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Investigating Mathematics Self-Efficacy Beliefs Of Elementary Pre-Service Teachers In A Reform-Based Mathematics Methods Course

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INVESTIGATING MATHEMATICS SELF-EFFICACY BELIEFS OF
ELEMENTARY PRE-SERVICE TEACHERS IN
A REFORM-BASED MATHEMATICS
METHODS COURSE

ABDELGHANI SETRA

DOCTORAL PROGRAM IN TEACHING, LEARNING AND CULTURE

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Dedication

This dissertation is dedicated to the memory and legacy of my departed parents, my mom Zahra and my dad Abdullah.

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ELEMENTARY PRE-SERVICE TEACHERS IN
A REFORM-BASED MATHEMATICS
METHODS COURSE

by

ABDELGHANI SETRA B.S., M.S., M.A.

DISSERTATION

Presented to the Faculty of the Graduate School of
The University of Texas at El Paso
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of the Requirements
for the Degree of
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without your love and support. There were times when I felt too worn-out to work, but you were always there to encourage me and to cheer me up, thank you.

Abstract

For the last thirty years research has unfailingly shown that teacher efficacy has a positive impact on student outcomes, making teacher efficacy an critical element in quality mathematics instruction. The purpose of this study is to examine the impact of a math methods course on the mathematics teaching efficacy beliefs of elementary pre-service teachers.

Seventy participants from four classes were students enrolled in ELED 4310 math methods course responded to the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) on the first and last week of class. Paired sample t-tests were used to analyze the quantitative data. A mixed methods design was implemented to collect and analyze quantitative and qualitative data. Instruments included pre- and post-condition surveys and semi-structured interviews. The four theorized sources of self-efficacy grounded in Bandura's social cognitive theory, served as the theoretical framework of this study. Semi-structured interviews were conducted with four pre-service teachers to examine how the theorized four sources of efficacy have influenced their self-efficacy beliefs.

Overall, the quantitative data on the PMTE and MTOE subscales of the MTEBI show statistically insignificant changes between the pre- posttest administration. But in some items in both subscales participants reported appreciable increase in their self-efficacy. The qualitative findings indicated that mastery experiences and vicarious experiences were the most influential sources in increasing the pre-service teachers' mathematics efficacy beliefs, with verbal persuasions and physiological states making an appreciable contribution. Results of this study can inform teacher preparation programs on the type of training that provide opportunities to positively impact mathematics teaching efficacy of preservice teachers.

Keywords: Elementary pre-service mathematics teacher, mathematics teaching self-efficacy, math methods course, teacher preparation.

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Chapter 1: Introduction

Over the past three decades, researchers have attempted to clarify and measure the concept of teacher efficacy (Bandura, 1977, 1997; Pajares & Miller, 1994, 1997; Pajares & Schunk, 2005; Pajares & Urdan, 2006; Lent, Lopez, & Bieschke (1991); K. J. Lent, Brown, Gover, & Nijjer, 1996; Palmer, 2006). Research on teacher efficacy has been inspired by the construct's strong effect on both student and teacher outcomes. Bandura (1977) defined self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 2). Bandura (1997) stated that self-efficacy beliefs influence motivation, affect, and actions more than what is objectively true. Self-efficacy beliefs shape the choice of activity, task perseverance, the level of effort expended, and ultimately, the degree of success achieved. Bandura's theory (1997) of self-efficacy suggests that teacher efficacy may be most malleable early in learning. He stated that the way individuals act could be predicted by self-efficacy beliefs, rather than by what they are capable of doing, as these self-perceptions can determine what individuals are capable of accomplishing with the knowledge and skills they possess (Bandura, 1986).

A large number of studies have revealed the existence of a positive relationship between teacher efficacy and student achievement. Woolfolk and Hoy (1990) remarked, "Researchers have found few consistent relationships between characteristics of teachers and the behavior of learning of students. Teachers' sense of efficacy is an exception to this general rule" (p. 81). Several studies have documented a positive relationship between teacher efficacy and student achievement (e.g., Armor et al., 1976; Ashton, Webb, & Doda, 1983). Teacher efficacy has been reported to influence how teachers persevere and interrelate with problematic students (Gibson &

Dembo, 1984), how teachers design and shape their instruction (Allinder, 1995), and how teachers manage their classrooms (Woolfolk, Rosoff, & Hoy, 1990).

For at least the past thirty years, mathematics education in the United States has been under the microscope. It has come under fire by policymakers and the general public. With the passage of the No Child Left Behind Act (NCLB) of 2001, the emphasis on teacher accountability and student achievement became a very debated issue. In this age of accountability, what is being demanded of schools is becoming more complex and challenging despite the fact that the organizational system of schools remains static and rigid. With increased accountability, American schools are being asked to engage in the systematic improvement of the educational experience of students, and to measure their success by students' academic performance.

A significant dilemma exists, however, in that some teachers who currently teach in public schools have not been adequately prepared to do this work, either through their professional education or their prior experience in schools. Adding to this problem is the difficulty in hiring and retaining quality mathematics teachers. The National Mathematics Advisory Panel (2008) and the National Council on Teacher Quality (2007) concur that quality mathematics teachers are the keystone to student achievement, and thus advocate for strong teacher preparation programs.

More than ever before, stakeholders in schools are tasked to increase achievement for all students. Salinas and Kritsonis (2006) argue that for students to reach this goal, quality teaching must take place in classrooms. Teacher quality, as well as accountability, is the ubiquitous topic in education among policymakers and the general public. As a result of this concern, pressure for school accountability has increased in the form of teacher quality (Darling-Hammond, 1999).

Consequently, improving the quality of teaching mathematics relies greatly on the improvement of the teacher. Research has indicated that the quality of teaching mathematics is dependent on teacher efficacy, or teachers' attitudes and beliefs about their abilities to have a positive effect on student learning (Enon, 1995).

1.1 Statement of the Problem

The results of the 2006 PISA study on mathematics achievement have exposed the disturbing state of mathematics education in the United States. In the United States, students' performance in mathematics has consistently fared far below that of students in other countries. Unfortunately, it is often implied that the United States has lost its competitive edge in the global economy because of poor precollege mathematics and science preparation (Helgeson, 1977; Darling-Hammond, & Hudson, 1990; Bazler, 1993; Niess, 2006). For the United States to be able to compete in a more and more technological global economy, it is vital to educate and prepare a well-trained scientific workforce. For this reason, an educational improvement in US schools is necessary, which also relies heavily on improving the quality of the teachers. All stakeholders, including educators and policymakers, all agree that if teachers are not well prepared to address the academic needs of their students and the content knowledge demands of their respective subjects, any reform strategy will likely not succeed.

Although the results of the 2007 Trends in International Math and Science Study (TIMSS) indicate progress in the math education of fourth and eighth-grade students in the United States when compared to 1995 results, US students are still outperformed by students around the world. In 2007, the average scores of American fourth-grade students were higher than 23 of the 35 other countries included in the TIMSS report. The scores of the American

eighth-grade students were greater than 37 of the 47 other countries included in 2007. For the past half-century, educational leaders, and practitioners have been attempting to answer the lingering question of why some students, achieve so little in the public school model. Ball et al. (2001) contend “much about mathematics education has remained the same as it was in 1950 or even 1900...” To affect student mathematics proficiency, it is of the utmost importance that teachers become knowledgeable about the methods of building conceptual understanding and how students learn mathematics (Carpenter et al., 1989). A large body of research supports the notion that to be an effective teacher in mathematics, at any level requires competence in subject knowledge (Wilson, Floden, & Ferrini-Mundy, 2001). The teacher must understand not only the content of the material to be taught, but also decide what the best way to deliver that material is, how to identify and assess those needs and be flexible enough to modify and adapt the instruction to individual student needs.

The continual concern over improving mathematics education has always prompted educators to look for ways to provide opportunities for all students to be successful (NCTM, 2003). Research has shown that the instructional methods teachers' use has a substantial impact on the mathematics content that taught and learned (Spungin, 1996). If mathematical content and methods of instruction are not adequately presented in teacher training, then teachers are unlikely to dispense the content in ways that are meaningful to children. Teachers will more likely rely on a more traditional way of teaching mathematics; that is about telling, or providing step-by-step explanations of procedures while students learn by listening and practicing these methods. The research literature in mathematics education makes a compelling case for the deficiencies of this traditional approach (Hiebert, 2003). This traditional approach to teaching mathematics is in contrast to the mathematics reform perspective. The NCTM (1989, 1991,

2000) has been advocating, for at least two decades, a constructivist view of teaching and learning. This view emphasizes students' conceptual understandings and discourse in the mathematics classroom. Studies have highlighted the benefits of such instructional programs and have proven that students can acquire higher levels of mathematical concepts as well as skills than those in more traditional programs (Ebby, 2000; Hiebert, et al, 2003; Hiebert et al, 2007; Berk, et al, 2009; Jansen, et al, 2009; Lampert & Graziani, 2009; Morris, et al, 2009).

1.2 Purpose and Significance of the Study

A large body of educational literature on teacher effectiveness has revealed the impact of teachers' behaviors on their students' learning. However, few studies have been conducted that integrate both teacher efficacy and teacher self-efficacy beliefs. Many of the correlates of high teacher efficacy are consistent with the vision of mathematics proposed by NCTM. This study will strive to add to the body of research knowledge in an area of mathematics teaching efficacy beliefs of elementary pre-service teachers, to further reveal the need for this research, and to provide a basis for methodology decisions. Understanding what factors might be related to higher teaching efficacy could help teacher preparation programs by focusing on those factors when providing preparation to pre-service elementary teachers. This study aims to provide valuable insight into the nature of mathematics teacher efficacy of pre-service teachers and provide understanding about possible ways to boost the level of mathematics teaching efficacy among elementary education pre-service teachers.

Researchers in mathematics education are applying Bandura's theory of self-efficacy to teaching. They have acknowledged the importance of this type of research by realizing that the individual teacher's mathematics efficacy beliefs are factors that have an effect on change in

mathematics' classrooms (Tschannen-Moran, et al., 1998, 2001; Guskey, 1981; Gibson, et al, 1984; Riggs & Enochs, 1990; Enochs, et al, 2000; Wenner, 2001; Heneman, et al, 2006; Gordon, 2001; Swars, 2005; Swars, et al, 2006; Tournaki & Podell, 2005; Utley, et al, 2005; Palmer, 2006; Cantrell, 2003; Poulou, 2007; Charalambos, et al, 2008). Briley (2012) contends that a clearer picture of the relationships among mathematics beliefs, mathematics self-efficacy, and mathematical teaching efficacy for elementary pre-service mathematics teachers is needed to gain a deeper understanding of the complexity of learning how to teach.

The goal of this mixed methods study is to gain a greater understanding of the influences on mathematics teacher efficacy for pre-service elementary teachers to inform teacher education and eventually future professional development programs. This study examines pre-service elementary teachers' mathematics teaching efficacy beliefs to uncover whether or not those beliefs have changed after the completion of math methods courses. The results of a self-report survey instrument (MTEBI) of individuals' mathematics self-efficacy are used to find out the extent to which mathematics teaching efficacy and mathematics self-efficacy beliefs change in a teacher certification program. It will explore if a paradigm shift in pre-service teachers' beliefs happens, as well as attitudes, and motivation about teaching mathematics occurs.

Ma (1999) argues that preservice teacher education programs have a determining role in influencing the quality of the mathematics teaching that takes place in most elementary schools. A large body of research has ascertained the importance of pre-service education programs in increasing the mathematics content knowledge of pre-service elementary teachers and in positively affecting their beliefs regarding mathematics and the teaching of mathematics (Ball, 1990; Battista, 1986; Quinn, 1997).

Since teacher education programs play a major role in promoting teacher quality, many questions are raised for those involved in the mathematics teacher education of pre-service elementary teachers. The results of this study of teacher beliefs could provide evidence about the mathematics methods course's effectiveness and could be used to inform practice for the teachers' preparation programs. The following research questions form the basis of the study:

- Q1. Do pre-service elementary teachers' mathematical self-efficacy change after enrolling in a reform-based university elementary mathematics methods course?
- Q2. How do pre-service elementary teachers who have completed a reform-based university elementary mathematics methods describe their beliefs?
- Q3. How do pre-service elementary teachers who have completed a reform-based university elementary mathematics methods describe their classroom learning experiences?
- Q4. Do quantitative findings on teacher self-efficacy constructs relate to the qualitative findings obtained from the four case-study interviews? In this way, are the quantitative results explained in more detail through the qualitative data?

This study was designed to investigate these questions and contribute to the literature regarding pre-service elementary teachers' self-efficacy beliefs to teach mathematics. It appears that it is essential to create a theoretical framework to understand fully pre-service teacher efficacy and possibly uncover the contributing factors influencing pre-service teacher efficacy in the context of the pre-service program. For example, findings from quantitative data about pre-

service mathematics self-efficacy can be explored further with qualitative focus groups to better understand how the personal experiences of individuals match up to the instrument results.

1.3 Theoretical Framework

Bandura's (1986) construct of self-efficacy theory will serve as the framework for this study's on mathematics self-efficacy beliefs in pre-service mathematics elementary teachers. Bandura (1997) defines perceived self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainment." Self-efficacy belief has to do with self-perception of competence rather than the actual level of competence. Self-efficacy is a motivational construct that is based on how teachers perceive their abilities rather than their actual levels of knowledge (Tschannen-Moran & Woolfolk-Hoy, 2001). Dellinger, Bobbett, Olivier, and Ellett (2008) offer a definition of self-efficacy beliefs, which is analogous to Bandura's (1977) definition. Self-efficacy beliefs are individuals' capabilities to perform specific teaching tasks at a specified level of quality in a specified situation (Dellinger et al., 2008, p. 752).

Self-efficacy is situated within a social cognitive theory of human behavior. The construct was first introduced in 1977 by Bandura in his work "Self-efficacy: Toward a Unifying Theory of Behavioral Change." (see Figure 1.1)

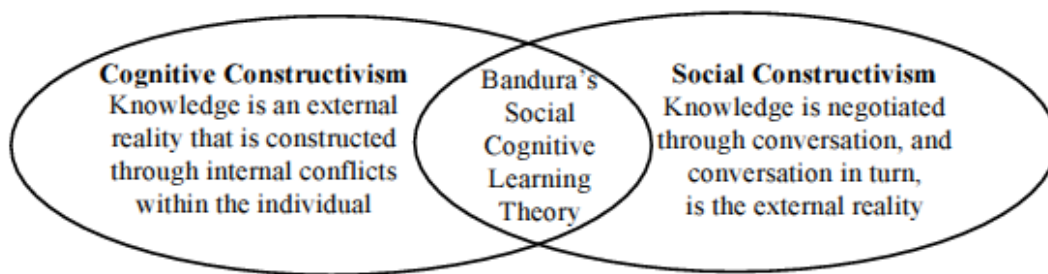


Figure 1.1: Bandura's Unifying Social Cognitive Learning Theory

Social Cognitive Learning Theory suggests that learning occurs through observations of others in a social context. According to Bandura, the “learning process requires both the cognitive processing and decision-making skills of the learner” and “results in the acquisition of verbal and visual codes of behavior that may or may not later be performed” (Gredler, 2001, p. 345). Albert Bandura’s Social Cognitive Learning Theory suggests that learning is an internal process. It is influenced by a dynamic relationship involving a person, his or her behavior, and the environment (Bandura, 1977, 1986). People are motivated to attempt behavior that they believe can result in positive outcomes. Individuals with high self-efficacy who believe they can perform well are more disposed to view difficult tasks as something to be mastered rather than to be avoided. People with a strong sense of self-efficacy still view tasks as challenges to be overcome, but they recover quickly from setbacks, on the other hand, those with a weaker sense of self-efficacy shun challenging tasks believing them to be beyond their capabilities. Bandura identified four major sources of self-efficacy, the most important being mastery experience. Vicarious experience, verbal (social) persuasion and physiological state (emotional arousal) are also sources of self-efficacy expectations (Bandura, 1977).

The theoretical underpinning of this study, which is based on Bandura’s self-efficacy theory, is of particular relevance to practitioners who are involved in pre-service teacher preparation programs. Learning experiences in the pre-service teacher preparation programs serve to develop the prospective teachers’ understanding and ability. Research demonstrates that effective teachers believe in their abilities (Minor et al., 2002). Preservice teachers who believe they are better prepared with the knowledge and skills necessary to teach math are likely to persist in efforts to teach math successfully (Hackett & Betz, 1989).

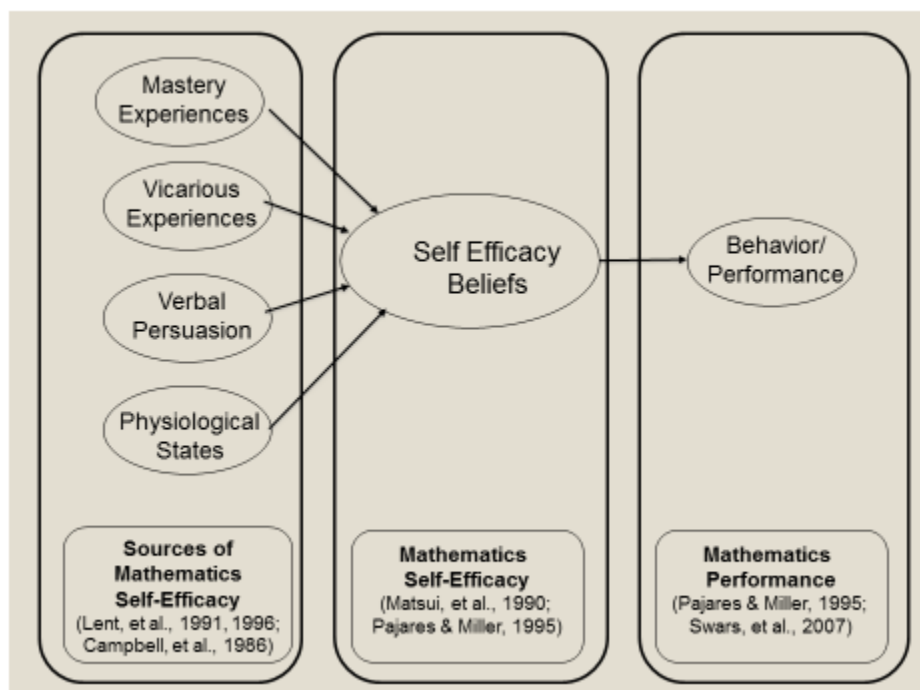


Figure 1.2: Theoretical Framework

According to Bandura's Social Cognitive Theory, learning is a three-way interlocking relationship between the environment, personal factors, and behavior (Figure 1.2). Self-efficacy is dependent on the domain of action, such as mathematics teaching, and how the teacher demonstrates beliefs about her or his capabilities in the presence of challenging situations that pertain to teaching math. Teacher efficacy is considered to be subject-matter specific (Tschannen-Moran & Woolfolk Hoy, 2001). They define teacher efficacy as a teacher's "judgment of his or her capabilities to bring about desired outcomes of student engagement and learning ..." (Tschannen-Moran & Woolfolk Hoy, 2001, p. 783).

In the area of mathematics, teaching efficacy encompasses two facets that are similar to the two dimensions of teacher efficacy: personal mathematics teaching efficacy and mathematics teaching outcome expectancy (Enochs et al., 2000; Briley, 2012). Several studies have indicated a statistically significant increase in mathematics teaching efficacy upon completion of one

methods course or a sequence of methods courses as well as at the end of a mathematics content course (Charalambous, Philippou, & Kyriakides, 2008; Huinker & Madison, 1997; Rethlefsen & Park, 2011; Swars et al., 2007; Utley, Moseley, & Bryant, 2005). Mathematics teaching efficacy also was found to be associated with teachers' past experiences as learners of mathematics (Charalambous et al., 2008; Swars, 2005; Briley, 2012; Brown, 2012).

This study intends to provide valuable information on teacher efficacy in the context of a university teacher preparation program. Identifying the specific factors and determining their impact on levels of mathematics teacher efficacy will be instrumental in developing strategies for a teacher preparation program so that pre-service teachers can become effective in-service mathematics teachers.

1.4 Delimitations of the Study

The study was delimited to investigating the change in mathematics self-efficacy of pre-service elementary teachers enrolled in one semester of a math methods course in one university. The quantitative part of the study was based on data collected from questionnaires from a survey. The data interpretation in this part of the study was limited by the representation of items on the survey. One additional delimitation of the study is the relatively small sample: four pre-service teachers took part in the interviews in the qualitative part of the study.

1.5 Plan of the Dissertation

This dissertation is organized as follows:

Chapter Two addresses the literature review pertaining to teacher beliefs, teacher efficacy in the context of pre-service mathematics education. The literature review describes

the social cognitive theory background, the development of measurements of teacher self-efficacy instruments, preservice teacher beliefs, and mathematics teacher self-efficacy.

Chapter Three provides a description of the methodological basis for this research and the mixed methods design of this study. This chapter describes the methodological quantitative and qualitative steps of this research study.

Chapter Four presents an in depth account of the collective and individual stories of elementary pre-service teacher self-efficacy in a math methods course during the teacher preparation program. Participant experiences are investigated through survey and interview results. The findings develop from the merging of quantitative and qualitative data of preservice teacher responses from the interviews.

Chapter five reexamines the research questions and presents some major findings relating elementary pre-service teacher self-efficacy and some contributing factors. A summative discussion offers suggestions and considerations for pre-service programs. Finally, the implications of this study on further research are presented.

Chapter 2: Review of Literature

This study is predicated upon Bandura's (1997) social cognitive theory. This chapter presents an analysis of the relevant literature focusing on the areas of teacher efficacy and teachers' self-efficacy beliefs. A large number of researchers have explored teacher efficacy, and this review will discuss the quantitative research that has significantly influenced the definition and the measurement of teacher efficacy, as well as the qualitative studies that offer the understanding of the reasoning process in teachers' appreciation of their self-efficacy beliefs.

In some studies educational researchers have used *Teacher efficacy* and *Teacher Self-Efficacy Beliefs* interchangeably and, as a result, it can be confusing to some extent. Therefore, it is critical to define these terms to make a distinction between them. *Teacher efficacy* is a social construct that involves the perception of the teacher's competence required to influence outcomes, whereas *teacher's self-efficacy* is defined as an individual's decision of his/her capability to accomplish certain levels of performance.

2.1 Teacher efficacy

Over the past three decades, researchers have undertaken the task to explain and efficiently measure teacher efficacy theoretically. Teacher efficacy is a social construct that was developed more than 30 years ago. Around the mid-1960s, research on teacher efficacy or teachers' sense of efficacy (as it was referred to in earlier studies) was based on Rotter's general expectancy theory. It focused on internal versus external locus of control, and subsequent studies were framed by Bandura's (1977; 1982; 1993; 1997) theory of self-efficacy. This review is an attempt to clarify different terminology, as well as theoretical models, and operational definitions to measure and to identify the constructs under investigation.

Teacher efficacy resulted from the conceptualization of self-efficacy of Bandura's (1986) social cognitive theory. According to Bandura (1977), teacher efficacy refers to teachers' perception of their capabilities to lead to desired outcomes of student engagement and learning, even with those students who may be difficult to teach or unmotivated. Under the development of social cognitive theory and self-efficacy, researchers in the field of education began to be interested in this concept and how it could be used in teaching and learning.

