt that her or his teaching was successful is the most powerful impact on the development of

efficacy beliefs. Although Adriana had a difficult first semester of student teaching, all preservice teachers with high level of efficacy beliefs noted they, overall, had a successful student teaching experience. Christina and Isabella, who had low levels of efficacy, expressed they would like to teach mathematics after their student teaching experience. This desire could be a result of their student teaching experience and having some successful moments of teaching mathematics.

Poulou (2007) found that student teachers emphasize their affection for their students. All of the preservice teachers with high levels of mathematics teaching efficacy referenced their students and the excitement they had in working with these students. The students' reactions to the lessons taught by the preservice teachers motivated and encouraged these future teachers. It validated their beliefs of being effective teachers of mathematics.

Implications

It is clear that whatever is happening during the student teaching experience is really working for those preservice teachers with high levels of mathematics teaching efficacy beliefs. Sadly, the same is not true for all of those preservice teachers who enter student teaching with low levels of beliefs. This issue is important because "once efficacy beliefs are established they appear to be somewhat resistant to change" (Hoy, 2000, p. 5). Furthermore, Riggs (1990) found that teachers who felt less efficacious in a particular subject (e.g., mathematics) tend to avoid the subject and spend less time on instruction in the area. Therefore, it is crucial that teacher preparation programs strive to meet the needs of all preservice teachers, especially, those with low efficacy beliefs.

According to Bandura, "enactive mastery experiences are the most influential source of efficacy information because they provide the most authentic evidence of whether one can

muster whatever it takes to succeed" (p. 80); preservice teachers encounter such experience as they participate in student teaching. Mulholland and Wallace (2001) noted experiences during student teaching could be some of the most powerful influences on efficacy development. This may be the reason why each of the preservice teachers in this study highlighted her student teaching experience. It is important to that teacher preparation programs monitor these experiences. An experience, which occurred with Adriana during her first placement, needed immediate attention. Adriana's situation called into question whether she had an avenue by which she could express her experience and feelings. If not, then teacher preparation programs need to establish a means by which preservice teachers may express their experiences in real time.

What is being done to address situations where a preservice teacher is having difficulty or a less than positive experience? The results from this study suggest that teacher preparation programs should reach out and support preservice teachers with low efficacy beliefs. The intervention should be almost immediate in order to improve the efficacy beliefs of all preservice teachers. It should be noted that teachers with low efficacy beliefs are entering the profession of teaching. In their attempts to do no harm, they may be having the opposite effect on students. Research has shown that efficacy beliefs affect teachers' level of persistence during difficult times, their resilience, and their willingness to work with students who are experience difficulty with a lesson (Gibson & Dembo, 1984). Teachers with high levels of efficacy are more enthusiastic about teaching (Guskey, 1984), committed to teaching (Coladarci, 1992), and willing to try new teaching strategies (Guskey, 1988). Therefore, it is imperative upon teacher preparation programs to monitor not only the performance of preservice teachers in the

classroom but also to be mindful of their feelings and attitudes toward the teaching and learning of mathematics.

Recommendations for Future Research

Clearly, this area needs further investigation. Larger studies are needed to acquire more information and to add to the findings of this study. Additionally, more longitudinal studies are needed whereby preservice teachers are studied from the beginning of acceptance into the teacher education program to the end of the student teaching experience and then at least to the conclusion of the first year of teaching.

Furthermore, greater efforts are needed to identify early and assist preservice teachers who possess low levels of teaching efficacy. As indicative from this study, preservice teachers with low levels of efficacy may be reluctant to share their challenges and difficulties. If teacher education programs and the nation are going to improve teaching and mathematics teaching, it is imperative that efforts are taken to find ways to help preservice teachers with low levels of efficacy. Addressing this issue will benefit the future teachers and their future students.

To continue to produce effective teachers, both teacher education programs and educational stakeholders need to place future teachers with experienced, talented in-service teachers who are willing to mentor future teachers. These teachers would need to work in a partnership with teacher preparation programs to produce effective teachers.

In the area of mathematics, this would lead into a further investigation into the factors that affect the development of how preservice teachers develop their mathematics teaching efficacy beliefs. The results of such research can be used to assist preservice teachers who possess low levels of mathematics teaching efficacy beliefs. Most importantly, this type of

research can be used to strengthen teacher preparation programs and thereby produce more effective teachers of mathematics.