Teacher efficacy was defined as the extent to which the teacher believes to have the capability to affect student performance (Berman et al., 1977, p. 137). Since then, an extensive body of research established a relationship between teachers' sense of efficacy and meaningful educational outcomes such as student achievement and motivation (Ashton and Webb, 1982; Pajares, 1996; Tschannen-Moran and Woolfolk Hoy, 2001; Labone, 2004). Guskey and Pasaro (1994) defined it as —teachers' belief or conviction that they can influence how well students learn, even those who may be difficult or unmotivated (p. 3). Tschannen-Moran, Woolfolk-Hoy, and Hoy (1998) defined teacher efficacy as —the teachers' beliefs in their capabilities to organize and execute courses of action required to accomplish a specific task in a particular situation (p. 233). In other words, teacher efficacy has focused on the self-judgment of competence in skills required to accomplish specific tasks in certain contexts. That is, it reflects a teacher's belief that the consequences of teaching, such as student learning and motivation, are controlled internally (Tschannen-Moran, Woolfolk-Hoy, & Hoy, 1998).

2.1.1 Rotter's Theory of Locus of Control

Rotter's (1966) theory of locus of control deals with how individuals consider rewards or outcomes as contingent upon their intrinsic behavior (internally-driven) or stimulated by extrinsic factors such as luck or (externally-driven). According to Rotter an individual with an internal locus

of control has the certainty that their rewards are dependent on their decisions and efforts. However, if they do not succeed, they perceive it is a result of their lack of effort. Individuals with an internal locus of control tend to internalize both failures and successes. On the other hand, persons with an external locus of control perceive their life as being subjected to control by luck or other people, particularly those of higher status than them. When they do not succeed, they think forces beyond their control are responsible for their failure. Individuals with an external locus of control tend to externalize both successes and failures. Evidence has supported the theory that locus of control is learned and can be refashioned.

To measure the level of internal-external orientation, Rotter (1966) developed the I-E scale. The scale consists of 23 items using forced-choice format and six filler questions. According to Marsh and Richard (1984), the scale is based on the assumption that I-E is a bipolar construct. They contend that the bipolarity of responses to the Rotter scale is a necessary condition of the forced-choice format. The scale makes a distinction between a belief in internal control (dependent upon the individual's actions) vs. external control (dependent upon chance or the actions of others). Each item consists of one externally-oriented statement and one internally-oriented statement (e.g., (a) *Many of the unhappy things in people's lives are partly due to bad luck* or (b) *People's misfortunes result from the mistakes they make*). In general, the I-E scale measures beliefs (generalized expectations) about the relationship *between behavior and outcomes*. Thus, the internal vs. external locus of control, as conceptualized and operationalized by Rotter, is an overall belief, or generalized expectation, about relationships between behavior and outcomes or "the nature of the world" (p. 10). Rotter's (1966) theory of locus of control was used to develop two items used in two studies sponsored by the RAND Corporation in the 1970's.

2.1.2 The RAND studies

In the mid-1970s teacher self-efficacy concept as it was referred to *Teacher Sense of Efficacy* was investigated by two research groups from the RAND Corporation (Berman et al., 1977; Armor et al., 1976). The RAND Corporation was a federally funded project designed to introduce a range of innovative practices in U. S. public schools. The RAND Corporation conducted a study on the factors impacting the reading achievement of students in the Los Angeles Unified School District. From the results of this study, Armor et al. (1976) determined that, in addition to student background characteristics, teacher attributes influenced the variation in the reading scores of minority students significantly. Teacher attributes included background characteristics (e.g., ethnicity) and predispositions toward teaching, which the authors identified as "the extent to which the teacher believes he or she can produce an effect on the learning of students" (Armor et al., 1976, p. 23).

This construct, which the researchers called *teacher efficacy*, was measured with two questions that were based on Rotter's locus of control theory. The two items that were developed are presented below and will be referred as RAND Item 1 and RAND Item 2. The first question, (RAND Item 1) which reflected external locus, was: "*When it comes right down to it, a teacher really can't do much – most of a student's motivation and performance depends on his or her home environment.*" A teacher who strongly agrees with this statement believes that regardless of any efforts exerted by the teacher, it is always the external factors of the environment that supersede them. The impact of external factors compared to the influence of teachers have been referred to as general teaching efficacy (GTE) (Ashton et al., 1982). The second question, (RAND Item 2) which reflected internal locus, was "*If I try hard, I can get through to even the most difficult or unmotivated students*" (Armor et al., 1976, p. 73). A teacher who strongly agrees

with this statement exhibits confidence in his or her ability (i.e., Personal Teaching Efficacy (PTE)) to influence student learning regardless of the difficulties present. The results of the study suggested that teachers with a high teacher efficacy believed they could control or influence student motivation and academic performance.

Although the RAND study initiated an important conversation in educational research, a general confusion of the construct's development arose among researchers' use of the term teacher *efficacy* when the items, in fact, signified Rotter's concept of *locus of control* (Cybulski, 2003). The RAND study has mainly provided the model for subsequent studies. For several years following the RAND study, researchers (Guskey, 1981; Ashton et al., 1982; Riggs and Enoch, 1990; Gibson and Dembo, 1984) used Rotter's locus of control theory as a groundwork to seek a greater comprehension of a construct that effectively impacted student achievement.

2.1.3 Other Rotter-based Studies

Guskey (1981) used the Responsibility for Student Achievement instrument to measure how much teachers perceived their responsibility for student results, whether they might be successes or failures. The findings of this study indicated that teachers feel more responsibility for successes than for failures. They held a strong belief in their ability to influence students' positive outcomes than to prevent negative ones.

Tschannen-Moran and Woolfolk Hoy (2001) explain that as teachers analyze the teaching task and its context, they evaluate the importance of the different factors that might make teaching difficult, or that behave as constraints against an assessment of the resources available that make learning possible. Their model interprets teacher efficacy as a context and tasks specific construct. It is evident that teachers do not always feel efficacious about every teaching situation. Thus, Tschannen-Moran et al. (1998) assert, "greater specification is needed to

understand what information is drawn from the task of teaching, the context, and the assessment of personal teaching competence to form self-efficacy” (p. 239).

Rose and Medway (1981) built on Rotter’s Locus of Control and created the Teacher Locus of Control (TLC) instrument to measure how teachers assign responsibility for student successes or failures either internally to the teacher or externally to the student. They observed that the TLC was a more reliable predictor of teacher behaviors than Rotter’s (Internal-External) I-E Scale, possibly because it is more situational, reflecting a teaching context. The TLC predicted teachers’ disposition to implement innovative instructional approaches, whereas Rotter’s scale did not.

Ashton et al., (1982) created a seven-item instrument, the Webb Scale, for each of the seven items, teachers had to answer which statement they agreed most strongly with the first or the second. They observed that teachers who scored higher on the Webb efficacy scale expressed fewer negative interactions in their teaching. However, none of these measures were adopted to any great extent in subsequent teacher efficacy research. Ashton et al., (1982) also used the Ashton Efficacy Vignettes instruments, which consisted of 25 teaching problem situations to investigate teachers’ sense teaching efficacy. In one version, teachers were required to self-assess themselves as extremely ineffective to extremely effective; the second version required the teachers to respond whether they are much less effective than most teachers or much more effective than other teachers. The researchers worked on the assumption that teacher efficacy was mostly subject to the teaching context. They used items such as; *"Your school district has adopted a self-paced instructional program for remedial students in your area. How effective would you be in keeping a group of remedial students on task and engaged in meaningful learning while using these materials?"* This study revealed that the majority of the teachers

surveyed tended to judge the effectiveness of their performance in comparison with the performance of other teachers. These findings suggested that in this instance, teacher efficacy can be viewed as a norm-referenced construct. The norm-referenced vignettes provided a significant correlation to the Rand items, whereas, the self-referenced did not. Although the RAND items were used as a basis to measure teacher efficacy, subsequent teacher efficacy studies did not utilize this instrument extensively.

2.2 Teacher Self-Efficacy

Self-efficacy is grounded in the work of Bandura and his definition of self-efficacy. Bandura defined self-efficacy beliefs as "judgments of how well one can execute courses of action needed to deal with potential situations" (Bandura, 1982). In his theory, he suggests that both general outcome expectancy (GTE) and personal self-efficacy (PSE) determine an individual's behavior. According to Bandura (1997), self-efficacy influences human functioning through motivation, thoughts, feelings and actions.

Bandura (1977) introduced self-efficacy as part of a theory of behavior that encompasses, yet different from, other descriptions of behavior. In social cognitive theory, self-efficacy is one component of a simple behavioral model previously termed reciprocal determinism (Bandura, 1986) now referred to as the triadic reciprocal causation model (Bandura, 1997; Pajares, 2002). The model (Figure 2.1) consists of three elements (personal, behavior, and environmental) that are hypothesized to interact reciprocally. In this model, self-efficacy beliefs are personal factors that are supposed to be instrumental in the human agency by facilitating connections between knowledge and action (Bandura, 1982). Bandura contends that self-efficacy beliefs are reliable predictors of an individual's accomplishments and therefore are the foundation of human agency.

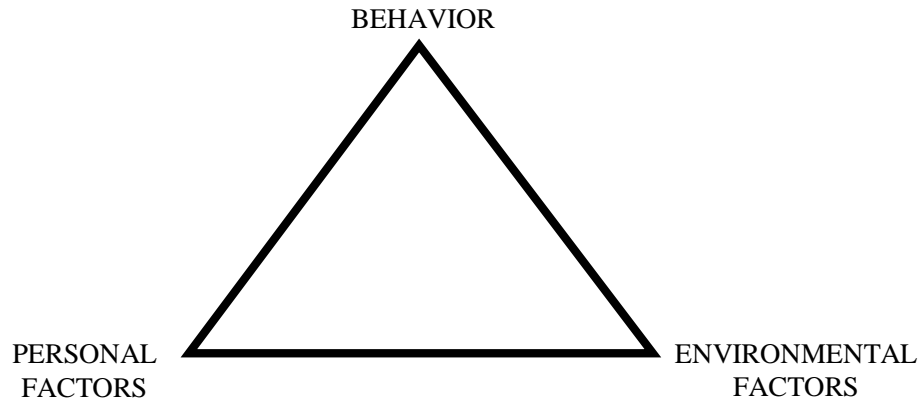


Figure 2.1: Bandura's Triadic Reciprocal Causation Model

Self-efficacy belief is a social cognitive construct that involves a person's perceptions of her or his abilities, attitudes, and cognitive skills in the self-system (Bandura, 1977). Bandura believes that individuals develop generalized expectancies about behavioral contingencies based on experience. According to Bandura, promoting particular beliefs about one's personal effectiveness and capabilities are domain- and context-dependent. Other researchers (Dellinger, Bobbett, Olivier, and Ellett, 2008) concur and describe self-efficacy beliefs as individuals' abilities to perform given teaching tasks at a particular level of quality in a specified situation (Dellinger et al., 2008, p. 752). Given that, self-efficacy is dependent on the domain of action, such as mathematics teaching, and how the teacher exhibits beliefs about her or his capabilities when tackling difficult situations that relate to teaching mathematics. Accordingly, understanding self-efficacy beliefs and the influence this construct has on a teacher's success is critical.

Bandura stresses, nonetheless, that self-efficacy and self-esteem may sometimes be confused with one another even though these two constructs are different. Self-efficacy is mostly about judgments of own capabilities, whereas self-esteem is about perceptions of self-worth (1997, p. 11). Tschannen-Moran and Woolfolk Hoy (2001, p. 783) concur with Bandura in that

teacher efficacy or teacher's judgments of their abilities "to bring about desired outcomes of student engagement, and learning affects the effort teachers invest in teaching. Teacher efficacy also affects the goals they set, their persistence in difficult teaching circumstances, and their resilience in the face of setbacks.

Bandura's self-efficacy consists of two dimensions: efficacy expectations and outcome expectancies. Efficacy expectation is defined as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p.2). While, outcome expectancy is the belief that the behavior will produce particular results (Bandura, 1986). Bandura (1977; 1986; 1982; 1993; 1995c; 1997) repetitively makes a distinction between efficacy expectations and outcome expectations by stressing the chronological order of occurrence and focus of each type of expectation (Figure 2.2).

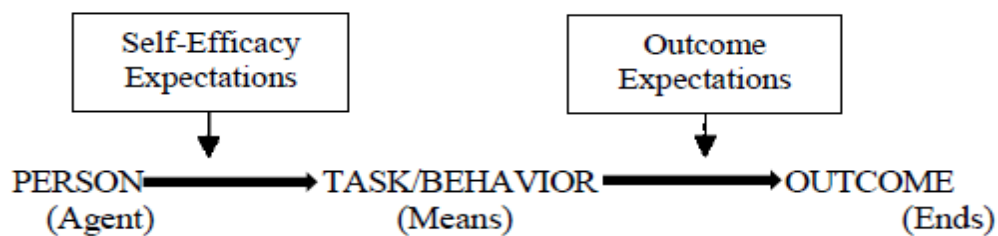


Figure 2.2: Chronology and Focus of Self-Efficacy and Outcome Expectations
(see Dellinger, 2001)

The construct of personal self-efficacy has been defined as the belief in a person's ability to organize and execute the courses of action required to produce given results (Bandura, 1997). On the other hand, outcome expectancy is a judgment of the possible consequence such performances will generate. Bandura (1997) states, "human behavior and affective states would be best predicted by the combined influence of efficacy beliefs and the types of performance outcomes expected within given social systems" (p. 20) (Table 2.1).

Table 2.1: Relationships between Efficacy Beliefs and Outcome Expectancy

	High levels of Efficacy Beliefs	Low levels of Efficacy Beliefs
High Outcome Expectancy	Individuals see themselves as capable of performing behaviors that can lead to valued outcomes	Individuals see themselves as incapable of performing behaviors that can lead to valued outcomes
Low Outcome Expectancy	Individuals are likely to become engaged and work to change environmental conditions which inhibit positive outcomes for successful performances	Individuals tend to behave with resignation and feel powerless.

Bandura goes on to state that self-efficacy beliefs can motivate people towards specific actions, therefore, having predictive value. He also suggests that other self-referent constructs, such as self-concept are linked to outcomes mostly through the influence of self-efficacy beliefs. One's sense of self-efficacy mediates the effects of self-concept on task success. For instance, individuals with high levels of efficacy beliefs and low outcome expectations would be more motivated to confront the challenge presented by the task at hand and manipulate the environment to produce positive results for successful performances. On the contrary, individuals with low efficacy beliefs and low outcome expectations will be likely to feel powerless and renounce because they perceive themselves as incompetent not being able to perform with success.

According to Bandura's Social Cognitive Theory, efficacy beliefs influence choices, "when applied to teaching, social cognitive theory predicts that the decisions teachers make about their classroom practices are directly influenced by their sense of efficacy for teaching. The higher teachers' sense of efficacy, the most likely they are to overcome obstacles and persist

in the face of failure. Such resiliency, in turn, tends to foster innovative teaching and student learning." (Goddard, Hoy, and Woolfolk Hoy, 2004). Self-efficacy beliefs determine how people feel, think, motivate themselves and behave. Such beliefs produce these diverse effects through four processes. They include cognitive, motivational, affective and selection processes (Bandura, 1994). A strong sense of efficacy enhances human accomplishment and personal well-being in many ways (Bandura, 1994). When people believe that they are self-efficacious, they are more motivated to do well in a given task; they are more likely to put in a greater effort and work longer at the task (Mayer, 2008). The most efficient way of building a strong sense of efficacy is through successful experiences. Successes create a firm belief in one's efficacy. On the other hand, failures undermine it, especially if failures occur before a sense of efficacy is firmly established. Bandura (1997) contends that efficacy beliefs are most malleable early in training. Once they are set, they become resistant to change. According to some researchers (Pintrich, 2000; Wolters et al., 1996), once in place, self-efficacy beliefs are likely to become somewhat stable over time and may become resistant to change. However, in some instances self-efficacy beliefs can be increased or diminished through the Bandura's four sources of efficacy. Bandura's model of triadic reciprocal causation (Figure 2.1) connecting the person, environment and behaviors provide opportunities for learning through a) mastery experiences, b) vicarious experiences, c) verbal and social persuasion and d) physiological and emotional states.

Bandura (1986, 1997) hypothesized that self-efficacy beliefs are flexible during skill acquisition when individuals are engaged in new tasks. Self-efficacy beliefs can be shaped or transformed by performance accomplishments, vicarious experiences, verbal persuasion, and physiological states (Bandura 1977, 1986). When an individual experiences success at a particular task (mastery experiences), observes role models, either peers or teachers, perform the

task successfully (vicarious experiences), is encouraged and supported by those peers or role models (verbal persuasions), and is stimulated about the task so that it puts the student in a positive frame of mind (physiological states), the student's self-efficacy beliefs may be enhanced: the student's self-efficacy beliefs may be boosted. Even if the individual could experience failure occasionally, it is likely that they would notice an improvement in skills, thus an increase in their self-efficacy.

Mastery experiences have been proven to be the most effective source for the formation of self-efficacy beliefs (Bandura, 1982). Mastery experiences source of information is about the ability gained as a result of successful or yet unsuccessful performance of tasks in a given context. How much effort put forth by the individual to accomplish a task can also reveal the ability level, but when the individual experiences failure after putting great effort, their efficacy belief can be diminished. In the same way, the success that is achieved with external help does not provide a clear picture of one's personal ability when compared to success driven by internal motivation. Exposure to sources of efficacy information is necessary but not sufficient to modify efficacy beliefs. Instead, it is through the combination of cognitive, motivational, affective and selection processes that efficacy information is filtered to form self-efficacy beliefs that regulate human functioning (Bandura, 1977; 1997).

2.3 Difference between teacher efficacy and teacher self-efficacy

Teacher efficacy as defined by Bandura (1977, 1997) is a social construct that involves the judgment of a teacher's competence required to influence outcomes, whereas teacher self-efficacy is about the confidence to accomplish a specific task in a particular context. Bandura (1977, 1997) has explained how self-efficacy beliefs differ from teacher efficacy beliefs

regarding expectations of behaviors, that is efficacy and outcome expectations. While efficacy expectations focus on the conviction that a given behavior can be successfully performed to achieve specific outcomes, outcome expectations focus on whether an estimated behavior can lead to either a negative or a positive outcome. Therefore, teacher self-efficacy is related to efficacy expectations and teacher efficacy is related to outcome expectations of behaviors.

Tschannen-Moran et al. (1998) view teacher efficacy as the “teachers’ belief in his or her capabilities to organize and execute courses of action required to be successful in accomplishing a specific task in a particular situation” (p.233). Tschannen-Moran & Woolfolk Hoy (2007, p. 954) argue that there is a real need to know more about how those beliefs are formulated and sustained throughout a teacher’s career. According to Tschannen-Moran & Woolfolk Hoy (2001), teacher efficacy is conceived to be subject-matter specific. For example in the domain of mathematics, teaching efficacy consists of two dimensions that are parallel to the two dimensions of teacher efficacy: personal mathematics teaching efficacy and mathematics teaching outcome expectancy (Enochs et al., 2000). GTE is the outcome expectancy to have all students learn (Armor et al., 1976). A teacher's efficacy belief is an estimation of their capacity to bring about desired outcomes of student learning and involvement.

According to Rotter (1966), outcome expectation is linked to the locus of control - a generalized expectancy about the connection between behavior and outcome. On the other hand, teacher self-efficacy belief is task and situation-specific (Bandura, 1997), which focuses on performing a specific teaching task in a particular teaching situation (e.g., classroom or students). When predicting human behavior, self-efficacy expectations turned out to be better predictors than a combination of efficacy and outcome expectations because measurements of self-efficacy

beliefs are task- or behavior-related, while those of teacher efficacy are outcome-based (Bandura, 1977).

2.4 Measurement of Teacher Efficacy

Efficacy is measured through specific objective indicators such as people responding to questionnaires reporting their efficacy beliefs. On the other hand, measuring people's perceived self-efficacy is more complex. It involves not the skills that the individuals possess to perform a certain task, but collecting the information about the beliefs of how they can use those skills in a variety of situations (Bandura, 1997). Henson (2002) contends that the study of teacher efficacy presents significant limitations from poor construct validity and poor instrument validity. She suggests that rigorous measurement methodologies should be used with the inclusion of qualitative methods of inquiry into this field of study. Labone (2004) agrees and suggests that qualitative methods should be utilized to provide more understanding of how teacher efficacy beliefs are formed. One of the most vital goals within the field of study of teacher efficacy is the development of a reliable and valid instrument that measures this construct.

Chen & Zimmerman (2007) cited a concern that might result in measuring self-efficacy. They looked at how the calibration of math self-efficacy instruments affected students' response to self-evaluations or effort judgments. They stated, "the difficulty level of the task may also influence one's accuracy in estimating one's capability to solve the task" (p. 224). Onafowora (2005) brought attention to a similar concern when studying teacher efficacy issues. She conducted a mixed methods study design to measure the level of self-efficacy of novice teachers. The data revealed an inconsistency in the results with teachers presenting higher self-

efficacy on the Likert scale instruments and the opposite on the results from written responses to open-ended questions.

Educational researchers have utilized many different tools to measure the sources of self-efficacy. In quantitative studies, there are many issues related to constructing validity or to theoretical guidelines related to the nature of the sources. Few researchers have, however, examined the sources using a qualitative approach.

2.4.1 Measuring the Sources of Self-Efficacy Quantitatively

Many researchers have used various approaches to assess the validity of the items used to measure the sources of the Self-Efficacy construct. By the mid-1970s inclusion of two items on a RAND study in the seventies (Armor et al., 1976) launched the idea of measuring teacher efficacy. The RAND researchers included those items based on Rotter's (1966) theory of locus of control. The study was centered on Rotter's Social Learning Theory a theoretical basis (Bandura's Social Cognitive Theory has not been published yet) which highlighted locus of control as an element of efficacy. The instrument was constructed on two, 5-point Likert-type items: *(a) 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* and *(b) If I try really hard, I can get through to even the most difficult or unmotivated students* (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998; Woolfolk & Hoy, 1990). This item has been related to an internal locus of control; it was labeled personal teaching efficacy (PTE). PTE is primarily defined as a teacher's belief in his or her capability to impact student achievement positively. GTE has been described as a teacher's belief that all students can be successful, irrespective of outside factors, for example, socio-economic status and family background. These two items

gave the impulse for the development of teacher efficacy instruments by various educational researchers.

The evaluation of teacher efficacy was solely based on computing a total score from the two items. Many researchers were concerned about the reliability of a two-item instrument and attempted to create a more comprehensive tool to measure self-efficacy. Nevertheless, the limited success of the Rand studies motivated several researchers to improve and refine the concept of teacher self-efficacy.

Guskey (1981) created a 30-instrument to measure Responsibility for Student Achievement (RSA). Participants in the study were asked to respond to each item by distributing 100 points between two choices, one stating that the event is produced by the teacher and the other saying that the event happened because of factors not under the teacher's immediate control. Scores on the RSA produced a measure of how much the teacher assumed responsibility for student outcomes in general, as well as two subscale scores indicating responsibility for student success (R+) and student failure (R-). Guskey (1982, 1988) looked at scores from the RSA and compared them with the sum of the two RAND items; he uncovered positive correlations between teacher efficacy and a sense of responsibility for student success (R+) or failure (R-). Overall, teachers demonstrated greater efficacy for positive results than for negative ones. They believed that they feel more apt to influence positive results than preventing negative ones.

Another group of researchers worked toward to develop a new measuring instrument to expand the RAND efficacy questions to strengthen their reliability; the Webb Scale (Webb, R. & Ashton, P. T., 1987). Webb and Ashton used a forced-choice format with items matched for social desirability (See Table 2.2).

Table 2.2: Studies of self-efficacy based on Rotter's TLC
(Tschannen-Moran, et al., 1998)

Authors	Instrument	Sample items
Rand Measure (Aox, King, McDonnell, Pascal, Pauly, & Zellman, 1976)	Two items on a 5-point Likert scale from strongly agree to disagree strongly. Scoring: Sum of the two items	<p>a) 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.</p> <p>b) If I try hard, I can get through to even the most difficult or unmotivated students.</p>
Teacher Locus of Control (Ross & Medway, 1981)	28 items with a forced-choice format. Scoring: Half of the items describe situations of student success (I+) and half describe student failure (I-)	<p>Suppose you are teaching a student a particular concept in arithmetic or math and the student has trouble learning it. Would this happen:</p> <p>a) Because the student was not able to understand it, or</p> <p>b) Because you could not explain it very well?</p> <p>If the students in your class perform better than they usually do on a test, would this happen</p> <p>a) Because the students studied a lot for the test, or</p> <p>b) Because you did a good job of teaching the subject are</p>
Responsibility for Student Achievement (Guskey, 1981)	Participants are asked to give a weight or percent to each of the two choices. Scoring: A global measure of responsibility with two subscales: responsibility for student success (R+) & responsibility for student failure (R-)	<p>If a student does well in your class, would it probably be:</p> <p>a) Because that student had the natural ability to do well, or</p> <p>b) Because of the encouragement you offered?</p> <p>When your students seem to have difficulty learning something, is it usually:</p> <p>a) Because you are not willing to work at it, or</p> <p>Because you were not able to make it interesting for them?</p>

Table 2.2: Continued

Authors	Instrument	Sample items
Webb Efficacy Scale (Ashton et al., 1982)	Seven items forced-choice. Participants must determine if they agree more strongly with the first or the second statement.	<ul style="list-style-type: none"> a) A teacher should not be expected to reach every child; some students are not going to make academic progress. b) Every child is reachable. It is the teacher's obligation to see to it that every child makes academic progress. c) My skills are best suited for dealing with students who have low motivation and who have a history of misbehavior in school. d) My skills are best suited for dealing with students who have low motivation and who are academically motivated and generally well behaved.

The findings of the study revealed that teachers who scored higher on the Webb Efficacy Scale exhibited fewer negative occurrences in their teaching. In the 1980s, Gibson and Dembo developed a more reliable instrument to measure teacher efficacy. When Gibson and Dembo (1984) developed the Teacher Efficacy Scale (TES), teacher efficacy included already two subconstructs: Personal Teaching Efficacy (PTE) and General Teaching Efficacy (GTE). The TES became the principal instrument for the study of teacher efficacy. Researchers used this tool to investigate the impact of a teacher's sense of efficacy on their behaviors and attitudes and student achievement.

Emmer and Hickman (1991) modified the TES to include the subconstruct of classroom management to the two subconstructs of PTE and GTE. Other researchers (Soodak and Podell, 1996) also expanded the scale by adding new items. They argued that teacher efficacy could be

viewed as a three-dimensional construct consisting of personal efficacy, outcome efficacy, and teaching efficacy. According to Soodak and Podell (1996), personal efficacy is the teacher's belief that he or she possesses the skills essential for teaching. Outcome efficacy is the belief that the teaching skills are applied they will generate the expected student outcome. Teaching efficacy is the belief that teachers can overcome the adverse effects of all external influences on their students. It is evident that such studies were attempting to refine the construct of teacher efficacy.

While these studies were trying to strengthen the construct of teacher efficacy, they were using a poorly designed instrument that did not adequately capture the complexity of Bandura's theory of self-efficacy. Therefore, researchers began the work of redefining and remodeling the construct of teacher efficacy. To address this issue and broaden the teacher efficacy measurement, some researchers (Emmer and Hickman, 1991) adapted Gibson and Dembo's instrument to classroom management situations. Soodak and Podel (1996) expanded on Gibson and Dembo's instrument by considering students' behavioral and emotional issues and not merely looking at the learning process. Rich et al., (1996) improved Gibson and Dembo's instrument by adding a scale for measuring teacher efficacy to encourage social relations among students. Woolfolk et al. (1990) examined the relationship between the two dimensions (PTE and GTE) of teacher efficacy through the lenses of teachers' orientations toward management, control, and student motivation. Their study revealed that teachers with high levels of PTE appeared to have a more humanistic approach to classroom control and more reasonable beliefs about control of students and supporting student autonomy.

Gordon (2001) conducted a study of 96 high efficacy elementary teachers and 93 low efficacy elementary teachers. The study revealed that high efficacy teachers were less likely to

judge challenging students; more predisposed to expect student improvement; more prone to feeling confident about positively influencing student behavior and outcome. Witcher et al., (2002) examined the relationship between TE and educational beliefs. They found that a transmissive approach of teaching was associated with lower GTE, and a more progressive approach was linked to high levels of GTE. Huang et al. (2007) conducted a study of 151 pre-service teachers and 67 in-service teachers. In this study, they examined the relationship between TE, teacher self-esteem, and orientation to seeking help. This study revealed a positive correlation between PTE and teacher self-esteem. Several researchers (Tournaki & Podell, 2005; Malow-Iroff et al., 2004; Gordon, 2001; Henson, 2001) concur that teachers' high levels of TE were positively correlated with students' achievement.

Building on their previous conceptual model (Tschannen-Moran & Woolfolk Hoy, 1998) of teacher efficacy, Tschannen-Moran and Woolfolk Hoy (2001) created a new measure of teacher efficacy, the Teacher's Sense of Efficacy Scale (TSES). This instrument was intended to measure "both personal competence and an analysis of the task regarding the resources and constraints, in particular, teaching contexts" (p. 795). The instrument tries to define routine teaching tasks and broadens the attention from unmotivated students to include high-performing students. Further refinement of the instrument resulted in 2 versions, an extended version of 24 items and 12 items shorter version. They conducted a factor analysis to determine how the participants respond to the questions. Three factors consistently emerged from their study: *Efficacy in Student Engagement, Efficacy in Instructional Practices, and Efficacy in Classroom Management*. They recommend that the full 24-items scale to be used with pre-service teachers. The scale appears to summarize the efficacy expectation and outcome expectancy subconstructs

of Bandura's self-efficacy theory potentially completely. But, Henson (2002) recommends that confirmatory qualitative analysis should be used to corroborate the validity of this instrument.

Building on Bandura's sources of teacher efficacy, Lent et al., (1996) created an instrument - Perceived Sources of Math Self-Efficacy Inventory (PSMSI) - in a study to explore the influences of Bandura's sources of teacher efficacy on mathematics self-efficacy. The study included 295 university students and 481 high school students. The researchers used a mathematics self-efficacy scale coupled with the PSMSI. Although this study did not specifically focus on teacher efficacy, it nonetheless gave some valuable insights on mathematics self-efficacy underscoring the fact that students' experiences with math may influence other sources of efficacy.

In the same vein, Tschannen-Moran & Woolfolk Hoy (2001) concurred saying, "this belief has been related to student outcomes such as achievement, motivation, and students' sense of efficacy." Self-efficacy has been shown to be a significant predictor of effective teaching practices. Teachers, who view themselves to be able to combine the vast knowledge and skills needed to design differentiated instruction, taking into account the obstacles of a particular teaching context, will likely yield greater effort, perseverance, and resilience as a result of higher self-efficacy beliefs. Teachers who possess high levels of self-efficacy tend to employ better-planned and more meaningful teaching experiences for their students (Goddard, Hoy, & Woolfolk Hoy, 2004). Riggs and Enochs (1990) developed an instrument based on Gibson and Dumbo's Teacher Efficacy Scale to measure the effects of efficacy on science teaching and learning – the Science Teaching Efficacy Belief Instrument (STEBI) (see Table 2.3).

Table 2.3: Studies of self-efficacy based on Bandura's Concept of Self-Efficacy (Tschannen-Moran, et al., 1998)

Authors	Instrument	Sample items
Teacher Efficacy Scale (Gibson & Dembo, 1984)	30 items on a 6-point Likert scale from strongly disagree to strongly agree. Scoring: A global measure of teacher efficacy derived from the sum of all items. Two subscales emerge from factor analysis- personal teaching efficacy and general teaching efficacy.	a) When a student gets a better grade than he usually gets, it is usually because I found better ways of teaching. b) The hours in my class have little influence on students compared to the influence of their home environment. c) If a student masters a new math concept quickly, this might be because I knew the necessary steps in teaching that concept.
Science Teaching Efficacy Belief Instrument (Riggs & Enochs, 1990)	25 items on a 5-point Likert scale from strongly agree to disagree strongly.	a) I understand science concepts well enough to be effective in teaching elementary science. b) Effectiveness in science teaching has little influence on the achievement of students with low motivation.
Ashton Vignettes (Ashton et al., 1982)	50 items describing problem situations concerning various dimensions of teaching, including motivation, discipline, academic instruction, planning, evaluation, and work with parents. Self-referenced: "extremely ineffective to extremely effective." Norm-referenced: much less effective than most teachers."	a) Your school has adopted a self-paced instructional program for remedial students in your area. How effective would you be in keeping a group of remedial students on task and engaged in meaningful learning while using these materials? A small group of students is constantly whispering, passing notes and ignoring class activities. Their academic performance on tests and homework is adequate and sometimes even good. Their classroom performance, however, is irritating and disruptive. How effective would you be in eliminating their disruptive behavior?
Bandura's Teacher Efficacy Scale (1977)	30 items on a 9-point scale anchored at nothing, very little, some influence, quite a bit, a great deal. Seven subscales: 1. Influence on decision-making, 2. Influence on school resources, 3. Instructional efficacy, 4. Disciplinary efficacy, 5. Enlisting parental involvement, 6. Enlisting community involvement, and 7. Creating a positive school climate.	a) How much can you influence the decisions that are made in your school? b) How much can you do to overcome the influence of adverse community conditions on student learning? c) How much can you do to get children to follow classroom rules? d) How much can you assist parents in helping their children do well in school? e) How much can you do to get local colleges and universities involved in working with your school? f) How much can you do to make students enjoy coming to school? g) How much can you do to get students to believe they can do well in school work?

Concurring with Gibson and Dembo, they distinguished two distinct factors, one they called personal science teaching efficacy (PSTE) and a second factor they labeled science teaching outcome expectancy (STOE).

Science educators have conducted extensive research on the effects of efficacy on science teaching and learning. Riggs and Enochs (1990) developed an instrument, based on the Gibson and Dembo approach, to measure the efficacy of teaching science--the Science Teaching Efficacy Belief Instrument (STEBI). Consistent with Gibson and Dembo they have found two separate factors, one they labeled personal science teaching efficacy (PSTE) and a second factor they named science teaching outcome expectancy (STOE).

Swars (2005) used a mixed-methods approach to investigate a group of students enrolled in an elementary mathematics methods course using the Mathematics Teaching Efficacy Belief Instrument (MTEBI). Enochs et al. (2000) designed the MTEBI by modifying the Science Teaching Efficacy Belief Instrument (STEBI-B). The MTEBI consists of 21 items, 13 items on the Personal Mathematics Teaching Efficacy (PMTE) and the Mathematics Teaching Outcome Expectancy (MTOE) subscale comprises eight items. Enochs et al. (2000) conducted an item analysis of the original 23-item. Two of the 23 items had an item-total correlation less than 0.30. Those two items were subsequently dropped from the instrument. They undertook a confirmatory factor analysis of the 21-item scale and concluded that the subscales PMTE (*alpha coefficient of 0.75*) and MTOE (*alpha coefficient of 0.88*) are independent, adding to the construct validity of the MTEBI (see Table 2.4).

Table 2.4: Corrected Item-total Scale Correlations and Factor Loading
(Enochs, L.G., Smith, P.L., and Huinker, D., 2000)

Measure	Item #	Positive/ Negative Wording	Item-total Correlation
PMTE (SE) Total SE scale Alpha= .88	2	P	.36
	3	N	.62
	5	P	.54
	6	N	.56
	8	N	.55
	11	P	.59
	15	N	.50
	16	P	.62
	17	N	.62
	18	N	.58
	19	N	.65
MTOE (OE) Total OE scale Alpha= .77	20	P	.47
	21	N	.61
	1	P	.49
	4	P	.49
	7	P	.42
	9	P	.42
	10	P	.48
	12	P	.45
	13	P	.53
	14	P	.49

Consistent with prior research utilizing the STEBI instruments (Bleicher, 2004; Utley, Bryant, & Moseley, 2000; Palmer, 2006; Cantrell, 2003; Cakiroglu, Cakiroglu, & Boone, 2005), the MTEBI seems to be a valid and reliable instrument to assess mathematics teaching self-efficacy and outcome expectancy.

However, Enoch et al. (2000) caution that the validation of instruments remains an ongoing process; additional validity assessment is needed in the form of predictive validity. Swars (2005) examined the similarities and differences of pre-service elementary teachers with high and low levels of mathematics TE. The study focused on their perceptions of their skills and abilities to teach mathematics effectively. For the qualitative portion of the study, two students who scored the highest and two students who scored the lowest were interviewed to explain the difference between the two groups. Three themes emerged from the data. Past experiences with

mathematics, influences on perceptions of mathematics teaching effectiveness, and instructional strategies. The two highest TE participants had positive experiences, whereas, the two participants with low TE had prior negative experiences with math. Swars's (2005) study supported the finding of Lent et al. (1996). It confirmed that prior experiences had a determining influence on the perceptions of mathematics teaching effectiveness with the low efficacy students recognizing that they would have to work longer and harder to be effective math instructors and acknowledging the high efficacy students' strong mathematics content knowledge is an advantage to becoming an effective mathematics instructor.

Utley, et al. (2005) surveyed 60 pre-service elementary teachers. They investigated the change in math and science TE during teacher preparation courses and student field experiences. The first survey was administered at the beginning of the science and math methods courses, the second at the end of the completion of the courses, and a third one at the end of their student teaching field experience. The study revealed that levels of PMTE and PSTE were highly correlated as were levels of MTOE and STOE.

Huinker and Madison (1995) examined teacher beliefs and how they develop their conceptions of mathematic teaching as pre-service teachers progressed through a mathematics methods course. Huinker and Madison explored to what extent changes in mathematics teaching efficacy corresponded to changes in their pedagogical conceptions of mathematics. In addition to administering the MTEBI pre- and post-mathematics methods course, they conducted extensive qualitative research that included three semi-structured interviews with two participants, observations in their methods courses and field placements, and collection of artifacts, such as course assignments, assessments, and journal entries.

2.4.2 Measuring the Sources of Self-Efficacy Qualitatively

A number of researchers have employed different qualitative methods to investigate students' sources of Self-Efficacy; the most widely used has been the use of interviews. Participants in these studies were asked focused questions that address targeted their sources of self-efficacy (i.e., mastery experiences, vicarious, experiences, verbal persuasions, and physiological arousal). For example, Zeldin and Pajares (2000) investigated the sources of self-efficacy of 15 women with careers in math, science, and technology. They asked the participants how their choices made them feel (physiological arousal)¹; how they reacted when others commented about their decisions (social persuasions)²; and what experiences motivated them to pursue those vocations (mastery and vicarious experiences)³. The findings of the study revealed verbal persuasions and vicarious experiences seem to be significant sources of women's self-efficacy beliefs. A large number of researchers have explored teacher efficacy, and this review discussed the quantitative research that has significantly influenced the definition and the measurement of teacher efficacy, as well as the qualitative studies that offer the understanding of the reasoning process in teachers' appreciation of their self-efficacy beliefs.

Over the past three decades, researchers have undertaken the task to explain and efficiently measure teacher efficacy theoretically. A large body of research findings suggests that Pajares, 1996; Schunk, 1995). Teacher efficacy was defined as the extent to which the teacher believes to have the capacity to affect student performance (Berman et al., 1977, p. 137). Since then, an extensive body of research established a relationship between teachers' sense of efficacy and meaningful educational outcomes such as student achievement and motivation.

¹ How did pursuing mathematics make you feel? (Zeldin & Pajares, 2000)

² What did people say to you as you were pursuing mathematics? (Zeldin & Pajares, 2000)

³ Tell me one memorable story that would really help me understand how you came to do what you do. (Pajares & Zeldin, 1999). What experiences contributed to your decision to pursue your occupation? (Zeldin & Pajares, 2000).

Bandura's social cognitive theory, self-efficacy, as it relates to teacher self-efficacy, has been placed at the forefront of educational research. In educational settings, many studies have measured the sources in a number of different ways.

Quantitative studies of the self-efficacy construct used items and scales that differed considerably. Rotter's (1966) theory of locus of control deals with how individuals consider rewards or outcomes as contingent upon their intrinsic behavior (internally-driven) or stimulated by extrinsic factors such as luck or (externally-driven). To measure the level of internal-external orientation, Rotter (1966) developed the I-E scale. The scale consists of 23 items using forced-choice format and six filler questions. According to Marsh and Richard (1984), the scale is based on the assumption that I-E is a two-prong construct. Rotter contends that an individual with an internal locus of control has the certainty that their rewards are dependent on their decisions and efforts.

Rose and Medway (1981) built on Rotter's Locus of Control and created the Teacher Locus of Control (TLC) instrument to measure how teachers assign responsibility for student successes or failures either internally to the teacher or externally to the student. They observed that the TLC was a more reliable predictor of teacher behaviors than Rotter's (Internal-External) I-E Scale, possibly because it is more situational, reflecting a teaching context. The TLC predicted teachers' disposition to implement innovative instructional approaches, whereas Rotter's scale did not.

In the mid-1970s teacher self-efficacy was investigated by two research groups from the RAND Corporation (Berman et al., 1977; Armor et al., 1976). The RAND Corporation was a federally funded project designed to introduce a range of innovative practices in U. S. public schools. From the results of this study, Armor et al. (1976) determined that, in addition to student

background characteristics, teacher attributes influenced the variation in the reading scores of minority students significantly. Teacher attributes included background characteristics (e.g., ethnicity) and predispositions toward teaching, which the authors identified as "the extent to which the teacher believes he or she can produce an effect on the learning of students" (Armor et al., 1976, p. 23). Although the RAND study initiated an important discussion in educational research, a general confusion of the construct's development arose among researchers' use of the term teacher *efficacy* when the items, in fact, signified Rotter's concept of *locus of control* (Cybulski, 2003). For several years following the RAND study, researchers (Guskey, 1981; Ashton et al., 1982; Riggs & Enoch, 1990; Gibson & Dembo, 1984) used Rotter's locus of control theory as a groundwork to seek a greater comprehension of a construct that effectively impacted student achievement. The RAND study has mainly provided the model for subsequent studies.

Guskey (1981) used the Responsibility for Student Achievement instrument to measure how much teachers perceived their responsibility for student results, whether they might be successes or failures. The findings of this study indicated that teachers feel more responsibility for successes than for failures. They held a strong belief in their ability to influence students' positive outcomes than to prevent negative ones.

Tschannen-Moran and Woolfolk Hoy (2001) developed a model that interprets teacher efficacy as a context and tasks specific construct. It is evident that teachers do not always feel efficacious about every teaching situation. They explain that as teachers analyze the teaching task and its context, they evaluate the importance of the different factors that might make teaching difficult, or that behave as constraints against an assessment of the resources available that make learning possible. It is likely that teachers do not always feel efficacious about every

teaching situation. Thus, Tschannen-Moran et al. (1998) assert, “greater specification is needed to understand what information is drawn from the task of teaching, the context, and the assessment of personal teaching competence to form self-efficacy” (p. 239).

Ashton et al. (1982) created a seven-item instrument, the Webb Scale, for each of the seven items, teachers had to answer which statement they agreed most strongly with the first or the second. They observed that teachers who scored higher on the Webb efficacy scale expressed fewer negative interactions in their teaching. Ashton et al. (1982) also used the Ashton Efficacy Vignettes instruments, which consist of 25 teaching problem situations to investigate teachers’ sense teaching efficacy. In one version, teachers were required to self-assess themselves as extremely ineffective to extremely effective; the second version required the teachers to respond whether they are much less effective than most teachers or much more effective than other teachers. The researchers worked on the assumption that teacher efficacy was mostly subject to the teaching context.

Gibson and Dembo (1984) developed the Teacher Efficacy Scale (TES). Teacher efficacy included already two sub-constructs: Personal Teaching Efficacy (PTE) and General Teaching Efficacy (GTE). The TES became the principal instrument to the study of teacher efficacy. Researchers used this tool to investigate the impact of a teacher’s sense of efficacy on their behaviors and attitudes and on student achievement. Emmer and Hickman (1991) modified the TES to include the sub-construct of classroom management situations to the two sub-constructs of PTE and GTE.

While these studies were trying to strengthen the construct of teacher efficacy, they were using a poorly designed instrument that did not adequately capture the complexity of Bandura’s theory of self-efficacy. Rich et al. (1996) improved Gibson and Dembo’s instrument by adding a

scale for measuring teacher efficacy to encourage social relations among students. Woolfolk et al. (1990) examined the relationship between the two dimensions (PTE and GTE) of teacher efficacy through the lenses of teachers' orientations toward management, control and student motivation. Their study revealed that teachers with high levels of PTE appeared to have a more humanistic approach to classroom control and more reasonable beliefs about control of students and supporting student autonomy.

Building on their previous conceptual model (Tschannen-Moran and Woolfolk Hoy, 1998) of teacher efficacy, Tschannen-Moran and Woolfolk Hoy (2001) created a new measure of teacher efficacy, the Teacher's Sense of Efficacy Scale (TSES). This instrument was intended to measure "both personal competence and an analysis of the task regarding the resources and constraints, in particular, teaching contexts" (p. 795). The instrument tries to define routine teaching tasks and broadens the attention from unmotivated students to include high performing students. Further refinement of the instrument resulted in 2 versions, an extended version of 24 items and 12 items shorter version. They recommend that the full 24-items scale be used with pre-service teachers. The scale appears to summarize the efficacy expectation and outcome expectancy subconstructs of Bandura's self-efficacy theory.

Riggs and Enochs (1990) developed an instrument based on Gibson and Dumbo's Teacher Efficacy Scale to measure the effects of efficacy on science teaching and learning – the Science Teaching Efficacy Belief Instrument (STEBI). Concurring with Gibson and Dumbo they distinguished two distinct factors, one they called personal science teaching efficacy (PSTE) and a second factor they labeled science teaching outcome expectancy (STOE). Enochs et al. (2000) designed the MTEBI by modifying the Science Teaching Efficacy Belief Instrument (STEBI-B). The MTEBI consists of 21 items, 13 items on the Personal Mathematics Teaching Efficacy

(PMTE) and the Mathematics Teaching Outcome Expectancy (MTOE) subscale comprises eight items. Although the MTEBI may be the "gold standard" instrument to measure the mathematics teacher efficacy construct, more reliability and validity evidence is needed to guarantee that the measuring instrument can produce reliable data in different teacher groups. As valuable a survey instrument as the MTEBI happens to be, by itself, it cannot provide answers to all of the questions this construct presents.