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APPENDICES
APPENDIX A
INSTITUTIONAL REVIEW BOARD REQUEST

INSTITUTIONAL REVIEW BOARD

Mail: P.O. Box 3999
Atlanta, Georgia 30302-3999

In Person: Dahlberg Hall
30 Courtland St, Suite 217

Phone: 404/413-3500
Fax: 404/413-3504

April 07, 2016

Principal Investigator: Christine Darling Thomas, PhD

Key Personnel: Brown, Don K; Thomas, Christine Darling, PhD; Tinker Sachs, Gertrude, PhD

Study Department: Middle Sec Educ & Instruc Tech

Study Title: Impact of Student Teaching on the Mathematics Teacher Efficacy Beliefs of Preservice Teachers

Review Type: Expedited 6, 7

IRB Number: H16493

Reference Number: 338360

Approval Date: 04/07/2016

Expiration Date: 04/06/2017

The Georgia State University Institutional Review Board (IRB) reviewed and approved the above referenced study in accordance with 45 CFR 46.111. The IRB has reviewed and approved the study and any informed consent forms, recruitment materials, and other research materials that are marked as approved in the application. The approval period is listed above. Research that has been approved by the IRB may be subject to further appropriate review and approval or disapproval by officials of the Institution.

Federal regulations require researchers to follow specific procedures in a timely manner. For the protection of all concerned, the IRB calls your attention to the following obligations that you have as Principal Investigator of this study.

1. For any changes to the study (except to protect the safety of participants), an Amendment Application must be submitted to the IRB. The Amendment Application must be reviewed and approved before any changes can take place.

2. Any unanticipated/adverse events or problems occurring as a result of participation in this study must be reported immediately to the IRB using the Unanticipated/Adverse Event Form.
3. Principal investigators are responsible for ensuring that informed consent is properly documented in accordance with 45 CFR 46.116.

 The Informed Consent Form (ICF) used must be the one reviewed and approved by the IRB with the approval dates stamped on each page.

4. For any research that is conducted beyond the approval period, a Renewal Application must be submitted at least 30 days prior to the expiration date. The Renewal Application must be approved by the IRB before the expiration date else automatic termination of this study will occur. If the study expires, all research activities associated with the study must cease and a new application must be approved before any work can continue.

5. When the study is completed, a Study Closure Report must be submitted to the IRB.

All of the above referenced forms are available online at http://protocol.gsu.edu. Please do not hesitate to contact the Office of Research Integrity (404-413-3500) if you have any questions or concerns.
Sincerely,

Cynthia A. Hoffner, IRB Vice-Chair

Federal Wide Assurance Number: 00000129

APPENDIX B
INFORMED CONSENT FORM

Georgia State University
Department of Middle Grades and Secondary Education
Informed Consent

Title: Impact of Student Teaching on the Mathematics Teacher Efficacy Beliefs of Preservice Teachers

Principal Investigator: Dr. Christine D. Thomas
Student Principal Investigator: Don K. Brown

I. Purpose:

You are invited to participate in a research study. The purpose of the study is to investigate the efficacy beliefs of pre-service elementary school teachers toward the teaching of mathematics. You are invited to participate because you have recently completed an internship (i.e. student teaching) experience at the university. Thirty recent graduates of the undergraduate program in elementary education will be invited to participate in the quantitative portion of this study which will be to grant access to all three of your Mathematics Teacher Efficacy Beliefs Instrument (MTEBI) results taken during your final year at the university for the purpose of a quantitative analysis. From this group of participants, a total of 16 former preservice teachers will be invited to participate in the qualitative portion this study. In the qualitative portion, participation will require a one-hour, in person, interview to seek responds to a few questions about your student teaching experience and teaching mathematics. Lastly, for those participating in the qualitative portion, you are being asked to grant access to your mathematics history activity.

II. Procedures:

If you decide to participate, you will be asked to grant permission to access the results of all three of your MTEBI results and mathematics history activity, which were completed during your last year of training at the university. Additionally, you may be asked to participate in a one-hour, in-person interview about your student teaching experience and your experience teaching mathematics. The interviews will be conducted in a quiet space at a public library or coffee shop. The interview will be audio recorded, transcribed, and made available to you for accuracy. The interview participants will also complete a demographic sheet. Also, you will be asked to bring one artifact of your choosing from your student teaching experience (e.g. lesson plan, classroom activity, assessment instrument, etc.).