2.5 Summary

The research in this field has been mostly dominated by quantitative studies that cannot explore fully a construct that is expressed by the human behavior. Future research must incorporate qualitative inquiry into the study of teacher efficacy. More research on teacher self-efficacy is needed to continue to investigate ways to improve teacher efficacy. It is of great importance that, researchers must come to an agreement between the construct of teacher efficacy and the appropriate measurement instrument. A large body of research findings over the last 30 years (Pajares, 1996) has established that self-efficacy beliefs as major factors influencing behavior and performance.

This review underscored the now well-established finding that self-efficacy beliefs are important determining factors of human motivation and performance. In educational settings, they have an effect on motivation, self-regulation, and achievement. Bandura (1986) theorizes that self-efficacy beliefs constitute the key factor of human agency, therefore investigating the development of these beliefs and the factors that either foster or weaken them is essential. Findings from this type of study will eventually make substantial contributions to educational theory, thinking, practice, and policy.

Chapter 3: Methodology

This study investigates what impact math methods course has on mathematics self-efficacy and outcome expectancy beliefs of elementary pre-service teachers enrolled in a university teacher preparation program. This study utilized a validated instrument, the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) and semi-structured interviews with selected participants to examine the sources that play a role in increasing high mathematics efficacy and high mathematics teaching efficacy beliefs of pre-service elementary teachers.

Given that, the following research questions were examined:

- Q1. Do pre-service elementary teachers' mathematical self-efficacy change after enrolling in a reform-based university elementary mathematics methods course?
- Q2. How do pre-service elementary teachers who have completed a reform-based university elementary mathematics methods course describe their beliefs?
- Q3. How do pre-service elementary teachers who have completed a reform-based university elementary mathematics methods course describe their classroom learning experiences?
- Q4. Do the quantitative findings on teacher self-efficacy constructs related to the qualitative findings obtained from the case-study interviews?

A mixed methods approach was employed to obtain data in this study of a group of pre-service elementary teachers' sense of efficacy to teach math as they relate to their epistemological beliefs about mathematics. This mixed methods study focused on the elementary mathematics teacher preparation of pre-service teachers. The purpose of this study was to examine the impact of a reform-based university mathematics methods course on pre-service elementary teachers' mathematical beliefs, knowledge, and classroom teaching practices.

3.1 Research Design

In this study, the teaching efficacy of 70 elementary preservice teachers was examined, but the main goal of the study was to understand the experiences of preservice teachers qualitatively and examine what factors influenced their efficacy beliefs and why. The purposes that guided the study of preservice teacher efficacy were three folds: (1) to explore preservice teachers' previous math experience as sources of stress, either failure or success; (2) to identify factors that contribute to the development of the pre-service teacher sense efficacy related to mathematics reform-based teaching methods and; (3) to collect information on how efficacy beliefs of preservice teachers changed through experience (Table 3.1)

Table 3.1: Data Collection methods and purposes

Collection Method	Participant Involvement	Specific Research Purpose
Mathematics Teaching Efficacy Belief Instrument (MTEBI)	All participants completed the MTEBI scale on two occasions	To collect information on how efficacy beliefs changed through experience elementary for pre-service teachers To select participants for the second phase of the study
One-on-one interviews	At the end of the semester, selected participants met with researcher for 45-minute one-on-one interviews (Four interviews)	To explore preservice teachers' previous math experience as sources of stress, either failure or success; to identify factors that contribute to the development of the pre-service teacher sense efficacy related to mathematics reform-based teaching methods and; to collect information on how efficacy beliefs of preservice teachers changed through experience

While a quantitative methods approach's goals are to correlate or predict, qualitative data is much richer in detail, and is more helpful to examine certain aspects of the problem; for example addressing "the what" of research questions as well as "the how" of these issues.

Strauss and Corbin (1990, p. 17) have stated that investigation using qualitative data produces findings not obtained by statistical procedures or other quantifying measures, thus permitting researchers in education to improve the understanding of learning and teaching. The qualitative approach aims to understand the processes of those phenomena by using data collection techniques such as questionnaires, observations, and collecting of artifacts.

Because of the complexity of the influences on teaching, classroom practice, beliefs, and efficacy and given that educational settings are socially, emotionally, and instructional multifaceted, it is necessary to employ as many methods as practically possible to find and express the contextual influences of a teacher's sense of teacher efficacy (Ball & Sleep, 2007; Davis & Upitis, 2004; Frykholm & Glasson, 2005; Tschannen-Moran et al., 1998). In consideration of the previously mentioned explanation, a mixed-method design is warranted for various reasons.

A number of definitions for mixed methods have appeared over the years that incorporate elements of various methods, philosophy, and research design. Tashakori and Teddlie (1998) defined mixed methods as the combination of “qualitative and quantitative approaches in the methodology of a study” (p.ix). Johnson, Onwuegbuzie, and Turner (2007) tried to find a common understanding about one definition of mixed methods based on 19 different definitions provided by 21 mixed methods researchers (Creswell & Plano Clark, 2011). Johnson et al. (2007), synthesized all the various definitions and ended with their definition:

Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques for the purposes of breadth and depth of understanding and corroboration. (p.123)

Creswell and Plano Clark (2007) provide a more comprehensive definition of mixed methods as follows:

“Mixed methods research is a research design with philosophical assumptions as well as methods of investigation. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone.” (p. 5)

A mixed method approach enhances studies in the sense that it provides more clarity, reliability, and nuance. Ultimately, the underlying assumption is that: research is more robust when it combines both research paradigms; to promote a fuller comprehension of human phenomena. Furthermore, several educational researchers suggest that it is more ethical to mix methods so that plurality of interests, voices, and perspectives could be represented (Rocco, Gallagher & Perez-Prado, 2003). This chapter describes the study’s methodology, procedures, and data analysis.

The choice of this design by the researcher is motivated by the use of the results obtained in the qualitative strand to explain quantitative results (Creswell, Plano Clark, et al., 2003). According to Creswell et al. (2003, p.223) sequential explanatory mixed methods studies involve the collection and analysis of quantitative data followed by the collection and analysis of qualitative data (see Table 3.2). The researcher begins by collecting data using quantitative experimental procedures, the sequence includes the testing of hypotheses in an experiment as the first stage of the investigation, and follows up with interviews with a few individuals who participated in the experiment to help explain their scores on the experimental results.

Table 3.2: Basic Procedures in Implementing an Explanatory Mixed Methods Design approach
(Creswell & Plano Clark, 2011, p. 88)

Procedures in an Explanatory Design approach			
QUANTITATIVE PHASE	STEP 1	Design and implement the Quantitative Strand	<ol style="list-style-type: none"> 1. State quantitative research questions and determine the quantitative approach. 2. Identify the quantitative sample 3. Collect closed-ended data with instruments 4. Analyze the quantitative data using descriptive statistics, and effect size to answer the quantitative research questions and facilitate the selection of participants for the second phase.
QUANTITATIVE PHASE (continued)	STEP 2	Use strategies to follow from quantitative results	<ol style="list-style-type: none"> 1. Determine which results will be explained, such as significant results, non-significant results, outliers, or group differences. 2. Use the quantitative results to refine the qualitative and mixed methods questions, determine which participants will be selected for the qualitative sample, and design qualitative data collection protocol.
QUALITATIVE PHASE	STEP 3	Develop and implement the Qualitative Strand	<ol style="list-style-type: none"> 1. State qualitative research questions that follow from the quantitative results and determine the qualitative approach. 2. Purposefully select a qualitative sample that can explain the quantitative results. 3. Collect open-ended data with protocols informed by the quantitative results. 4. Analyze the qualitative data using procedures of theme development and those specific to the qualitative approach to answer the qualitative and mixed methods questions.
	STEP 4	Interpret the connected results	<ol style="list-style-type: none"> 1. Summarize and interpret the quantitative results. 2. Summarize and interpret the qualitative results. 3. Discuss to what extent and in what ways the qualitative results help explain the quantitative results.

For the researcher to understand further and gain more in-depth information about findings from the quantitative analysis, a qualitative research phase is warranted. A mixed

methods design is appropriate for this research approach. Today, there is more acceptance of the importance of qualitative studies together with quantitative research within the educational research field. Mixed methods have been promoted by some researchers particularly those writing about and discussing research models (Burke Johnson & Onwuegbuzie, 2004; Creswell & Clark, 2007). The mixed methods approach offers an alternative paradigm because it combines quantitative and qualitative

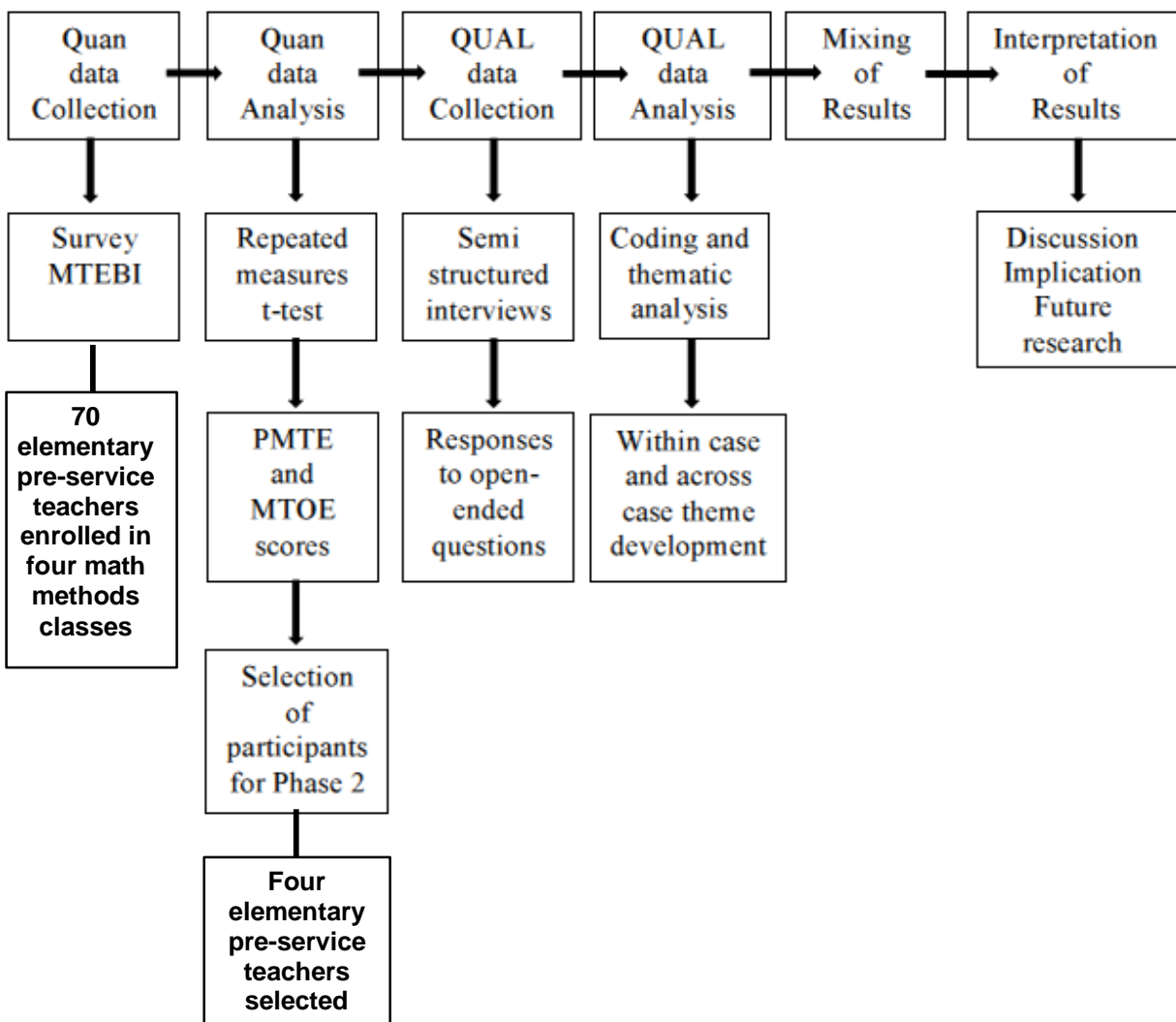


Figure 3.1: Explanatory Sequential Mixed Methods Design

methodologies by pragmatism. Several researchers (Johnson & Onwuegbuzie, 2004; Maxcy, 2003; Rallis & Rossman, 2003) argue that pragmatism offers a set of assumptions about

knowledge and inquiry that supports the mixed methods approach. Their view distinguishes the mixed methods approach from quantitative approaches that are based on a philosophy of (post)positivism and from qualitative approaches that are based on a philosophy of constructivism. Hall and Howard (2008) see mixed methods design as a dynamic approach to research, which they also refer to as the synergistic approach. In mixed methods, this means that the combination of quantitative and qualitative approaches was greater than either method alone. For this study, the researcher utilizes an explanatory sequential mixed method research design (Tashakkori & Teddlie, 1998; Creswell & Plano Clark, 2011; Iyankova, & Stick, 2006). Due to the emergent nature of this study, the sequential mixed model research design will be implemented after the completion of Phase 1 of the research (see figure 4). Because the results or inference of Phase 1 would determine the research activities and directions that would follow in Phase 2 (Creswell, Plano Clark, et al., 2003; Morgan, 1998; Tashakkori & Teddlie, 1998).

3.2 Participants

The participants in this study were students enrolled in an undergraduate elementary teachers' preparation program at a university located in the Southwestern border of the United States. The group of pre-service teacher participants consisted of 66 female, and four male students participated in a math methods course for pre-service teachers during the Fall semester of 2015 (see Table 3.3).

3.3 Context and Setting

In the teacher preparation program, the methods course is the last course of a series of courses that covers math education content in the prescribed program of study (Appendix C). All,

mathematics content courses in the program are designed to develop the fundamental concepts, skills, and techniques for teaching number, number theory, and fractions. The methods course focuses on developing models for teaching the appropriate mathematical content, relevant learning theories, and alternative teaching strategies. The methods course extends work to

Table 3.3: Demographic Makeup of Sample for Study

Demographic Information				
Gender	Female		66	
	Male		4	
Ethnicity	Hispanic		65	
	Native American		2	
	Caucasian		2	
	African merican		1	
Math Courses Taken	<u>High School</u>		<u>College</u>	
	Algebra 1	70	Intermediate Algebra	40
	Algebra 2	70	College Algebra	59
	Geometry	70	Linear algebra	11
	Precalculus	9	Analysis	1
	Calculus	1	Precalculus	13
			Calculus	2
			Statistics	35

include number and operation, all rational numbers and also geometry, probability and statistics concepts commonly taught in the elementary school (Appendix F). In the teacher preparation program, a course of study is implemented that are required courses students have to attend, and ELED 4310 (Appendix D) course is a required course. Pre-service teachers in the program take four mathematics content courses before enrolling in mathematics methods (ELED 4310). All four courses are designed around constructivist learning principles that emphasize problem solving and development of conceptual understanding.

The National Council of Teachers of Mathematics (NCTM, 1989) recommendations for reform in mathematics education call for an increased emphasis on meaningful experiences in school mathematics and decreased emphasis on rote memorization and repeated practice of

computational algorithms. For the last several years, curriculum programs that align with the vision of the reform for school mathematics have been developed. These programs, also known as Standards-based curricula, were designed to promote a conceptual approach to teaching and learning mathematics. NCTM is a standards-based reform, largely known as reform-based mathematical instruction (Van de Walle, 2003). The NCTM Principles and Standards for School Mathematics (NCTM, 2000) is considered the model for reform-based instruction.

During the school year, 2015-2016, 78 elementary pre-service teachers were enrolled in a math methods course in classes in four different sites located on elementary school campuses. The math methods courses in this study were taught in a new and unique setting, on-site at the elementary schools, where the pre-service teachers were able to observe in-service teachers teaching in real time. Additionally, they were given several opportunities during the semester to facilitate lesson activities with K-6 learners either individually or as a team.

An essential element of the course is the focus on student-centered approach to learning and students' independent investigations of mathematical ideas versus the more traditional content-centered approach. Inherent in the design of this course is the lens through which the role of the teacher is viewed as the facilitator of learning within the classroom, mediating knowledge between students and content. This view is supported by the class adopted textbook, *Elementary and Middle School Mathematics: Teaching Developmentally* (Van de Walle, 2010, 7th edition), a leading K-8 math methods text that has the most coverage of the *NCTM Standards*, the strongest coverage of middle school mathematics, and the highest student approval of any text currently available. It provides an incomparable depth of ideas and discussion to help students develop a real understanding of the mathematics they will teach. This text is strictly aligned with the view

of the NCTM *Principles and Standards* and the student-centered constructivist approach to mathematics instruction.

A constructivist-based approach in conjunction with the development of a learning community was the foundation for learning in this course. All the participants, including the teacher were active participants within a learning community. Teacher and students were co-constructors of the learning process; the constructive approach to teaching this course gave the learners preeminent value to the development of their personal mathematical ideas. Constructivism focuses on how people learn. It emphasizes the fact that math knowledge results from people forming models in response to the questions and challenges that come from actively engaging math problems and environments - not from simply taking in information.

Students were given opportunities to work in teams so that they can reflect on their learning experiences. As students engaged in investigations, the teacher ensured that students were active participants in mathematical discourse in a safe environment, she made sure that students can express their thinking in an open forum for the exchange of ideas. The teacher also encouraged students to synthesize their findings and connect those findings to a coherent mathematical structure as she suggests strategies for transforming students' thinking from an intuitive to a more rigorous level. Because the role of the constructivist teacher is to guide and support students' discovery of mathematical ideas rather than transmit "correct" ways of doing mathematics.

The reform-based math methods course taught at this university has all the characteristics of a course based on the vision expressed by the NCTM. But unfortunately, students who have difficulties learning mathematics are not mentioned in the reform documents (Baxter, Woodward, and Olson, 2001). It is important to note that the four classrooms using an innovative

curriculum, this course introduces pre-service teachers to pedagogy methods, strategies, and materials for teaching mathematics in elementary dual language classrooms. Emphasis on dual language learners, the equity principle (mathematics for all).

3.4 Design and Implementation

Participation in the study was voluntary. Participants for the study were those who signed a consent form, and a completed the survey. They were informed that their identity would not be revealed, and their answers to the questionnaire will remain anonymous. The researcher also informed the pre-service teachers of the purpose and procedures of this study as well as timelines for participation at the beginning of the math method courses for pre-test measures of teacher self-efficacy. All participants who enroll in the math methods class during Fall semester 2015 were invited to complete anonymous surveys. The researcher distributed survey questionnaires to pre-service teachers during the math methods class at the beginning of the semester for the pre-test of teacher self-efficacy. Upon completion of the math methods course at the end of the semester, the investigator administered the survey questionnaire to pre-service teachers for post-test measures.

This part of the study used the one-group pretest-posttest design. It involves a single group (e.g., pre-service elementary teachers in a math methods course) that is pretested, exposed to a treatment (e.g., reform-based math methods course), and then tested again (posttest). It is important to mention that the math methods course was not designed to have a direct impact on the math self-efficacy beliefs of the pre-service teachers. But the overall content of the course may have had some influence on the pre-service teachers' self-efficacy growth.

The course included a constructivist approach along with the development of learning communities. An individualized approach to constructivist learning theory promotes the need for participants to co-design learning experiences so that their interests, talents, and needs related to the course outcomes are better addressed. In this course, students worked in teams to share their learning experiences, but they were still responsible for their own learning. The collaborative setting in this course was essential for self- and peer-feedback. This approach provided opportunities to the pre-service teachers to take roles as active learners and the instructor as the facilitator; they are co-constructors of knowledge in the learning process. Both pre-service teachers and the instructor worked together to support each other and strive to reach the goals of the course.

3.5 Quantitative Phase of the Study

The quantitative phase of this study was conducted with a single-group pre-test-post-test using a pre-experimental design. Pre-experimental designs consist of the same basic steps as in experimental designs but do not include a control group. In this type of design, the same group of participants is given a pre-test, then the treatment and then the post-test. Pre-test and post-test are the same except given at different times (McMillan & Schumacher, 2010), a single group pre-test-post-test design was carried out by the researcher. For this reason, there was no need to assign participants to control or experiment groups.

3.5.1 Survey Instrument

In this phase of the study, the Mathematics Teachers Efficacy Belief Instrument (see Table 3.4) was administered to the participants during the second week of the semester as a pre-test and the last week of the semester as a post-test. The Mathematics Teaching Efficacy Belief

Instrument (MTEBI) for preservice teachers stemmed from the modification of the Science Teaching Efficacy Belief Instrument STEBI-B of Enochs and Riggs (1990). The MTEBI used in

Table 3.4: MTEBI Scale

	Item	D	U	A	SA	D
O-1	When a student does better than usual in mathematics, it is often because the teacher exerted a little effort.	1	2	3	4	5
T-2	I am continuously finding better ways to teach mathematics.	1	2	3	4	5
T-3	Even if I try hard, I will not teach mathematics as well as I will most subjects*	1	2	3	4	5
O-4	When the mathematics grades of students improve, it is often due to their teacher having found a more effective teaching approach.	1	2	3	4	5
T-5	I know how to teach mathematics concepts effectively	1	2	3	4	5
T-6	I am not very effective in monitoring mathematics activities*	1	2	3	4	5
O-7	If students are underachieving in mathematics, it is most likely due to ineffective mathematics teaching	1	2	3	4	5
T-8	I generally teach mathematics ineffectively*	1	2	3	4	5
O-9	The inadequacy of a student's mathematics background can be overcome by good teaching	1	2	3	4	5
O-10	When a low-achieving student does better than usual in mathematics, it is due to extra attention given by the teacher.	1	2	3	4	5
T-11	I understand mathematics concepts well enough to be effective in teaching elementary mathematics.	1	2	3	4	5
O-12	The teacher is generally responsible for the achievement of students in mathematics.	1	2	3	4	5
O-13	Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching.	1	2	3	4	5
O-14	If parents comment that their child is showing more interest in mathematics at school, it is probably due to the performance of the teacher	1	2	3	4	5
T-15	I find it difficult to use manipulatives to explain to students why mathematics work*.	1	2	3	4	5
T-16	I typically am able to answer students' questions about mathematics.	1	2	3	4	5
T-17	I wonder if I have the necessary skills to teach mathematics*	1	2	3	4	5
T-18	Given a choice, I will not invite the principal to evaluate my mathematics teaching*	1	2	3	4	5
T-19	When a student has difficulty understanding a mathematics concept, I usually am at a loss as to how to help the student understanding better*.	1	2	3	4	5
T-20	When teaching mathematics, I usually welcome students' questions	1	2	3	4	5
T-21	I do not know how to turn children on to mathematics*	1	2	3	4	5

**These items must be reversed scored in order to produce consistent values between positively and negatively worded items.*

the quantitative part of the study used a Likert-type scale with five response categories (1: strongly disagree; 2: disagree; 3: uncertain; 4: agree; 5: strongly agree).