III. Risks:

In this study, you will not have any more risks than you would in a normal day of life.

IV. Benefits:

Participation in this study may not benefit you personally. Overall, we hope to gain information about how preservice teachers develop their attitudes toward teaching mathematics. Thereby, benefit the preparation of future elementary teachers of mathematics.

V. Voluntary Participation and Withdrawal:
Participation in research is voluntary. You do not have to be in this study. If you decide to be in the study and change your mind, you have the right to drop out at any time. You may skip questions or stop participating at any time. Whatever you decide, you will not lose any benefits to which you are otherwise entitled.

VI. Confidentiality:
We will keep your records private to the extent allowed by law. The principal investigator, Dr. Christine Thomas, and I, Don Brown, will have access to the information you provide. Information may also be shared with those who make sure the study is done correctly (GSU Institutional Review Board, the Office for Human Research Protection (OHRP). We will use a random number rather than your name on study records. Because your name will not appear on the study records, the key to the random number will be kept separately from the study records in a different file that will be on a password protected computer. Pseudonyms will be used instead of your name in reference to your audio recordings. All information you provide and used in this study will be stored in a secure locked cabinet and on a password protected computer in Don's home. The audio recordings and documents will be stored in the locked cabinet and computer at Don's home until the dissertation is complete. After that time (December 2016), all information, including the audio recording, MTEBI results, and math histories will be destroyed. Your name and other facts that might point to you will not appear when we present this study or publish its results. For accuracy, Don will provide you with copies of all transcripts of your audio recordings for input.

VII. Contact Persons:
Contact Dr. Christine Thomas at 404-413-8065 or cthomas11@gsu.edu or Don Brown at 478-471-2816 or don.brown@mga.edu if you have questions, concerns, or complaints about this study. You can also call if you think you have been harmed by the study. Call Susan Vogtner in the Georgia State University Office of Research Integrity at 404-413-3513 or svogtner1@gsu.edu if you want to talk to someone who is not part of the study team. You can talk about questions, concerns, offer input, obtain information, or suggestions about the study. You can also call Susan Vogtner if you have questions or concerns about your rights in this study.

VIII. Copy of Consent Form to Participant:
We will give you a copy of this consent form to keep.

If you are willing to volunteer for this research and be audio recorded, please sign below.

_____ _____
Participant Date

_____ _____
Principal Investigator or Researcher Obtaining Consent Date

APPENDIX C
MATHEMATICS TEACHING EFFICACY BELIEF INSTRUMENT
(Enochs, Smith, Huinker, 2000)

Please indicate the degree to which you agree or disagree with each statement below by circling the appropriate value to the right of each statement.

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
When a student does better than usual in mathematics, it is often because the teacher exerted a little extra effort.	5	4	3	2	1
I will continually find better ways to teach mathematics.	5	4	3	2	1
Even if I try very hard, I will not teach mathematics as well as I will most subjects.	5	4	3	2	1
When the mathematics grades of students improve, it is often due to their teacher having found a more effective teaching approach.	5	4	3	2	1
I know how to teach mathematics concepts effectively.	5	4	3	2	1

I will not be very effective in monitoring mathematics activities.	5	4	3	2	1
If students are underachieving in mathematics, it is most likely due to ineffective mathematics teaching.	5	4	3	2	1
I will generally teach mathematics ineffectively.	5	4	3	2	1
The inadequacy of a student's mathematics background can be overcome by good teaching.	5	4	3	2	1
When a low-achieving child progresses in mathematics, it is usually due to extra attention given by the teacher.	5	4	3	2	1
I understand mathematics concepts well enough to be effective in teaching elementary mathematics.	5	4	3	2	1
The teacher is generally responsible for the achievement of students in mathematics.	5	4	3	2	1

Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching.	5	4	3	2	1
If parents comment that their child is showing more interest in mathematics at school, it is probably due to the performance of the child's teacher.	5	4	3	2	1
I will find it difficult to use manipulatives to explain to students why mathematics works.	5	4	3	2	1
I will typically be able to answer students' questions.	5	4	3	2	1
I wonder if I will have the necessary skills to teach mathematics.	5	4	3	2	1
Given a chance, I will not invite the principal to evaluate my mathematics teaching.	5	4	3	2	1

When a student has difficulty understanding a mathematics concept, I will usually be at a loss as to how to help the student understand it better.	5	4	3	2	1
When teaching mathematics, I will usually welcome student questions.	5	4	3	2	1
I do not know what to do to turn students on to mathematics.	5	4	3	2	1

APPENDIX D
HOW TO SCORE THE MTEBI
(Enochs, Smith, and Huinker, 2000)

Step 1: Item Scoring: Items must be scored as follows: Strongly Agree = 5; Agree = 4; Uncertain = 3; Disagree = 2; and Strongly Disagree = 1.