The MTEBI is an instrument to measure the degree in which preservice teachers feel that they can teach mathematics effectively. This instrument consists of two subscales, personal mathematics teaching efficacy (PMTE), and mathematics teaching outcome expectancy (MTOE). Among the 21 items of the MTEBI, 13 items (T2, T3, T5, T6, T8, T11, T15, T16, T17, T18, T19, T20, and T21) constitute the PMTE subscale describing personal beliefs about one's ability to teach mathematics effectively; and eight items (O1, O4, O7, O9, O10, O12, O13, and O14) are included in the MTOE subscale addressing the expectancy belief that effective mathematics teaching will result in a positive outcome in student's mathematical learning. Scores on the PMTE scale may range from 13 to 65; MTOE scores may range from 8 to 40. Reliability analysis gave an alpha coefficient of 0.88 for the PMTE subscale and an alpha coefficient of 0.75 for the MTOE subscale (n = 324). Confirmatory factor analysis suggested that the two scales (PMTE and MTOE) are independent, adding to the construct validity of the MTEBI. The MTEBI was further validated by research with a sample of pre-service elementary teachers. Enochs et al. (2000) sampled 324 pre-service elementary teachers in a study designed to determine the reliability and validity of the instrument. The reliability coefficient analysis done by Enochs et al. (2000) produced Cronbach's alphas of internal consistency of 0.88 for the PMTE and 0.81 for the MTOE subscales. Further confirmatory factor analysis yielded results indicating that the two subscales (PMTE and MTOE) are independent. The two subscales of the MTEBI were consistent with the teacher efficacy aspects as outcome expectancy beliefs and self-efficacy beliefs. Consequently, the creators concluded that MTEBI is a valid and reliable assessment of personal math teaching efficacy and mathematics teaching outcome expectancy (Enochs et al., 2000).

In this study, the MTEBI survey was distributed to a pool of 74 teachers at four different elementary school sites. Surveys were scored, and demographic information for each participant was recorded. Data collected on each of the scores of pre-service teachers on pre-test and post-test for each item on the two subscales of the MTEBI were analyzed through paired sample t-test, to answer the following research questions.

- Q1. Do pre-service elementary teachers' mathematical self-efficacy change after enrolling in a reform-based university elementary mathematics methods course?

3.5.2 Validity and Reliability of the Quantitative Instrument

The standards of validity and reliability are essential keystones of any research method. The idea of reliability is that any significant results must be more than a one-off finding and be inherently repeatable. Validity involves the entire experimental concept and ascertains whether the results obtained meet all of the requirements of the research method (see Table 3.5). In the quantitative phase, the reliability issues of the efficacy scale mathematics teaching efficacy instrument (MTEBI) are established measurement tools that were validated with previous researchers' factor analyses (Enochs, Smith, and Huinker, 2000). Reliability statistics were performed with the data in this study, and the efficacy scales were determined to be of high reliability.

Table 3.5: Reliability Statistics

	Cronbach's Alpha (This study)	Cronbach's Alpha (Enochs, et al., 2000)	Total Items (Pre & Post tests)
MTEBI	.831	.837	42
PMTE	.830	.836	26
MTOE	.741	.746	16

The reliability coefficient analysis done produced Cronbach's alphas of internal consistency of 0.83 for the personal mathematics teaching efficacy (PMTE) and 0.74 for the mathematics teaching outcome expectancy (MTOE) subscales. The two subscales of the MTEBI were consistent with the teacher efficacy aspects as outcome expectancy beliefs and self-efficacy beliefs. Consistent with prior research the MTEBI appears to be a valid and reliable assessment of mathematics teaching self efficacy and outcome expectancy.

3.5.3 Analysis of Survey Data

Once the survey was collected, only the completed MTEBI surveys were utilized for the quantitative data analysis. The quantitative methods of the MTEBI subscales (PMTE and MTOE) data provide reliable teacher efficacy values to answer the first research question. A repeated measures paired t-test on the pre- and post-test scores of participants on the MTEBI was conducted to compare the total scores for the first and final survey administrations. The categorical independent variable, in this case, is the time of administration of the pre- and posttest, and the continuous dependent variable is the change in the pre-service teaching self-efficacy.

The participants scores on the pretest are compared to scores on the posttest after completing the math methods course. The paired-samples t-test informed the study whether there is a statistically significant difference in the mean scores for the pretest and the posttest. It is assumed that the samples were normally distributed (Figure 3.2).

Quantitative data were analyzed in the form of descriptive statistics (e.g., item-specific means). The descriptive statistics for the MTEBI items (Table 4.1) included in the output the number of subjects (N), the mean, and the standard deviation (SD). In this chart, the researcher used only matched scores for evaluation. At the end of the semester, pre-service teachers'

surveys were analyzed by creating a table in which the responses to each question in each of the surveys are displayed.

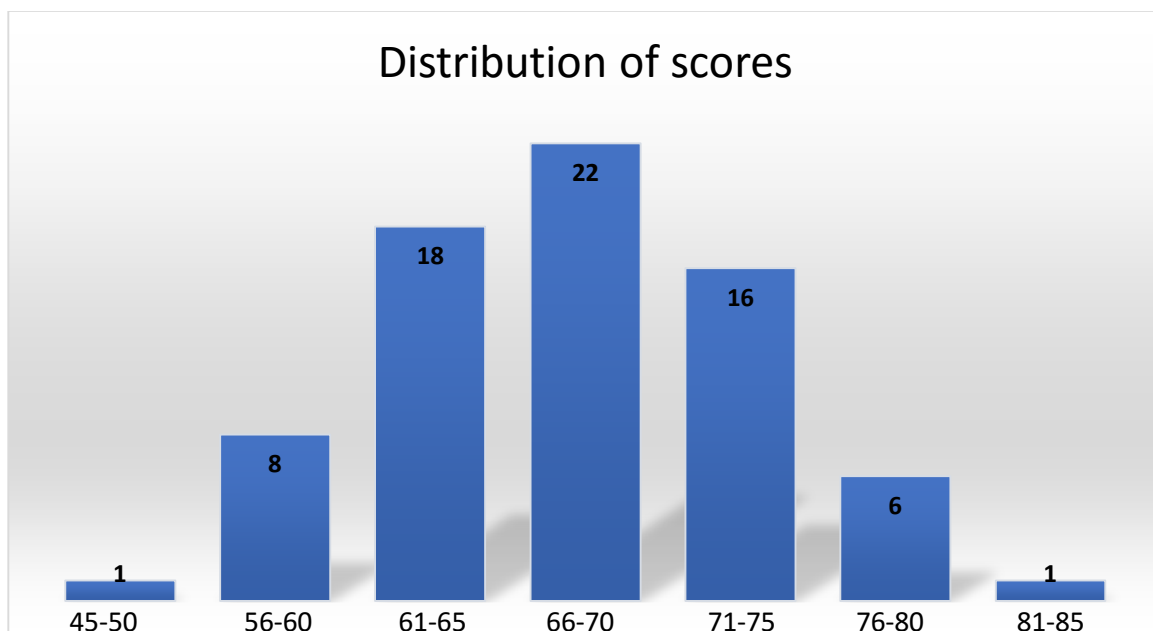


Figure 3.2: Distribution of Participants' Raw Scores

A table was constructed with participants' total scores for each of the survey administration and the change in score in the program, from the first to the second survey administration. The results of the data analysis were used to identify pre-service teachers at the high and low ends of the distribution. The analysis of the data arising from this phase of the study guided the purposeful sampling of participants for the qualitative phase of the study. Two participants with the highest level of mathematics teaching self-efficacy and two participants with the lowest level of mathematics teaching self-efficacy were selected.

3.6 Qualitative Phase of the Study

Collection in this phase of the study was designed to gather information to clarify issues that may emerge from analyzing data collected during Phase 1. The principal goal of this part of the study was to examine the experiences of preservice teachers qualitatively and understand

what factors influenced their teaching efficacy beliefs. Because survey instruments used to measure sources of self-efficacy are limited in their scope, and they do not provide an in-depth understanding of this phenomenon; interviews are more appropriate for this purpose.

Data from Phase 2 was obtained via one-on-one interviews through semi-structured and open-ended questions. Merriam (1988) states that interviewing provides the opportunity to “enter into the other person’s perspective” (p. 72) and allows to focus on the topic at hand as told by the personal story of the individual interviewed. A typical qualitative study recommends that the research method used is inductive: reasoning from the specific to a whole and focusing on the particulars rather than the general (Bruce, 2007). The qualitative data may clarify and explain the statistical results by examining participants’ views in more depth (Creswell, 2003; Rossman & Wilson, 1985; Tashakkori & Teddlie, 1998). Three main objectives drove this study of the preservice teacher efficacy. They were: (a) to understand how efficacy beliefs of preservice teachers changed as they relate to a reform-based math methods course; (b) to examine preservice teachers’ math experiences as sources of stress, either “success” or “failure” ; (c) and to find out which factors had a positive impact on the development of efficacy as they relate to a reform-based math methods course. This part of the study attempted to answer the following research questions:

- Q2: How do pre-service elementary teachers who have completed a reform-based university elementary mathematics methods course describe their beliefs?
- Q3: How do pre-service elementary teachers who have completed a reform-based university elementary mathematics methods course describe their classroom experiences?

In this phase of the study, four participants volunteered to participate in this phase of the study. They participated in semi-structured interviews upon the completion of the mathematics methods course. The interview protocol was used to gather in-depth information on the participants' perceptions of their skills and abilities to teach mathematics effectively. Interview questions were adapted to the PMTE subscale of the MTEBI. The interview protocol was used to gather in-depth information on the participants' perceptions of their skills and abilities to teach mathematics effectively. The questions were open-ended because to allow for participants' personal narratives to emerge (Connelly & Clandinin, 1990) (see Appendix F). The protocol was based on the work of Zeldin and Pajares (2000) who created open-ended questions for a narrative interview protocol to study self-efficacy. The questions were adjusted so that they address the pre-service teachers' experiences in the math methods course. The protocol was based on Bandura's (1977, 1986) four sources of self-efficacy. In this way, the protocol was aligned with the theoretical framework of this study.

Each interview lasted approximately between 30 and 45 minutes. All the interviews were conducted after the researcher obtained consent to audio-record the interviews. The data from the interviews was later transcribed from the recordings.

3.6.1 Qualitative Data Collection

The qualitative methods of the data from the interviews offer opportunities to understand the emerging teacher self-efficacy and its contributing factors in a narrative at the individual level. They provide information to answer research two, and the second research question, 'how do pre-service elementary teachers who have completed a reform-based university elementary mathematics methods course describe their beliefs? Factors that influenced pre-service teacher self-efficacy, as reported by pre-service teachers can be interpreted holistically, as powerful

expressions and texts of lived experience. This data is instrumental in answering research question two. During the interviews, researcher's influence was minimal. Respondents freely discussed and critiqued the valuable contributions of other courses in the preservice program, with and without comparison to the mathematics education courses.

Bandura's (1977, 1986, 1997) four main sources of influences on self-efficacy served as the framework to guide the data collection in this part of the study. These sources of influence on self-efficacy include mastery experiences (ME), vicarious experiences (VE), verbal persuasions (VP), and physiological states (PS). The interview protocol was developed based on Bandura's theorized four sources of self-efficacy. It was semi-structured so that the participants have all the latitude to tell their stories. In order to appreciate fully the heuristic process by which the pre-service teachers develop their self-efficacy beliefs, follow-up questions were asked if the participants failed to mention the effect of any one of the sources of efficacy on their experience.

Interviews were utilized to identify the types of teaching self-efficacy-forming experiences that pre-service teachers' experiences during their teacher education program and the perceived influence that these experiences had on the development of their teaching self-efficacy beliefs. The researcher began each interview by asking the participants about their early mathematics experiences. Sometimes, the researcher did not ask the questions in the same order depending on the participant personal prior experiences.

Positioning the researcher as the participants' partner in the research process, rather than as an objective analyst of subjects' experiences, is vital to developing a constructivist grounded theory design. Making clear the place from which the researcher starts provokes a need to reflect critically on one's underlying assumptions and heighten one's awareness of listening to

participants' stories as openly as possible. As well, it provides the reader with a sense of the analytical lenses through which the researcher looks at the data. Each of the interviewees' understanding was respected, so that the interaction and exchange of information with them, would lead to meaningful conversations. Essentially, participants and researcher were conducting the meaning-making process together to co-construct a theory through the analysis of the data.

Before the collection of data began, the participants were briefed on the meaning of self-efficacy so that the data results could be organized into exact groups of meaning that could be used to label the structural description of the construct. Teacher self-efficacy was described to the teachers as "the teacher's belief in his or her capabilities as a teacher to bring about the desired outcomes of student motivation and learning." The term self-efficacy was also used to describe teachers' self-beliefs being determinants of their own teaching behavior. A focus group of four elementary pre-service teacher was used in this study to gain a better understanding of the teachers' math teaching self-efficacy. A semi-structured interview was used to gather in-depth information on the participants' perceptions of their skills and abilities to teach mathematics effectively. Each interview lasted approximately between 30 and 45 minutes. All the interviews were conducted after the researcher obtained consent to audio-record the interviews. The interview questions were adapted from Usher and Pajares (2006) who synthesized research on self-efficacy from several researchers (see Table 3.6).

The questions were designed to record the four hypothesized sources of efficacy to uncover which one contributes to the positive experience of the interviewee. It was important to understand through which of the four theorized sources of efficacy pre-service teachers develop their efficacy beliefs. These questions were asked in a way so that the participants can evoke significant experiences in the development of their self-efficacy beliefs. The remaining questions

were constructed so that the interviewees can explain at what point in time of their educational experience they became aware of a high sense of efficacy towards mathematics.

Table 3.6: Sample Interview Questions

Bandura's Sources of Efficacy	Adapted from Usher & Pajares (2006)	Questions from Interview
Mastery experience	<ul style="list-style-type: none"> Recall a story that would really help me understand how you came to do what you do. (Pajares & Zeldin, 1999) Can you recall something that stands out as being a useful or valuable aspect of the course in giving you more confidence to teach science. (Palmer, 2006) 	<ul style="list-style-type: none"> Can you recall and describe a positive experience(s)? Can you recall and describe a good lesson modeled by someone else such as your teacher or your peers?
Vicarious experience	<ul style="list-style-type: none"> Think about the things you considered in increasing your confidence in teaching math. Think of how important each factor you mentioned was in influencing your self-efficacy (Hutchison, Follman, Sumpter, & Bodner, 2006; Lent, Brown, Gover, & Nijjer, 1996) 	<ul style="list-style-type: none"> Who do you think contributed to making that experience feasible?
Verbal persuasions	<ul style="list-style-type: none"> Who encouraged you by praising your math ability. (Matsui et al., 1990) 	<ul style="list-style-type: none"> Has anyone given you feedback to inform you that it was a good lesson or experience? Can you describe that experience?
Physiological states	<ul style="list-style-type: none"> I received good grades in my high school math classes. (Lent et al., 1991) 	<ul style="list-style-type: none"> How some of the mathematics experience(s) made you feel? Can you identify why or what part of the experience(s) that made you feel good about your mathematical ability?

3.6.2 Issues of Credibility and Legitimation

The standards of validity and reliability are essential keystones of any research method. The idea of reliability is that any significant results must be more than a one-off finding and be inherently repeatable. Validity involves the entire experimental concept and ascertains whether the results obtained meet all of the requirements of the research method. In quantitative research, there is the issue of validity, whereas, in qualitative research, validity is considered as trustworthiness, credibility, plausibility, and dependability. In mixed methods, Onwuegbuzie and Johnson (2006) suggest the word 'legitimation. To ensure credibility of the instrument being used for interviews in this study, the interview questions were presented to the dissertation chair for discussion. During the interviews the researcher asked the questions in a certain order but let the interviewees discuss and engage in open dialogue so that they can expand on their responses.

In general, small sample sizes impact the generalizability of results in a quantitative study, the sample size in this study has less of an effect as the inference quality remains high because of the mix of quantitative and qualitative data and the mixed methods design (Teddlie & Tashakkori, 2003). Despite the fact the sampled population was relatively small for the collection of quantitative data from the survey in phase one (70 respondents) and the qualitative interview data in phase two (four participants); the combination of quantitative and qualitative data have the potential to support and to complement one another. Finally, both the quantitative and qualitative methods offer information and perspectives from which to answer research question three, 'how do pre-service elementary teachers who have completed a reform-based university elementary mathematics methods course describe their classroom learning experiences?' The qualitative sense of teacher efficacy is mixed with the quantitative sense from statistical results to provide as complete a picture of preservice teacher self-efficacy. The

qualitative findings of the study provided a more detailed understanding of the quantitative findings to gain additional insight in pre-service teachers self-efficacy. The data from the interviews was later transcribed from the recordings. Each response was noted on a table similar to Tables 3.7 and 3.8.

Table 3.7: Sample interview Questions Addressing Research Question 2

	Mastery Experiences	Vicarious Experiences	Verbal Persuasions	Physiological States
<u>Question 1:</u>				
a) Can you recall and describe a positive experience(s)?	√			√
b) Can you identify why or what part of the experience(s) that made you feel good about your mathematical ability.		√		
<u>Follow-up question 1:</u>				
a) Who was involved in this experience?			√	
b) Did you have role models while you were learning math?		√		
c) How some of the mathematics experience(s) made you feel?				√

The questions guided the participants to focus on their teacher preparation program, their math methods course, and also their experience in the classroom as students during their earlier years and also as student teachers. The participants' responses were audio recorded. Also, the researcher used a frequency table that contained the four sources of self-efficacy to note which of the four sources contributed to the experience as expressed by the participant (see Tables 3.7 & 3.8). The researcher probed further by asking follow-up questions to make certain that if at any moment the interviewee did not refer to any of the hypothesized sources. The researcher was

Table 3.8: Sample interview Questions Addressing Research Question 3

	Mastery Experiences	Vicarious Experiences	Verbal Persuasions	Physiological States
<u>Question 2:</u>				
a) When did that happen (math methods course, student teaching)?	√			
b) What evidence do you have that makes you believe it was a positive experience?	√			
<u>Follow-up question 2:</u>				
a) Can you recall and describe a good lesson modeled by someone else such as your teacher or your peers?	√			
b) Did you get stimulated and motivated by that positive experience? Can you describe that experience?				√
c) Has anyone given you feedback to inform you that it was a good lesson or experience? Can you describe that experience?			√	
d) Who do you think contributed to making that experience feasible?		√		
e) Are you confident so that you can reproduce that same experience in a different situation?	√			

deliberate that the follow-up questions did not lead in any other direction except to investigate how the interviewee attributes the development of his/her mathematics capability. Each interview was recorded and transcribed to make sure the narratives of each participant was correctly reported, in addition to the notes taken by the researcher. The transcripts were used for coding the participants' responses to identify the significant themes.

The interviews provided information to answer the second research question, 'how do pre-service elementary teachers who have completed a reform-based university elementary

mathematics methods course describe their beliefs? Factors that influenced pre-service teacher self-efficacy, as reported by pre-service teachers can be interpreted holistically, as powerful expressions and texts of lived experience. During the interviews, researcher's influence was minimal. Respondents freely discussed and critiqued the valuable contributions of other courses in the preservice program, with and without comparison to the mathematics education courses. Accordingly, to guarantee the collection of pertinent and rich data, the researcher employed general interviewing principles and techniques. Interviews always began with general questions to put interviewees at ease and feel more comfortable and to build up a rapport between the researcher and the participant from the beginning. Through engaging in dialogue with individual participants, the researcher was able to follow their responses, delve beneath the surface of their descriptions, inquire for more details, and facilitate their reflections; thus collecting rich data. The researcher was at all times attentive to new ideas that could emerge from the data.

3.6.3 Qualitative Data Analysis

The qualitative methods of the data from the interviews offer opportunities to understand the emerging teacher self-efficacy and its contributing factors in a narrative at the individual level. With the goal of maintaining consistency in qualitative data collection, an interview protocol with a few open-ended questions to keep the focus on the research purpose was designed (Appendix F). With the goal of facilitating the understanding of identity construction in elementary pre-service teachers, questions were framed to explore the background and demographics, experiences, opinions, and values of respondents.

The researcher investigated and interpreted participants' non-quantifiable phenomena such as feelings, emotions, and thought processes that cannot be otherwise gained through quantitative methods of inquiry. Positioning the researcher as the participants' partner in the

research process, rather than as an objective analyst of subjects' experiences, is vital to developing a constructivist grounded theory design. Explicating the place from which the researcher starts provokes a need to reflect critically on one's underlying assumptions and heighten one's awareness of listening to participants' stories as openly as possible. As well, it provides the reader with a sense of the analytical lenses through which the researcher looks at the data. This part of the study was conducted under a philosophical constructivist worldview to investigate elementary school teachers' mathematical self-efficacy beliefs in the process of learning mathematics. A constructivist paradigm posits that knowledge is not merely transmitted; it is constructed (Merriam, 2009).

Constructivism supports the idea that there is not one universal truth; every individual's truth is subjective and is based on how the individual perceives an event or interaction with the outside world. Hesse-Biber and Leavy (2011) refer to one aspect of constructivism that asserts that meaning does not happen outside of the human interpretive process. Constructivists believe that experience and context influence not only participants' belief system but researchers' interpretation of the findings as well (Creswell, 2013; Lincoln et al., 2011). They derive an interpretation of their results from the setting or combination of participants' answers and behaviors (Creswell, 2013; Lincoln et al., 2011), and carefully examine the meaning that is not overtly obvious. Several researchers (Creswell, 2013; Hatch, 2002; Lincoln, Lynham, & Guba, 2011; Neuman, 2011) look at the constructivist worldview as a philosophical standpoint. Looking through this lens requires researchers to listen to multiple worldviews people hold, and attempt to understand and present these worldviews with all the details possible. The constructivist paradigm allows the researchers to generate meanings inductively (Creswell, 2013). Their role forces them to become actively engaged in the field through interaction with participants so that they co-

construct the reality with them (Hatch, 2002). In this type of research, the researcher's position is that of a partner to the participants rather than a neutral observer of participants' experiences. It also provides the reader a view of the analytical lenses through which the researcher looks at the data.

3.6.4 Analysis Procedure: Grounded Theory

Several researchers (Charmaz, 1990; Creswell, 1998, 2005; Denzin & Lincoln, 2003; Harry et al., 2005; Seale, 1999), have documented qualitative data analysis procedures in the methodology literature to demonstrate the soundness of grounded theory as a research method and the credibility of its findings. Grounded theory has evolved over the past four decades since the original work by Glaser and Strauss (1967) to become a major qualitative research approach. According to Charmaz (2003), grounded theory refers to a set of systematic inductive methods for conducting qualitative research aimed at theory development. Also, grounded theory methodology offers a practical and flexible approach to interpret complex social phenomena (Charmaz, 2003); and it provides a substantial intellectual justification for using qualitative research to develop theoretical analysis (Goulding, 1998). Charmaz (2006) stated that grounded theory methodology could permit researchers to track their research concerns and questions regularly and focus along with on-going data collection. Also, the on-going data collection permits for adding more and more information to create a theory as researchers prod deeper into the phenomenon or process (Charmaz, 2006; Creswell, 2013; Hood, 2007). Grounded theory methodology utilizes several approaches. The four most used approaches in grounded theory methodology comprise Glaser's (1967) traditional approach, the systematic approach of Strauss and Corbin (1990, 1998), the situational analysis of Clark (2005), and Charmaz's (2000, 2006) constructivist approach.

Grounded theory methodology is characterized by theoretical sampling, constant comparison of data, and theoretical saturation of categories, which distinguishes itself from other generic qualitative methods (Hood, 2007). Theoretical sampling is purposeful sampling, but not vice versa. A purposeful sample can be preplanned. In contrast, a theoretical sample in grounded theory methodology is not chosen ahead of time but is gradually enrolled as data analysis goes on. During the process of data analysis, researchers find the emerging conditions that may potentially influence the process under study, and thus, participants who show diversity in those conditions will be enrolled for on-going data collection (Hood, 2007). At the same time, data are continuously compared to previous codes within categories (Hood, 2007). A grounded theory approach helps researchers develop an understanding and interpretation of the causes, situational conditions, and outcomes across multiple contexts concerning a process of change or interaction (Strauss & Corbin, 1990, 1998).