Step 2: The following items must be reversed scored in order to produce consistent values between positively and negatively worded items. Reversing these items will produce high scores for those high and low scores for those low in efficacy and outcome expectancy beliefs.

Item 3 Item 6 Item 8 Item 15

Item 17 Item 18 Item 19 Item 21

In SPSSx, this reverse scoring can be accomplished by using the recode command. For example, recode ITEM3 with the following command:

RECODE ITEM3 (5=1) (4=2) (2=4) (1=5)

Step 3: Items for the two scales are scattered randomly throughout the MTEBI. The items designed to measure Personal Mathematics Teaching Efficacy Belief (SE) are as follows:

Item 2 Item 3 Item 5 Item 6 Item 8

Item 11 Item 15 Item 16 Item 17 Item 18

Item 19 Item 20 Item 21

Items designed to measure Outcome Expectancy (OE) are as follows:

Item 1 Item 4 Item 7

Item 9 Item 10 Item 12

Item 13 Item 14

Note: In the computer program, DO NOT sum scale scores before the RECODE procedures have been completed. In SPSSx, this summation may be accomplished by the following COMPUTE command:

COMPUTE SE SCALE = ITEM2 + ITEM3 + ITEM5 + ITEM6 + ITEM8 + ITEM11 + ITEM15 + ITEM16 + ITEM17 + ITEM18 + ITEM19 + ITEM20 + ITEM21

COMPUTE OE SCALE = ITEM1 + ITEM4 + ITEM7 + ITEM9 + ITEM10 + ITEM12 + ITEM13 + ITEM14

APPENDIX E
BIOGRAPHICAL DATA SHEET

Name: _____

e-mail: _____

Age (check one):

_____20 – 24 years _____25 – 29 years _____30 – 34 years

_____35 – 39 years _____40 or more years

1. What was your **favorite** subject in high school?

_____

_____

2. What was your **least** favorite subject in high school?

_____

_____

3. What was your **favorite** subject to teach during student teaching experience?

_____

_____

4. What was your **least** favorite subject to teach during student teaching?

_____

_____

5. What grade are you going to teach?

_____

_____

6. What grade would you like to teach?

_____

_____

7. What mathematics courses did you take in high school?

_____

_____

_____

Appendix F
Interview Protocol

1. Tell me about when you decided you wanted to be a teacher and why?

2. What is your favorite subject and why?

    Probe: Tell me about a fun learning experience. What happened?

    Probe: Tell me about your favorite teacher.

    Probe: What did the teacher do?

3. What is your least favorite subject and why?

    Probe: What happened?

    Probe: What did the teacher do?

4. What is your favorite subject to teach and why?

    Probe: Did your favorite subject influence your favorite subject to teach and why?

    Probe: Did this playout in your student teaching and why?

5. What is your least favorite subject to teach and why?

6. Tell me about your student teaching experience.

    a. What were some of your favorite things about student teaching?

    b. What were some of your least favorite things about student teaching?

7. Talk about teaching math?

    Probe: Were you prepared?

    Probe: Did the student learns?

    Probe: Were the students engaged?

    Probe: Did you feel successful and why?

    Probe: What was your experience about teaching math?

    Probe: Tell me about your best lesson about teaching math.

Probe: Tell me about your least favorite lesson about teaching math.

Probe: How did you feel about your content knowledge?

Probe: What were some of the standards you used?

8. Tell me about your favorite lessons.

Probe: Why were these your favorite lessons?

9. Now that the student teaching experience has concluded, how you feel about teaching mathematics?

Probe: Are there any concerns?

Appendix G
Autobiographical Mathematics History

Now that you are completing your last mathematics course for your degree, reflect on your journey of studying mathematics from kindergarten to college. Please feel free to discuss specific events and/or persons (i.e. activities, experiences, teachers, etc.) from this journey. Discuss how you felt as a student learning mathematics, your challenges, how you reacted to them, and any successes as a student of mathematics. Also, please include your thoughts about mathematics (i.e. favorite subject, hated it, etc.).