The major purpose of grounded theory approach is to explain how people address issues that they experience in their world (Glaser, 1978). It situates research problems in a specific context and explains how people process and deal with those problems through theory inductively developed from the grounded data (Glaser and Strauss, 1967, Mills et al., 2007, Charmaz, 2008). Grounded theory approach is “grounded” in the data collected to develop or refine models of understanding through an inductive process. One significant assumption is that the researcher adopts a position of neutrality in the study and has the ethical responsibility of describing the situation in a non-evaluative way so that participant's voice is accurately represented over that of the researcher.

In-depth qualitative interviews are fitting with grounded theory as they are, according to Charmaz (2006, p.28), ‘open-ended but directed, shaped yet emergent, and paced yet has flexible

approaches'. In-depth interviewing keeps the focus on the topic and at the same time provides the interactive space and time to enable the interviewees' views and insights to emerge. She underlines the co-construction of knowledge (Babchuk, 2008, 2011; Charmaz, 2006; Creswell, 2013); it stresses the rapport with participants to co-construct the hidden structures (Charmaz, 2006). It also emphasizes the feelings and views of the participants rather than the true methods per se (Charmaz, 2006; Creswell, 2013). Their nature encouraged to bring forth the viewpoints of the participants' subjective world and made sure the abundant and dense data to be gathered (Charmaz, 2006). Charmaz (2006) indicates that the combination process of focused attention and open-ended inquiry in in-depth interviewing reflects grounded theory analysis (Appendix F).

3.6.5 Qualitative Data Coding

Coding encapsulates the framework of the analysis whereby data are conceptualized, refined and further organized to construct the final theory (Strauss & Corbin, 1998, p. 281). There have been different opinions regarding coding process among GT approaches. The major debate is the choice of the coding procedures between Glaser's (1978) and Charmaz's (2006) two-step approaches (the substantive and theoretical coding or the initial and focused coding) or Strauss and Corbin's (1990, 1998) three-step approach (open, axial and selective coding). In general, elemental coding methods are essential approaches to qualitative data analysis. They have key and focused filters for examining the data, and they build a basis for future coding cycles. Bandura's four sources of efficacy were used as categories to do the first cycle of coding.

Mac Queen et al. (2008) state "Structural Coding results in the identification of large segments of text on broad topics; these segments can then form the basis for an in-depth analysis within or across topics"(p. 125). The coding method can be kept at a basic level by applying it as a categorization technique for further qualitative data analysis. Namey et al.

(2008) suggest determining frequencies based on the number of individual participants who mentions a particular theme, rather than the total number of times a theme appears in the text. Applying active codes, the researcher focuses on the participants' thoughts, feelings, values, opinions, and beliefs, rather than just recording facts and describing situations. Code frequency report can help identify which themes, ideas, or domains were common and which rarely occurred" (Namey et al., 2008, p. 143). Each participant's transcript was coded with a priori themes from Bandura's theorized four sources of self-efficacy (i.e., mastery experiences, vicarious experiences, verbal persuasions, and physiological states). The structural coding was done simultaneously with the descriptive coding to capture as accurately as possible the essence of the thoughts of the interviewee. The similarity coded segments are then grouped for more detailed coding and analysis. Structural Coding results in the identification of large sections of text on broad topics; these segments can then form the basis for an in-depth analysis within or across topics" (Mac Queen et al., 2008, p. 125).

3.7 Summary

This study on pre-service elementary teachers' mathematical self-efficacy was conducted under a constructivist theoretical worldview. A constructivist philosophical worldview requires researchers to be extremely attentive to multiple world views people may hold. In doing so, the researcher must try to understand and expose these worldviews with details. Creswell (2013) contends that constructivist tend to be more predisposed to bring about meaning inductively. Unlike traditional ground theory where researchers usually play a distanced role, constructivists are engaged in the field through interaction with participants in co-constructing the reality. They recognize that experience and context influence not only participants' belief system but

researchers' interpretation of the findings as well (Creswell, 2013; Lincoln et al., 2011). According to Charmaz, grounded theory methods are systematic but flexible as well. As claimed by Charmaz (2006), "...neither data nor theories are discovered. Rather, we are part of the world we study and the data we collect. We construct our grounded theories through our past and present involvement and interactions with people, perspectives, and research practices" (p. 10).

In this study, a constructivist grounded theory was possible and appropriate because certain conditions were present. Charmaz (2003), insists that the researcher should make certain that the study is fully grounded in the data as well as being informed by existing theoretical and research literature. Positioning the researcher as the participants' partner in the research process, rather than as a dispassionate observer of their experiences, is central to developing a constructivist grounded theory design. The constructivist approach perspective dismisses the notion of a neutral observer and value-free expert: the researcher must acknowledge that his or her bias may influence the analysis of the data collected. Charmaz's notion of constructivist grounded theory aligns well with social constructivists such as Vigotsky (1962) and Lincoln (2013), who stress social contexts, interaction, sharing viewpoints, and interpretive understanding (Charmaz, 2014, p.14). Charmaz's constructivist approach to grounded theory methodology fits this research study on pre-service teachers' mathematical efficacy beliefs because it offered flexibility to the researcher to craft questions and progressively narrow down the focus of the research with data collection.

Chapter 4: Results

The purpose of the present study was to investigate the mathematics self-efficacy beliefs of pre-service elementary teachers in a university reform-based mathematics methods course. This study sought to underscore the impact of teacher preparation program in inspiring awareness of pre-service elementary teachers teaching efficacy beliefs in mathematics. Bandura's (1977, 1986, 1997) social cognitive theory has been used to study the development of teachers' belief in their ability to teach (Dembo & Gibson, 1985; Riggs & Enochs, 1990). Perception of self-efficacy is a very critical viewpoint because it denotes the "beliefs in one's capabilities to organize and execute the courses of action required producing given attainments" (Bandura, 1997, p 3). Bandura maintains that self-efficacy beliefs are intimately associated with classroom practice: "Teachers' beliefs in their instructional efficacy partly determine how they structure academic activities in their classrooms and shape students' evaluations of their intellectual capabilities" (p. 240). Therefore, looking at self-efficacy is a great way for examining pre-service teachers' beliefs about their future classroom practice. There is one overarching question for this study: Which aspects of participating in an elementary mathematics education methods course are most important for developing their self-efficacy in math teaching?

This chapter discusses the levels of mathematics teaching efficacy beliefs of 70 pre-service elementary teachers who took the Mathematics Teaching Efficacy Beliefs Instrument survey. Of the 70 pre-service teachers who took the questionnaire, four participated in the follow-up interviews for the qualitative part of the study. The role of the math methods course in their mathematics teaching efficacy beliefs is viewed and explained through the lens of the four participants who shared their experience via interviews.

A quantitative approach was warranted to examine the elementary pre-service teachers' mathematics teaching efficacy. Subsequently, a qualitative part explored four pre-service teachers' mathematics self-efficacy through interviews and considered how these beliefs changed after completing a reformed-based mathematics methods course.

Principally, the present study attempted to answer the following questions:

- Q1. Do pre-service elementary teachers' mathematical self-efficacy change after enrolling in a reform-based university elementary mathematics methods course?
- Q2. How do pre-service elementary teachers who have completed a reform-based university elementary mathematics methods course describe their beliefs?
- Q3. How do pre-service elementary teachers who have completed a reform-based university elementary mathematics methods course describe their classroom learning experiences?
- Q4. Do the quantitative findings on teacher self-efficacy constructs related to the qualitative findings obtained from the case-study interviews?

4.1 Quantitative Data Analysis

The Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) used in this part of the study uses a Likert-type scale with five response categories (1: strongly disagree; 2: disagree; 3: uncertain; 4: agree; 5: strongly agree)(Table 4.1). Data collected on each of the scores of pre-service teachers on pre-test and post-test for each item on the two subscales of the MTEBI were analyzed through paired sample t-test, to answer the two quantitative research questions. The quantitative part of the study used a single-group pre-experimental design to investigate the effects of Math Methods (MM) course on the teaching efficacy beliefs elementary pre-service mathematics teachers. Quantitative data were collected from the five-point Likert scale MTEBI survey. The MTEBI provided both the pre-service teachers' mathematics teaching outcome expectancy (MTOE) and their personal mathematics teaching SE

scores (PMTE). The MTOE examined the pre-service teachers' beliefs about teaching mathematics. The PMTE examined the pre-service teachers' beliefs about their teaching. The mean scores of pre-service teachers on pre-test and post-tests were analyzed through paired sample t-test using SPSS 22.0. The descriptive statistics for the MTEBI items (see Table 4.1) included in the output the number of subjects (N), the mean, and the standard deviation (SD). In this chart, the researcher used only matched scores for evaluation. Overall, in most instances, the mean increased between the pre- and the posttest.

Table 4.2: Test Score Differences for the Subscales of the MTEBI

Variables		N	Mean	SD
PMTE	Pre-test	70	3.73	0.91
	Post-test	70	3.91	0.95
MTOE	Pre-test	70	3.55	0.93
	Post-test	70	3.88	0.92

Analyses were done to verify that the data met the assumptions requisite for statistical procedures, and to ensure the reliability of the quantitative data for the current study. The Cronbach's alpha reliability test was conducted to test the internal consistency for the two subscales on the two-item MTEBI: PMTE and MTOE. The Cronbach's alpha for the overall scale was 0.83, which indicates a high level of reliability. Cronbach alpha coefficients of .83 for the PMTE subscale and .74 for the MTOE subscale were obtained, which were similar to results found in the original MTEBI study (Enochs et al., 2000).

Q1. Do pre-service elementary teachers' mathematical self-efficacy change after enrolling in a reform-based university elementary mathematics methods course?

Table 4.2: Test Score Differences for the MTEBI

Item #	Item	Pre test		Post test		Mean
		Mean	SD	Mean	SD	Diff
P M T E	2 I am continuously finding better ways to teach mathematics.	4.07	.74	4.40	.88	.33
	3 Even if I try hard, I will not teach mathematics as well as I will most subjects*	3.87	1.13	3.79	.95	-.08
	5 I know how to teach mathematics concepts effectively	3.37	.82	3.59	.87	.22
	6 I am not very effective in monitoring mathematics activities*	3.77	1.01	3.53	.96	-.24
	8 I generally teach mathematics ineffectively*	3.91	.83	3.71	1.14	-.20
	9 The inadequacy of a student's mathematics background can be overcome by good teaching	3.84	.71	3.96	1.12	.12
	11 I understand mathematics concepts well enough to be effective in teaching elementary mathematics.	3.81	.84	3.91	.85	.10
	15 I find it difficult to use manipulatives to explain to students why mathematics work*.	4.23	1.08	4.03	1.09	-.20
	17 I wonder if I have the necessary skills to teach mathematics*	3.54	.96	2.97	.96	-.57
	18 Given a choice, I will not invite the principal to evaluate my mathematics teaching*	3.69	1.03	3.63	1.05	-.06
	19 When a student has difficulty understanding a mathematics concept, I usually am at a loss as to how to help the student understanding better*.	4.00	.90	3.69	.96	-.31
M T O E	20 When teaching mathematics, I usually welcome students' questions	4.07	.89	4.37	.84	.30
	21 I do not know how to turn children on to mathematics*	4.20	.87	3.76	.95	-.44
	1 When a student does better than usual in mathematics, it is often because the teacher exerted a little effort.	3.07	1.15	3.79	1.05	.72
	4 When the mathematics grades of students improve, it is often due to their teacher having found a more effective teaching approach.	3.77	.87	4.07	.74	.30
	7 If students are underachieving in mathematics, it is most likely due to ineffective mathematics teaching	3.31	1.02	3.70	.97	.39
	9 The inadequacy of a student's mathematics background can be overcome by good teaching	3.84	.71	3.96	1.12	.12
	10 When a low-achieving student does better than usual in mathematics, it is due to extra attention given by the teacher.	3.71	.87	4.04	.82	.33
	12 The teacher is generally responsible for the achievement of students in mathematics.	3.55	.94	3.80	.91	.25
	13 Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching.	3.88	.98	3.70	.89	.18
	14 If parents comment that their child is showing more interest in mathematics at school, it is probably due to the performance of the teacher	3.77	.90	3.97	.81	.20
	16 I typically am able to answer students' questions about mathematics.	3.70	.79	3.76	.81	.06

The findings from the PMTE subscale reveal increases in the pre-service teachers' mathematics teaching efficacy beliefs. The analysis of the data indicates that there is a change between the means scores of the pre-service teachers before and after the completion of the math methods course.

The quantitative data from the MTEBI indicated insignificant ($p > .05$) positive change on the PMTE subscale [pre-test ($M = 3.73$, $SD = 0.91$) and post-test ($M = 3.91$, $SD = 0.95$)] and on the MTOE subscale [pre-test ($M = 3.55$, $SD = 0.93$) and post-test ($M = 3.88$, $SD =$ the data indicates that there is an appreciable improvement on the PMTE and MTOE subscales for some items (see Table 4.2).

Responses for the PMTE subscale (Table 4.4) indicate participants' self-efficacy has improved, particularly for item # 17 where they believe that they have acquired the necessary skills to teach mathematics. Improvement on item # 21, item # 19, and item # 20 suggest that the pre-service teachers have developed the confidence to turn students on to mathematics. Item# 2 reflects the desire for the pre-service teachers to improve their mathematics content knowledge so they can find better ways to teach mathematics. Responses for the MTOE subscale strongly suggest participants' outcome expectancy beliefs have significantly improved (see Table 4.3). They believe the role of the teacher is critical for the success of students in mathematics.

Table 4.3: Items Indicating Positive Change in Pre-service Teachers' Self-efficacy

Subscale	Item #	Positive/Negative Wording	Change Pre-Post test	Rank
PMTE	17	N	-.57	1
	21	N	-.44	2
	19	N	-.31	3
	2	P	.30	4
	20	P	.30	5
MTOE	1	P	.72	1
	7	P	.39	2
	10	P	.33	3
	4	P	.30	4

Even though, the quantitative data shows insignificant changes in the pre-service teachers' self-efficacy, there is evidence that the math methods course had a positive effect on the mathematics teaching efficacy beliefs of elementary pre-service mathematics teachers. The findings of the quantitative data analysis indicate that completion of this reform-based math methods course influenced positively the pre-service teachers' mathematics teaching efficacy beliefs. Furthermore, they hold the belief that they can influence student achievement and motivation (Tschannen-Moran et. al., 1998) and therefore become a determining agent of change to improve students' performances (Ashton et. al., 1982) even if the students experience adverse situations. These results are in agreement with earlier studies on the effects of mathematics methods courses and teacher education courses, mainly on the efficacy beliefs of pre-service teachers (Cakiroglu, 2000; Cone, 2009; Huinker & Madison, 1997; Liang & Richardson, 2009; Moseley & Utley, 2006; Richardson & Liang, 2008; Swars, 2005; Swars & Dooley, 2010; Woolfok Hoy & Spero, 2005, Giles, et al., 2016). Though the quantitative part of the investigation reveals interesting, significant results, the analysis does not identify which are the areas of the course that might have brought about those changes, and it does not determine if those changes resulted solely from the course by itself.

4.2. Qualitative Data Analysis

Answers for the second research question arose from the interview data and provided insights into personal mathematical teaching efficacy (PMTE) beliefs and mathematics teaching outcome expectancy (MTOE) beliefs. The interview data, on the whole, support the findings of the MTEBI. When considering self-efficacy beliefs, which were quantitatively measured by the MTEBI, the interview data corroborated the idea that the pre-service teachers

believed the role of the teacher is an essential mediating element of teaching to affect student learning in mathematics.

As previously mentioned, levels of the pre-service elementary teachers' mathematics self-efficacy were the only criteria used to select the participants for this part of the study. The pre-service raw scores ranged from 48 to 68 for the pre-test and from 60 to 81 on the post-test. Of the 70 elementary pre-service teachers who participated in the study, four were identified, two participants who scored high on the post test on teacher efficacy (raw score ranging from 79 to 81) and two participants who scored low on teacher efficacy (raw score ranging from 60 to 65) (see Table 4.4).

Table 4.4: Participants' Raw Scores

Participants	PMTE (max score 65)		MTOE (max score 40)		MTEBI (max score 105)	
	Pre	Post	Pre	Post	Pre	Post
Laura*	34	34	14	26	48	60
Brenda*	34	33	22	32	56	65
Josh*	38	43	30	36	68	79
Pam*	36	47	28	34	64	81

**pseudonyms*

Levels of the pre-service elementary teachers' mathematics self-efficacy were the only criteria used to select the participants for this portion of the study. Bandura's (1977, 1986) four theorized sources of efficacy (i.e. mastery experiences, vicarious experiences, verbal persuasions, and physiological states) in conjunction with the research questions guided the generation of themes and to structure the factors into the theorized sources of efficacy. Bandura (1997) said that individual efficacy beliefs "influence how people think feel, motivate themselves, and act" and he stated that self-efficacy beliefs regulate human functioning through four major processes that work in concert with one another. After comparing the

participant results to Bandura's (1997) four efficacy processes, each of the areas within themes was recognized and established according to participants' responses.

According to Bandura (1986), self-reflection is the most effective source of efficacy information because it is based on authentic mastery experience. Successes raise efficacy appraisals; failures lower them. Therefore, perceptions of self-efficacy are considered the most critical self-evaluations that occur through self-reflection. For that reason, participants were asked to recall some of their earliest positive or negative experiences in a math class. Also how those experiences made them feel about their mathematics ability and how those experiences were made possible? The participants' experiences ranged from elementary grades through middle school to high school.

Participants were asked to reflect on changes in their perception of self-efficacy that they had experienced from the beginning of the semester to the end. The interviews were steered toward uncovering interviewees' perceptions of their mathematical abilities and how that might shape their efficacy to teach mathematics, and that would include:

- a) their personal teaching efficacy beliefs to get students to believe they can do well in mathematics (Item 1- MTOE);
- b) their classroom teaching practices, including tensions associated with what they were learning in the mathematics methods course to provide alternative explanations or examples when students are confused (Item 11-PMTE);
- c) their knowledge of elementary mathematics to implement alternative strategies (Item 2-PMTE); and
- d) teaching outcome expectancy beliefs during mathematics instruction to motivate students who show low interest in mathematics (Item 10-MTOE).

Bandura (1977) draws a clear differentiation between teaching efficacy beliefs and outcome expectancy beliefs. The difference between PMTE and MTOE can be depicted by the following items in the MTEBI:

‘When teaching mathematics, I usually welcome students’ questions’ (PMTE)

‘Students’ achievement in mathematics is directly related to their teacher’s effectiveness in mathematics teaching.’ (MTOE)

The first item refers directly to an individual’s beliefs about mathematics efficacy. Whereas, the second one points out to the assessment of the outcome of good teaching. The raw scores of the PMTE portion of the survey showed that three of the four participants who participated in the interviews changed their responses from pre-test ‘agree’ to ‘disagree’ on the post-test. On the MTOE part of the survey, all four interviewees have changed their responses from “disagree” to ‘agree’ and ‘strongly agree’.

To uncover the underlying aspects of the interviewees’ experiences during their semester in the elementary math methods course, constructivist grounded theory was utilized (Charmaz, 2014). This approach provides a frame for qualitative inquiry, constructivist grounded theory emphasizes going into emergent phenomena, thus encouraging participants to reflect upon their experiences during the interviews. When the interviews stalled or proceeded at a slow reflective pace, I would probe the participant by asking questions to further clarify their thought.

Data collected was initially coded line-by-line using open coding to identify, name, categorize, and describe phenomena in the interviews. The data was subsequently coded using the sources of self-efficacy in the process to determine if the themes already identified fit in any of the self-efficacy categories. Some of the data from the interviews was reviewed a third and fourth time to uncover any additional details that may have been previously missed. The interview

analysis provided insight into the way the participants developed their self-efficacy during the semester.

Data were grouped by asking questions such as who, what, where, and when. Then, more or less similar responses were grouped together and assigned to the same theoretical concept or category. Later on, structural coding processes were used to integrate categories to build a framework with subsequent themes. Structural coding applies a content-based or conceptual phrase representing a topic of inquiry to a segment of data that relates to a specific research question used to frame the interview (Mac Queen et al, 2008).

Using structural coding approach as opposed to an entirely inductive approach of generating codes was to use Bandura's theoretical framework as a-priori codes to guide the analysis to explain the study's findings. The four theorized sources of Bandura's (1977) efficacy theory (mastery experiences, vicarious experiences, social persuasions, and physiological states) guided the organization of the qualitative data by following the primary research question and sub-questions. The rest of this chapter focuses on the qualitative findings of this study.

4.2.1 Interviews

Using semi-structured interviews provides the researcher the possibility to ask interviewees to elaborate extensively on any of their responses and share some of their experiences. The first profile was that of Pam. When asked to rate her mathematical ability, Pam admitted that "it would be low because I have not taken a math course in more than at least two years...maybe more." She was then asked what the word mathematics would conjure in her mind; Pam said "I am bad at it...I have always been bad at it." She attempted to

explain that her low ability in mathematics was the result of having terrible teachers. Her math performance and feelings are illustrated by the following conversation:

Pam: My bad experience began in middle school and continued in high school. It was just horrible. I just didn't feel connected to the school, and I disliked my teachers. I was struggling in math and some instances they made me feel stupid. After that, I was embarrassed to ask for help for fear to be ridiculed. I think that was the biggest factor that affected me. Though, I had an enough good experience in elementary school. In middle school, that is when my nightmare began and continued through high school. I think it is all because of the teachers in math. I believe that there were...[pause] just mean. It just made learning math not enjoyable at all for me.

Interviewer: So, you had negative experiences in your middle and high school math courses? But have you had any positive experience that you would like to share?

Pam: Yeah ... my fourth-grade teacher, she was probably the best.

Interviewer: The best?...How so? Can you elaborate?

Pam: Yeah, I always felt at ease in her class, she was very nice, and she was very patient with all the students. Especially, with the ones that were struggling like me. I felt comfortable with everything she was teaching me. I can still remember learning about division...and because I remember still writing in my daily journal about "Look at what I can solve." I was so proud of my work then.

Interviewer: But what about the other ones...how did they make you feel?

Pam: I felt like that I was just a number in their class...They were more focused on the material they were teaching and also being on schedule. I felt like they were not concerned about those of us who were falling behind...As time progressed, I felt dumber and dumber every day...I was afraid and embarrassed to ask for help...

Pam revealed that her positive experiences in elementary school influenced her decision tremendously to become an elementary school teacher. She admits that she is going to start her teaching profession with a huge handicap in mathematics and fears that might negatively affect her teaching. When asked about what would make it difficult for her to teach

math, she responded, “my concern is knowing the math that I have to teach.” She, later clarified her thoughts saying:

It has been a long time since I have taken a math class...I do not recall most of what I learned...and that makes it hard for me. Sometimes, I feel like I will not be able to teach those kids and not be able to offer them any help. I am afraid that if they ask me a question and I do not know how to answer it...I think that is my biggest fear.

Given the low confidence level of her knowledge base in the content, Pam was asked about what strategies she would use to motivate students who exhibit little interest in mathematics and are struggling. She responded:

I think I can motivate those students because I used to be one of those who was always struggling, and I will give them more of my attention. I will make learning math more fun using games and a variety of activities in class...I know how boring just to sit doing problems on paper or the board...I remember that because that is what we were doing all the time when I was a student.

She goes on to say:

The mathematics methods course I am currently enrolled in is helping me learn how to develop lesson plans that make learning math more fun. I can see myself using many of the activities that I learned in the mathematics methods course when I begin teaching in the classroom.

When asked to give examples of some of the activities that she might consider making math learning more fun, Pam mentioned using more hands-on activities such as manipulatives in her future classroom. She felt that it is the best way to teach a concept that is hard to grasp abstractly. She brought up several positive elements of the course that she thought helped her shape her attitude toward increasing her self-efficacy in teaching math. She mentioned the interaction within the collaborative working groups that provided positive verbal persuasion and shared vicarious experiences. These components of the course are significant to developing self-efficacy.

In spite of her poor experience struggling with mathematics in middle and high school where Pam thought her confidence in math was completely shattered, as a future teacher she understood the importance of building first her content knowledge to increase her confidence so that she can be more effective helping students who are struggling in mathematics. She believed that given the right guidance, mentoring, and more content knowledge, she will be able to develop her mathematics teaching efficacy.

The second profile was that of Josh. Overall, Josh considers his mathematical ability as average. He believes he can handle some mathematical tasks but has some difficulties when he is under pressure such as being in a testing situation because of a high level of anxiety. When asked to say the first thing that comes to his mind when he hears the word mathematics, Josh responded, “not fun.” He felt, like most the students who were struggling in math, that the teachers did not pay attention to them. Some teachers were more content centered rather than being student centered. Because of this, Josh thinks he had some trouble learning mathematics. However, Josh remembered one particular teacher, from his elementary school years, whom he could remember fondly. He goes on saying,

He always taught math in a fun, comfortable, and relaxing way that made me feel safe to ask for help when I do not understand. He taught in such a way that made us feel that we are teaching math to each other. He challenged us by answering our questions by asking us more questions. He would say “ask four before me,” meaning ask four of your classmates before you ask me. He believed in what we call mastery learning; he made sure that everyone got the concept or the skill before moving on forward.

Josh has always envisioned that this is the most efficient way to teach math. He is looking forward to when he will have his classroom so he can implement the same type of teaching methods. In addition to teaching the content in a more creative way, he is already

projecting to make math more relevant to the students' everyday lives through project-based lessons. When asked to elaborate on this idea, Josh mentioned shopping, for example, saying,

Given a situation where students (working in groups) create a list of purchase of groceries (using weekly flyers from the grocery store). They will apply addition and multiplication skills.

Josh's elementary school experiences in mathematics had mixed effects on him. He has ambivalent feelings, sometimes good and sometimes not so good. He is very cognizant of this situation; he is determined to be the best teacher he can be. He is confident that he will be able to motivate the most reluctant student who shows low interest in learning mathematics, stating,

I can relate to them because myself I struggled with math. It was not my favorite subject, but I made it work. I will share with them my experiences learning math, my difficulties and how I surmounted them. I will do my best so that they conquer their fear of mathematics.

Josh stated that looking forward for his students to be successful was a motivating force to increase his math teaching self-efficacy and was shaped by his meaningful experiences in the methods course. He drew his motivation from voices in the course that helped him reinforce his view about what teaching mathematics to elementary students should look like. When asked if a good teacher can make a difference in what a student can learn. He promptly concurred, saying,

The teacher is the most important factor in this. A good teacher should have a feel for where his students are so that he can pace the instruction accordingly. He should be more concerned about his students learning instead of just teaching the material.

Josh mentioned his experience teaching a math lesson in front of a classroom when thinking of his future teaching. Josh's lesson was about fractions, a topic he said he had not mastered completely before his preparation for the lesson. He admitted that he was very apprehensive about teaching the lesson. He did ask input from his classmates prior to preparing the lesson. The positive impact of the input of other adults helped reduce the physiological

stress and also helped his mastery experiences. For Josh, it seemed that the teaching experience was very helpful in developing his self-efficacy in math teaching.

The interview was closed by a final question asking Josh if he feels that he has acquired the sufficient tools to be an effective teacher. He responded saying,

Math was not really my strongest subject...I have struggled in the past because I think I had bad teachers but I did overcome my shortcomings...knowing what I know now, I will do my best to make sure to avoid what does not work...moreover, encourage them all the time. But, first I have to become more confident, it is something I will work on developing. I believe it is going to make me become a good teacher.

Given this comment, Josh thinks he will be an effective mathematics teacher despite the fact that he admits that he had always had difficulties with math.

The third profile is that of Brenda. Although, Brenda's math background is stronger compared to the other interviewees, she still believed her mathematical content knowledge to be minimal or at best medium. Brenda had taken two mathematics content courses in another department before enrolling in the teacher preparation program. She struggled and had barely satisfactory results. She commented about her new experience in the teacher education program saying:

You know, here [the teacher preparation program] we do more hands-on and project-based activities...it's like not doing any mathematics. It is, in fact, different from how I learned math before..."

Brenda admits that the project-based instruction she is experiencing in the program is presenting her with a new perspective on how to teach and learn math. She believes that this is the best way to teach math, she said,

Learning math should be fun... math is everywhere. Everything we deal with on a daily basis involves math...you go grocery shopping; you have to know how much you have and if you can afford to buy what you want...For example, if you are making money delivering papers...and you make fifty dollars a week, how

many weeks do you have to work before being able to buy the latest smartphone...you know we use math every day, it is everywhere.

Brenda considers herself more of a practical person, she learns math better when it is related to a particular situation. For her, learning math by watching the teacher demonstrating on the board how to solve problems did not help her learn when she was in school. She remembers her teacher from fifth grade, whom she liked. The teacher would give them a simple pattern without giving them the rules of the pattern, and encourage them to come up with the rules on their own. Students had to describe the steps and procedures to justify their rules. After giving the students the opportunity to solve the problem their way, the teacher demonstrates additional ways on how to address the problems using different approaches. Brenda mentioned that was her favorite way of learning math; she did not like the teaching of some of the teachers, she stated,

Some teachers briefly introduce the lesson, then basically say, "Watch me do sample problems from section A, you will do problems from section B as guided practice, problems from section C are for homework." And when you are done check your answers from the back of the book. Those were the most boring classes I ever had... I think math should be fun; teachers have to come up with new ideas to present the material, and not to stick to the textbook all the time...When I have my classroom, I will try to make learning math more fun...I am confident that I can do it.

Although Brenda wanted to project a sense of confidence, she admits that she still has some fear and anxiety about math. When asked about addressing the needs of those students who do not get it, she responded saying,

I think, if you make an intentional effort to teach it right the first time, every student should be able to learn the material... If some students are still struggling, I will use a variety of approaches so that everyone will get it... that would include using manipulatives or different types of visuals.

She feels that she will be able to implement alternative teaching strategies and feels confident to address the needs of those students who seem to be struggling by using alternate methods and examples. When asked what makes her think that she is going to be an effective

teacher, Brenda mentioned that she had acquired a good pedagogical knowledge base in the math methods course she completed as part of the teacher preparation program. She goes on to say,

I was fortunate to be with bright students in my methods class...they were like role models for me. We became very close during the semester. I was afraid to fail and disappoint them, and that motivated me to increase my effort and work harder to be successful... I believe students can teach each other... I think we all learn the same way whether we are in college or elementary school.

Throughout this interview, Brenda was able to reflect on the experience of teaching a lesson:

It was really a wonderful experience teaching a math lesson at the elementary school, although, I was very worried about delivering a meaningful lesson. I felt more at ease after I connected with the kids...it really made me more confident to teach math to kids having taking this course.

Brenda developed her personal identity as a teacher. Her early beliefs, about what kind of teacher she aspired to be, were formed and shaped through her experience in the course, and in particular, through teaching and reflecting upon her teaching experience. From her statements, it appears that this aspect of the course combined with the rich learning environment provided Brenda with ideas to implement her ideas about teaching and do some exploring of her own.

Laura is the fourth and final interviewee. From the onset, Laura expressed her distaste for math; she said, "I do not particularly like math, it has always been my least favorite subject."

When asked if she will be able to teach mathematics effectively, she hesitated before she responded saying,

I am not sure I can teach math effectively beyond third grade...Maybe in the future when I acquire more experience, I will teach fourth grade and above...First I want to be completely confident.

Laura mentioned that she had some bad experiences in mathematics during her elementary school years. She admitted that most of her belief and attitude regarding the role of the teacher were rooted in her childhood experiences. She mentioned, however, that she was doing

somewhat well in the early grades. However, over the years she has become less and less confident in her ability to do mathematics. She was then asked if she can remember any teacher that might be considered as a good teacher during her elementary school years, she promptly responded,

I am not sure I can remember any particular teacher...most of them were so boring. They would present the lesson by doing few examples on the board, and they would give us worksheets...it was mostly pencil and paper...they did not incorporate any manipulatives, for instance, ...it was hard, it was somewhat abstract to me.

Laura thinks that her teachers in elementary school were themselves struggling with math. She believed that they were not qualified teachers, they didn't seem like real professionals. She was very anxious because of her prior experience learning math. But she took on the task of learning how to teach math to elementary students with resolve and determination. Toward the completion of the program, Laura began to discover a meaningful mix of authentic standards-based instruction. After completing the math methods, she feels that she built up enough confidence to empower her to bring many qualities to the classroom. She goes on saying,

For example, if a student comes up with the answer whether right or wrong. You cannot say 'Wrong' go back and try again...this way you may crush their self-confidence and make them doubt their ability and may begin to dislike math. Say, 'by the way, you are getting very close, what can you do to make it better.' I want them to justify their answers... so that I can understand their thinking process. This way I will have an idea to make a correction if needed, and redirect them to the right path...This way, students will take more time to think and figure out the answer to the questions... Myself, I was one of the students who needed more time to figure out the problem...I hated it when by the time I got the answer, the teacher had already moved on to the next problem. I will make sure that this is not going to happen in my class, I am going to be patient and allow them enough time to work out the problems.

Moreover, when Laura was asked about what she might anticipate that she might struggle with as a teacher, she said,

My biggest fear is not mastering the math content necessary to teach a particular concept. Being in front of the students and not being able to explain the material ... That would be a disaster... I do not want my students to lose confidence in me. I have to master the content before I can teach it. I am concerned about finding the right teaching method because I want my students to get the most knowledge from my lessons.

The methods course was one the last classes in teacher education program that Laura had to take to fulfill her degree requirements. Laura had experience facilitating one lesson on developing concepts of decimals, percent, and proportional reasoning. She looked forward to find ways to incorporate the teaching of mathematics with other subjects:

I am really glad that I took the math methods course to learn how to teach math...Also the program prepared me and helped me understand what to expect. I look back at myself at the beginning of the program...Now, I realize how much my thinking has progressed from my first day and first observation. The image of the teacher who opens the textbook and starts to teach is forever gone as far as I am concerned.

Laura admits that her content knowledge in math is still not to the level she wants it to be. She believes that her math knowledge base will increase once she is in the classroom after one year or two. Even though Laura thinks that the first year may be challenging, she firmly believes that she will be an effective teacher. She is willing to implement alternative teaching strategies in the classroom so that students are exposed to different approaches especially during the early years of children schooling. She was asked to comment on the importance of the quality of the teacher and how that might impact what students get out of mathematics. She responded saying, “it is very, very critical.” In her view, an effective teacher should not only know how to teach the material but also be able to motivate the students to learn it.

4.3 Factors Contributing to Mathematics Efficacy Beliefs

Bandura's four theorized sources of efficacy (mastery experiences, vicarious experiences, social persuasions, and physiological states) were utilized to classify participants' experiences within each category. Using research questions two and three and Bandura's theorized sources of efficacy as guides to create themes for coding the data. Table 13 presents the themes and the frequency of the number of data coded for each category. The remainder of the chapter discusses the qualitative findings of this study in regards the factors that contribute to high mathematics efficacy beliefs.

4.3.1 Mastery Experiences

Participants were asked to reflect on their experiences, and what made those experiences unforgettable. According to Bandura (1986), self-reflection is viewed as the agency by which individuals perceive their behavior, judgment, and performance. Awareness of self-efficacy is among the most important self-evaluations that come about through self-reflection. Participants were able to recall experiences from their elementary school years through middle school to high school. They all agreed that high competency and success in mathematics are determining factors influencing self-efficacy beliefs when describing their mathematics experiences during the early years of their schooling. The congruency between the responses led these codes to be grouped as one theme because they were related to their perception of self-efficacy in mathematics and feeling of achievement (see Table 4.5).

The statement of one of the participants indicates the participant's competency and success on a specific task (fractions). Three of the four participants who took part in this phase of the study are persuaded that their positive experience involved a mastery of a math task. All

Table 4.5: Factors Contributing to Mastery Experiences

Participant	Interviews	Primary Coding
<i>Pam</i>	<ul style="list-style-type: none"> a) Sometimes, I feel like I will not be able to teach those kids and not be able to offer them any help.. b) I think I can motivate those students because I used to be one of those were always struggling, and I will give them more of my attention. c) I will make learning math more fun using games and a variety of activities in class... d) I can see myself using many of the activities that I learned in the mathematics methods course when I begin teaching my own students 	<ul style="list-style-type: none"> a) Competency and success b) Student success as an indicator of mastery. c) Competency and success d) Competency and success
<i>Brenda</i>	<ul style="list-style-type: none"> a) Learning math should be fun... math is everywhere... you know we use math every day, it is everywhere. b) I think, if you make an intentional effort to teach it right the first time, every student should be able to learn the material... If some students are still struggling, I will use a variety of approaches so that everyone will get it...that would include using manipulatives or different types of visuals. c) It was really a wonderful experience teaching a math lesson at the elementary school ... it really made me more confident to teach math to kids after taking this course. 	<ul style="list-style-type: none"> a) Competency and success b) Student success as an indicator of mastery c) Competency and success
<i>Josh</i>	<ul style="list-style-type: none"> a) Math was not always my strongest subject... but I did overcome my shortcomings... knowing what I know now, I will do my best to make sure to avoid what does not work... moreover, encourage them [students] all the time. b) First, I have to become more confident, it is something I will work on developing my knowledge of the math content... I believe it is going to help me become a good teacher. 	<ul style="list-style-type: none"> a) Competency and success b) Competency and success
<i>Laura</i>	<ul style="list-style-type: none"> a) ...Maybe in the future when I acquire more experience, I will teach fourth grade and above... First, I want to be completely confident about my math content knowledge. b) ... I want them [students] to justify their answers... so I can understand their thinking process... c) ... I have to master the content before I can teach it. I am concerned about finding the right teaching method because I want my students to get the most knowledge from my lessons. d) ... Now, I realize how the math methods course has been beneficial in helping me develop more confidence in teaching math 	<ul style="list-style-type: none"> a) Competency and success b) Student success as an indicator of mastery c) Student success as an indicator of mastery d) Competency and success

three participants mentioned eight different instances of experiences of success in mathematics. Each one of those experiences pointed out by the participants was considered as a mastery experience. The fourth participant recalled mastery experiences in mathematics but did not credit any her early positive experience in mathematics to mastery experiences in mathematics. However, all four participants recalled some aspects of their experiences that falls into one of the other categories of the theorized sources of efficacy beliefs.

One participant credited the student teaching component of the teacher preparation program for fostering and fortifying her beliefs about her capability to teach mathematics. One of the requirements of the methods course is to develop a math lesson to be taught; that obliged her to be very diligent in putting time and effort into creating the most effective lesson possible. This participant's experience was categorized as mastery experience because of the following statement made by that participant:

We are required to do our lessons plans and then teach a math lesson that we develop for our final project in the classroom.

It is worthwhile to mention that the math methods course in the teacher preparation program, provided the participants in this study with vicarious experiences, mastery experiences, and social persuasions that contributed to the formation of their mathematics teaching efficacy beliefs.

4.3.2 Vicarious Experiences

Some individuals draw on from different sources and experiences to develop their self-efficacy. According to Bandura (1977), vicarious experiences help individuals develop feelings of confidence in their abilities to execute a specific task. Vicarious experiences involve watching someone perform a task whether successfully or unsuccessfully or perceiving a positive influence towards one's performance through the performance or experience of another

individual. Some of the participants mentioned examples of positive experiences from their peers or positive feedback from their peers (see Table 4.6).

Table 4.6: Factors Contributing to Vicarious Experiences

Participant	Interviews	Primary Coding
<i>Pam</i>	a) ...my fourth grade teacher, she was probably the best b) The mathematics methods course I took helped me learn how to develop lesson plans that make learning math more fun	a) Adult role models b) Teacher preparation program
<i>Brenda</i>	a) You know here [the teacher preparation program] we do more hands-on and project-based activities...it's like not doing any math. It is, in fact, different from how I learned math before..." b) I was fortunate to be with bright students in my methods class... they were like role models for me... I believe students can teach each other...	a) Teacher preparation program b) Peers as role models
<i>Josh</i>	a) He always taught math in a fun, relaxed way... He taught us in such a way that made us feel like we are teaching math to each other... He challenged us by answering our questions by asking more questions... He would say "ask four before me," meaning asking four of our classmates before asking him. b) The teacher is of course the most important factor in this. A good teacher should have a feel for where his students are so that he can pace the instruction accordingly. He should be more concerned about his students learning instead of just teaching the material.	a) Adult role models b) Adult role models
<i>Laura</i>	a) I am really glad that I took the math methods course to learn how to teach math... Also the program in general, prepared me and helped me understand what to expect...now, I realize how much my thinking has progressed from my first day and my first observation	a) Teacher preparation program

In a classroom setting, vicarious mathematical experience involves watching someone being successful in completing a task in math or being successful in math in general.

Participants' responses that described vicarious experiences, related to Bandura's theoretical framework of self-efficacy, were grouped to uncover how their experience implicated vicarious experiences. Two participants stated the following about their mathematics experience:

I was fortunate to be with bright students in my methods class...they were like role models for me ... I was afraid to fail and disappoint them, and that motivated me to increase my effort and work harder to be successful... I believe students can teach each other... (Brenda)

It is apparent from the participant's responses that observing peers being successful in mathematics increased the confidence in her mathematics ability. Being in the presence of students, perceived to be successful in math, motivated the participant to work harder so that she could belong to that group. The experience, mentioned by the participant, which fits in Bandura's framework of vicarious experiences, may as well be coded as social persuasions.

Vicarious experiences are not limited to peers or individuals within the same age group. Participants mentioned siblings and friends, outside of the school setting, having success in mathematics and being role models they wanted to emulate. All four participants in this study mentioned the math methods course instructor as someone who delivered the most meaningful instruction to improve their mathematics experience. They considered the instructor as a role model figure who provided them with instructional strategies that they could put to use right away. The instructor provided vicarious experiences that helped those student teachers in developing beliefs in their personal abilities to execute any given mathematics tasks. Participants in this part of the study accredited their beliefs about math to experiences with a particular teacher or probably to a direct expression of their teacher's thoughts and beliefs. When preservice teachers received support from their teacher, they displayed a more positive

disposition toward math, a finding reported by the National Mathematics Advisory Panel (2008). Those pre-service teachers who reflected on negative feelings about math have recalled negative experiences from their education (Chapline, 1980; Chavez & Widmer, 1982).

Participants also stated that vicarious experiences, provided as part of the teacher preparation program, had a positive influence on their mathematics teaching efficacy beliefs. Two participants credited instructors in the preparation program as being role models who showed them strategies and techniques that were very constructive in their development as mathematics teachers. One participant recalled one instance as follows:

My instructor, she would say, “If you lose them on this, here’s one alternative strategy you can use. Once they get it, here is how you can reinforce it and extend it.”

For this participant, watching the instructor modeling different strategies, instilled in her the belief that she can be successful helping students. Another participant credited the instructor for teaching her strategies that were effective and made mathematics easy for children to understand. It is evident that role models during the teacher preparation program can have an enduring effect on pre-service teachers’ mathematics self-efficacy beliefs.

4.3.3 Physiological States

This section discusses the interaction of all aspects impacting efficacy beliefs for the four participants in this part of the study as experienced in their earliest positive experience with mathematics (see Table 4.7). Bandura (1977, 1986) refers to “physiological states” as the emotional arousal stimulated by a situation. An individual may have a positive response, a negative response, or no response at all to a given situation.

Table 4.7: Factors Contributing to Physiological States

Participant	Interviews	Primary Coding
<i>Pam</i>	<p>a) My bad experience began in middle school and continued in high school. It was just horrible. I just didn't feel connected to the school, and I disliked my teachers. I was struggling in math and in some instances they made me feel stupid.</p> <p>b) ...I was embarrassed to ask for help for fear to be ridiculed. I think that was the biggest factor that affected me...</p> <p>c) I felt like that I was just a number in their [teachers] class... As time progressed, I felt dumber and dumber every day... I was afraid and embarrassed to ask for help...</p> <p>d) I am afraid that if they [the students] ask me a question and I do not know how to answer it... I think that is my biggest fear.</p>	<p>a) Sense of belonging</p> <p>b) Fear of disappointment</p> <p>c) Sense of belonging</p> <p>d) Fear of disappointment</p>
<i>Brenda</i>	<p>a) I was fortunate to be with bright students in my methods class</p> <p>b) I was afraid to fail and disappoint them, and that motivated me to increase my effort and work harder to be successful...</p> <p>c) I did not have a good experience in my early school years, and I would not want my students to go through what I have been through when I was a student. That is one of the reasons that motivate to be a good teacher.</p>	<p>a) Sense of belonging</p> <p>b) Sense of belonging as source of motivation</p> <p>c) Student success as a source of positive PS</p>
<i>Josh</i>	<p>a) I can relate to them [students] because myself I struggled with math. I will share with them my experiences learning math, my difficulties and how I surmounted them. I will do my best so that they conquer their fear of mathematics</p> <p>b) It was really a wonderful experience teaching a math lesson at the elementary school... I felt more at ease after I connected with the kids...</p> <p>c) It made feel more confident to teach math after having taken this course.</p> <p>d) ...I want to be the key support in helping them [students] explore, and discover.</p>	<p>a) Student success as a source of positive PS</p> <p>b) Student success as a source of positive PS</p> <p>c) Student success as a source of positive PS</p>
<i>Laura</i>	<p>a) ...I hated when by the time I got the answer, the teacher had already moved on to the next problem...I am going to be patient and allow them [students] enough time to work out the problems.</p> <p>b) My biggest fear is not mastering the math content necessary to teach a particular concept...</p>	<p>a) Student success as a source of positive PS</p> <p>b) Fear of disappointment as a source of motivation.</p>

The physiological state is a source of information that has a significant influence on the individual's efforts and disposition in completing a given task. If a person has claustrophobia, the response to a request to ride in an elevator will produce a degree of emotional arousal that will have a negative effect in accomplishing the task of riding the elevator. Many people have math phobia or a deep-seated fear of mathematics. Math phobia has been and remains a source of fear and anxiety for many people. Individuals who experience math anxiety develop avoidance behaviors towards any mathematics' tasks. One of the reasons may be that students are afraid of getting wrong answers when doing math problems because they are scared of been considered stupid in front teachers and their peers, so they begin avoiding the subject at any cost. In contrast, participants with high self-efficacy beliefs in their math abilities will have a more positive disposition toward mathematics.

Participants in this study received praise, had positive role models in mathematics, and were successful in mathematics at some point that created a positive attitude and belief in their abilities to perform mathematics tasks. Participants also experienced positive emotional arousal instead of negative arousal during the math methods course. Individuals who have a positive physiological state towards a task will have an increased level of resilience towards performing the task. Physiological states codes turned out to be the most frequently used code in the analysis of the interview data from the four participants. There were 12 instances where participants' responses related their experiences to physiological states. Teaching mathematics when there is a negative physiological state towards mathematics is bound to be ineffective. Even though, some of the participants mentioned experiences that could be perceived as negative stimulus, further in the interview they mentioned that those negative experiences turned out to become a source of motivation and resilience.

4.3.4 Verbal Persuasions

An individual's self-efficacy beliefs towards performing a given task can be dependent on the feedback received on the individual's performance and by the amount of reinforcement received when performing that task. Bandura (1977, 1986) states that verbal persuasions (Table 4.8).

Table 4.8: Factors Contributing to Verbal Persuasions

Participant	Interviews	Primary Coding
<i>Pam</i>	a) I think one of the important experience in the methods course that I think showed me how to teach math, was when we had someone actually participated and helped us teach math...I thought that was the critical thing...	Cooperative and a supportive faculty
	b) I think the course has really made me discover that teaching math can be fun	Individual feedback
<i>Brenda</i>	a) ...when I was doing something wrong... she [classmate] would show mw she had had done it.	Peer feedback
	b) I was fortunate to be with bright students in my methods class...	Peer feedback
<i>Josh</i>	a) When I was a student teaching, the supervising teacher gave a small group of students to teach multiplication...	Student feedback
	b) Using counting chips, I demonstrated to them multiplication by creating a certain number of equal groups and then counting the total number of chips. We were going through the activity, when one of the student suddenly yelled: "I got it...I got it...it is like adding the chips over and over again, I understand now." The look on his face showed me that he understood the concept of multiplication being repeated addition. I felt so happy that I was able to get to someone who was a resource student, someone considered to be below grade level.	Student success as a positive source of efficacy
<i>Laura</i>	a) The classroom teacher I worked with during my student teaching experience was very supportive...she did push a little...when you find yourself challenged, you'll find the strength to overcome the situation...overall, I can say that she was part of helping gain more confidence to become a good math teacher.	a) Cooperative and a supportive faculty

have the potential of increasing an individual's efficacy beliefs if they are positive in nature and promote performing the task at hand. Although this aspect of efficacy beliefs is important, Bandura (1977) cautions that efficacy beliefs derived from verbal persuasions may not be as effective as those that stem from the individual's mastery experiences. Participants in this study were able to recall the earliest positive experience with mathematics.

Two of the participants recognized that the comments about their high mathematics ability coming from peers and adults had generated positive emotional state about their mathematics ability. The other two participants attribute their positive disposition and confidence towards their mathematics abilities saying statements such as "I feel that I can do this!", moreover, "I get the idea!" as an outcome of the perception of their newly acquired attitude resulting from the social persuasion expressed or implied by the adults.

Although Bandura (1977, 1986) does not discuss the role of group dynamics in an individual's self-efficacy beliefs, one participant in this study acknowledged that being part of a group had a positive influence on her educational experience:

I was fortunate to be with bright students in my methods class...they were like role models for me. We became very close during the semester. I was afraid to fail and disappoint them, and that motivated me to increase my effort and work harder to be successful... (Brenda)

The desire to belong to the group encouraged this participant to put forth more effort towards mathematics tasks to continue to be a part of the group. It is not quite evident that there is a causal relationship between the sense of belonging and the level of self-efficacy, but the motivation to do well in mathematics justified the increase in the exerted effort. Interviewees did not particularly care about who provided the positive reinforcement; they welcomed receiving encouragement about their mathematical abilities. The four participants interviewed in this part

of the study identified individuals including teachers, siblings, peers, and classroom instructors as sources of positive verbal feedback which helped them increase and reinforce their level of confidence. Another important factor that had an impact on teachers' mathematics teaching efficacy beliefs was students' verbal persuasions during the student teaching component of the preparation program.

Students making positive commentaries about their teaching effectiveness had a significant influence on participants' beliefs about their efficacy towards mathematics teaching. Student verbal persuasions may have been the catalyst to generate positive beliefs in participants or may have been instrumental in reinforcing their already perceived mathematics teaching efficacy beliefs. Two participants commented that the feedback given by students was a gauge of their mathematics teaching abilities. Participants recalled from their student teaching experiences in the classroom, students saying, "you are making math so easy to learn" or "You make math so much fun and no difficult at all."

Both participants added more comments of reflection about the effect of students' statements. One of the participants goes on saying:

When students react positively to me, it is an indication that I am doing something right. It is a sign that they are learning and math is making sense to them as a result of my teaching. It gives me more confidence in what I am doing.

This participant's statement illustrates Bandura's (1977, 1986) efficacy theory on the impact of verbal persuasions. In fact, students' comments can be construed as real-time assessment of a teacher's mathematics teaching performance. Positive reactions expressed by students, and student success as perceived by participants, can serve as an incentive for participants to teach mathematics in ways that would generate the same result in their students.

Themes that emerged from the data analysis connected to the perception of mathematics teaching efficacy included past experiences with mathematics, influences on beliefs of mathematics teaching efficacy, and mathematics teaching strategies. In this study, the preservice teachers with the lowest degrees of mathematics teacher efficacy are referred to as Laura and Brenda. The preservice teachers with the highest degrees of mathematics teacher efficacy are referred to as Josh and Pam.

Laura and Brenda, the two teachers with the lowest degree of mathematics teaching efficacy beliefs, alluded to negative experiences with mathematics during their formative educational years. Laura stated, “I always had difficulties with math, I struggled all the time. “Brenda also stated, “Math has always been my weakest subject.” Both Laura and Brenda expressed their feelings about the worthlessness of mathematics in everyday life in the real world. Laura said, “when I was in high school I always asked myself, why do I need this? Am I ever going to use it? I just could not see the relevance of all this. On the other hand, Josh and Pam, two teachers with a higher degree of teaching efficacy beliefs, shared different experiences regarding their past educational experiences with mathematics. Josh recalled positive experiences with mathematics. He declared, “I liked math when I was in elementary school, He stated, "Math was always a better subject in school, especially in the lower grades. I had a great teacher in third grade”, he goes on saying:

He always taught math in a fun, comfortable, and relaxing way that made me feel safe to ask for help when I do not understand. ... He believed in what we call mastery learning; he made sure that everyone got the concept or the skill before moving on forward.

On the other hand, Pam revealed that she had struggled with mathematics in school and had to give more attention to mathematics than other academic subjects. She declared:

I struggled with math in middle and high school...all the other topics were easy in comparison. High school was easy for me, one did not have to study that much, but for math, I had to study more to learn it.

All four pre-service teachers displayed a sense of confidence in their abilities to be effective teachers. However, Laura and Brenda, the two pre-service teachers with the lowest level of mathematics self-efficacy, had some uncertainties about their abilities. Although, they felt they could teach mathematics effectively, they believed that it would take them a little more time, effort, and preparation to attain a higher level of competency. Laura stated:

I am not sure I can teach math effectively beyond third grade...Maybe in the future when I acquire more experience, I will teach fourth grade and above...First I want to be completely confident. I know it will take more time and more effort. I know I can do it; it would just take more work.

Reiterating what Laura said, Brenda stated, "First I think I need to make an extra effort into mastering the subject in creating great mathematics lessons so that I can convey the information to my students. It is evident that Laura and Brenda were aware of their shortcomings in mathematics. Both of them expressed the desire to exert more effort and spent more time on mathematics instruction to overcome their feeling of inadequacy that stemmed from their past negative experiences with mathematics.

Pam and Josh, whom both had the highest degree of mathematics teacher efficacy, believed that they could teach mathematics effectively. Pam stated:

I think I will be able to teach mathematics effectively because I owe it to my students to be the best teacher possible. One of the reasons is that myself I struggled with it and I want to do my best for my students.

Josh also believed that he could teach mathematics effectively, but unlike Pam, it was mainly because of his higher level of comfort with mathematics. He considered his experiences with mathematics in school more positive. Josh stated, "I believe I can teach mathematics effectively. Math was always a better subject."

All four participants declared that the most effective mathematics instructional strategy to motivate students so that they learn mathematics was to develop lessons with real life mathematics activities. The two pre-service teachers, Laura and Brenda, both with the lowest level of mathematics teacher efficacy, recalled past experiences where they felt the subject was irrelevant, useless, and completely disconnected with daily life. Both of them agreed it is crucial to provide students with material that not only relate to real situations but also to their personal interests. Pam stated:

I think I can motivate those students because I used to be one of those who was always struggling, and I will give them more of my attention. I will make learning math more fun using games and a variety of activities in class...I know how boring just to sit doing problems on paper or the board...I remember that because that is what we were doing all the time when I was a student.

Brenda admits that the project-based instruction she is experiencing in the program is presenting her with a new perspective on how to teach and learn math. She believes that this is the best way to teach math, she said:

Learning math should be fun... math is everywhere. Everything we deal with on a daily basis involves math...you go grocery shopping; you have to know how much you have and if you can afford to buy what you want.

Josh and Pam, the two pre-service teachers with the highest level of mathematics teaching efficacy, concurred on the importance including real-life situations in mathematics lessons so that students can see the usefulness of mathematics. Josh gave the following example, saying:

For example, if you are making money-delivering papers...and you make fifty dollars a week, how many weeks you have to work before being able to buy the latest smartphone...you know we use math every day, it is everywhere.

He suggested finding something familiar to them to which they can relate, and incorporate in the lesson. Similarly, Pam spoke of the importance of making students aware of how much

mathematics is omnipresent in every aspect of their lives. She described a statistics activity where students would keep a daily log of how they feel every period through a school day. Students would rate their mood from very good (5) to very bad (1), then the data collected would be plotted as bar graphs. A classroom discussion would ensue; students could use multiple representations to determine in which period they have their peak performance and therefore appreciate the usefulness of mathematics in everyday life. The pre-service teachers' thoughts are captured in their responses on item 21 of the MTEBI (see Table 4.9).

Table 4.9: Participants' Responses to Item # 21 on MTEBI

	Josh		Pam		Laura		Brenda	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
<i>I do not know what to do to turn students on to mathematics.</i>	D	D	U	D	U	D	A	U
<i>(SD) Strongly Disagree; (D) Disagree; (U) Uncertain; (A) Agree; (SA) Strongly Agree</i>								

Three of the participants, Brenda, Josh, and Pam expressed an interest in using manipulatives. The pre-service teachers' thoughts are captured in their responses on item 15 of the MTEBI (see Table 4.10).

Table 4.10: Participants responses to item # 15 on MTEBI

	Josh		Pam		Laura		Brenda	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
<i>I find it difficult to use manipulatives to explain to students why mathematics work</i>	D	SD	D	D	U	A	U	U
<i>(SD) Strongly Disagree; (D) Disagree; (U) Uncertain; (A) Agree; (SA) Strongly Agree</i>								

Laura seemed to a little hesitant about the use of manipulatives. She did not value the use of manipulatives because she was not exposed to them in elementary school as she said, "we have never used manipulatives. I do not feel comfortable because I do not have any experience using

them.” On the other hand, Brenda, a pre-service teacher with a low level of mathematics efficacy, firmly believed the use of manipulatives as an effective teaching tool. She stated that manipulatives are an authentic means of teaching that gives students an additional opportunity for a hands-on experience. Josh and Pam, the pre-service teachers with a higher level of mathematics teacher efficacy, both showed keen interest in using manipulatives as a teaching and learning tool. Pam stated, “students learn best when they are empowered to be in charge of the learning process”. Josh continued saying, “students learn best when they are active participants in the learning process. Using manipulatives will help students make connections between concrete situations to learn mathematics.” He goes on saying, “manipulative use is a fun way to teach mathematics.” Both Josh and Pam believed that manipulatives tend to improve students' understandings of mathematics.

4.4 Summary and Conclusion

This study attempted to answer three research questions related to elementary pre-service teachers' efficacy to teach mathematics at the elementary grades level. To answer these questions, two surveys were administered, one pre-condition survey at the beginning of the ELED 4310 course and one post-condition survey upon completion of the ELED 4310 course. In addition, four pre-service teachers were interviewed at the end of the course.

The quantitative part of the study used a single-group pre-experimental design to investigate the effects of math methods course on the teaching efficacy beliefs elementary pre-service mathematics teachers. The MTEBI provided both the pre-service teachers' mathematics teaching outcome expectancy (MTOE) and their personal mathematics teaching SE scores (PMTE). The MTOE examined the pre-service teachers' beliefs about teaching mathematics.

The PMTE examined the pre-service teachers' beliefs about their teaching. Overall, and in most instances, the mean increased between the pre- and the posttest, while the standard deviation decreased between pre- and post-tests.

Overall, the results suggest that there was a significant difference between the pre-test and post-test scores on PMTE and MTOE subscales from paired sample t-test analysis. The findings from the MTEBI reveal increases in the pre-service teachers' mathematics teaching efficacy beliefs. The difference between scores implies that math methods course had a significant positive effect on the mathematics teaching efficacy beliefs of elementary pre-service mathematics teachers. Taken as a whole, the findings of the study indicate that completion of a math methods course has a positive influence on the mathematics teaching efficacy beliefs of pre-service elementary teachers.

Because of participating in math methods course for a semester, the pre-service teachers' PMTE and MTOE beliefs have improved appreciably. These results are in agreement with earlier studies on the effects of mathematics methods courses and teacher education courses, mainly on the efficacy beliefs of pre-service teachers (Cakiroglu, 2000; Cone, 2009; Huinker & Madison, 1997; Liang & Richardson, 2009; Moseley & Utley, 2006; Richardson & Liang, 2008; Swars, 2005; Swars & Dooley, 2010; Woolfok Hoy & Spero, 2005).

The findings from this study suggest that those pre-service teachers who took part in it have the predisposition to use more inquiry-based instruction, learner-centered and teaching approaches that are aligned with the NCTM standards, and to develop into effective teachers (Czerniak, 1990; Swars, 2005; Riggs & Enochs, 1990). Furthermore, they hold the belief that they can influence student achievement and motivation (Tschannen-Moran et. al., 1998) and therefore become a determining agent of change to improve students' performances (Ashton et. al., 1982a) even if the students experience adverse situations. Though the pre-service teachers

experienced substantial increases in beliefs about their individual capabilities to teach mathematics effectively, they did not have significant increases in beliefs that their teaching would have an effect on student learning in the classroom (e.g., Items # 3, 17, 21).

Findings from the qualitative part of this study resulted from the analysis of data collected via semi-structured interviews. Factors influencing mathematics and mathematics teaching efficacy beliefs were identified. The analysis of the data reveals that participants' mathematics efficacy beliefs began to take shape during their early years of schooling. Participants' previous experiences with mathematics strongly influenced their levels of mathematics teacher efficacy and significantly shaped their perceptions of mathematics teaching efficacy. Both pre-service teachers with a low degree of mathematics teacher efficacy mentioned negative past experiences in school.

Bandura (1986) asserted efficacy beliefs are mostly molded by an individual's previous performances and experiences. The fact that a student showed a certain degree of success made a positive impact on one of the teachers (Josh). For participants in this study, verbal persuasions and physiological states were some of the primary and most important factors influencing their efforts and beliefs towards mathematics during their formative years in elementary and middle school. The data point out to master experiences as being the strongest of all sources only during the latter part of their educational experience. Social persuasions became more valuable when they were from their peers and adults, and they turned out to be a significant driving force in their mathematics experiences. Participants mentioned facing negative experiences during their elementary school years; feeling overlooked in the classroom, feeling their teachers were going too fast for them, feeling their teachers were more interested in covering the material, or their teachers' style of teaching was not effective. These pre-service teachers think that they will be

effective mathematics teachers, notwithstanding their negative experience during their elementary school years; they also believe to be more empathetic toward students who struggle because they can relate to them. One of the pre-service teachers, with a high level of mathematics teacher efficacy, who had struggled as a learner during her early years declared that negative experiences were an excellent motivator for effective teaching of mathematics.

The four pre-service teachers, aside from their level of mathematics teaching efficacy, all stressed the importance of using real-world examples to motivate students. The two teachers with the low level of mathematics efficacy unequivocally espoused this vision of teaching mathematics because of their flawed perception of mathematics as useless in their early years of schooling. NCTM (2000) underscores the role of teachers in delivering content and processes that are interesting to students. The mathematics curriculum must offer opportunities to students so that they can see that mathematics has practical uses in modeling and explaining real life situations. Many researchers (Hami, Czerniak, & Lumpe, 1996; Riggs & Enochs, 1990; Ross, 1992) have indicated that teachers with a high level of efficacy tend to incorporate reform-based strategies in their instruction. All four pre-service teachers, regardless of their level of mathematics teaching efficacy, held beliefs that are congruent with the NCTM reform vision of mathematics, which emphasizes the integration of real world situations in mathematics teaching.

The pre-service teachers with the highest level of mathematics teacher efficacy right away accepted the use of manipulatives. NCTM (2000) supports this position, which stresses the use of manipulatives to represent and explain mathematical concepts. The position of the pre-service teachers with the highest level of mathematics teacher efficacy appears to be congruent with the vision advocated by NCTM. On the other hand, the pre-service teachers with low

levels of mathematics teacher efficacy exhibited little predisposition about using manipulatives in their teaching to support student learning in their mathematics classroom.

Overall, all four participants stated that after having used manipulatives in the math methods course they feel more comfortable integrating them in their classroom, with one of them saying that manipulatives could be an effective tool in building student confidence in mathematics. Also, all four participants mentioned that they would be able to use alternative teaching strategies.

Several researchers (Hami, Czerniak, & Lumpe, 1996; Riggs & Enochs, 1990; Ross, 1992) have also indicated that teachers with high teaching efficacy levels tend to be more willing to welcome reform strategies⁴. Results from this study seem to be confirmed by prior research (Wertheim & Leyser, 2002) which have established a strong causal link between teacher efficacy and instructional strategies as recommended by NCTM. Two of the four preservice teachers think their lack of mathematics content knowledge could be a handicap to their teaching efficacy in the mathematics classroom⁵. They believed they may not know how to teach the mathematics⁶. It is obvious that content knowledge and competency both play an important role in the process of teaching and learning. When asked if they think they will be effective mathematics teachers the four pre-service a sufficient level of confidence. These teachers felt with more exposure to the material and training over time; they would acquire more knowledge and experience to build their confidence to teach mathematics.

The analysis of the four participant interview transcripts, examination of the interview notes, review of the participants' individual MTEBI reports, and a comparison of the participant

⁴I am continuously finding better ways to teach mathematics.To item 5 in survey: I know how to teach mathematics concepts effectively

⁵ Item 11: I understand mathematics concepts well enough to be effective in teaching elementary mathematics.

⁶ Item 17: I wonder if I have the necessary skills to teach mathematics*

responses with the four sources of Bandura's (1997) self-efficacy theory, led to an emerging theory that is supported by these data. The data analyses revealed that some factors affecting mathematics efficacy beliefs appeared to be common to the four participants who took part in the interviews. Even though it was initially presumed that each of the four emerging themes should have an equal impact on participants it was revealed, through thorough analysis, that these themes are hierarchical in nature and thus do not have equal impact on participants.

According to efficacy theory, mastery experiences are considered to be the most influential sources of efficacy. Participants in this study indicated that mastery experiences and physiological states were determinant factors shaping their positive attitude and influencing their beliefs towards mathematics. All four credited social persuasions, which included feedback from peers and adults as important factors that shaped their attitude toward mathematics during their earlier school years. Physiological states, which includes the feeling of belonging and also the fear of disappointment, were a source of motivation to be resilient when confronted with challenges and provided participants with the determination to be successful in mathematics. Efficacy theory hypothesizes that fear is a driving force in blocking individuals from attempting a task. But in this study, fear had the opposite effect on participants. Instead, participants looked at fear and pressure as a motivation to perform well in mathematics. Participants recognized the critical influence of their teachers and peers as roles models in developing their efficacy beliefs. Teachers were the most important role models; they had the most significant impact on the development of efficacy beliefs. Teachers provided students with vicarious experiences, such as demonstrating how to solve math problems, and how learning math can be fun. They [teachers] were continuously providing them verbal feedback on their mathematics performance, and ensuring that learning is taking place in a safe environment.

Participants' teaching efficacy beliefs were positively influenced by student success, peers role models, peers persuasions, and student verbal feedback. Among the most important factors mentioned by the participants in impacting their efficacy beliefs were student success, and peer role models. Student success motivated the participants to explore innovative ways to make mathematics meaningful and fun for students. When students expressed their success in learning, participants became more confident in their ability to teach math and motivated them to seek ways to improve their math competency. Opportunities to teach a lesson in a real-life setting proved to be important and increased participants' confidence towards their teaching abilities and positive attitudes towards mathematics instruction.

All interviewed preservice teachers stated that at the math methods course contributed significantly to their teacher efficacy beliefs. This sense of contribution to their teacher efficacy appeared in the interviews. Since data for this study was collected at the beginning and at the end of semester when the participants were enrolled in the math methods course, it can be conjectured that teacher math efficacy beliefs were generally lower earlier in the teacher preparation program.

Chapter 5: Summary and Discussion

In my experience as a mathematics curriculum specialist and staff developer at a local school district, I came in contact with many new elementary teachers who were coming to the profession with different sets of beliefs about their mathematics abilities. Some begin their mathematical journey with a perceptible phobia of mathematics believing that there were not good in math and that no matter how much effort they would exert they would inevitably be ineffective teaching math. On the other hand, there are those individuals who possessed a set of positive beliefs in their abilities to accomplish math tasks.

Math performance of American students has for quite sometimes lagged behind that of students in other countries (National Council on Teacher Quality, 2008; TIMSS, 2007). Researchers have taken on the task to investigate the best instructional practices in the United States to improve student learning in math (Babcock, 1998; Van de Walle, 2001). Math education research has focused on students 'skills in computation and algorithms, understanding of math concepts, application of skills in problem-solving (National Mathematics Advisory Panel, 2008; Van de Walle, 2001) and self-confidence in their mathematical abilities (Van de Walle, 2001). Unfortunately, there is evidence that some teachers still deliver instruction in the same way as they were taught, mainly restricted to memorization of procedures and algorithms (Ball, 1988; Ball et al., 2001; National Advisory Committee on Mathematical Education, 1975; Romberg & Carpenter, 1986). Current research indicates that understanding how students learn math has a significant effect on student performance (Carpenter et al., 1989). An individual's personal experiences in math may have an impact on his or her disposition toward math, enthusiasm to teach math, and ability to teach math efficiently (Ambrose, 2004; Ball, 1988; Ball, 1989; Buchmann & Schwille, 1983; Dewey, 1938).

The purpose of this study was to examine factors that contribute to preservice teachers' self-efficacy in teaching math to elementary school students upon completion of a required Math Methods course in a teacher preparation program. A mixed methods design was used in this study. The quantitative part of the study investigated the mathematics teaching efficacy beliefs of elementary pre-service teachers enrolled in a math methods course as measured by the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI).

This study consisted of three research questions related to pre-service teachers' self-efficacy beliefs in teaching mathematics in the elementary grades. Two surveys were given, one pre-condition survey before the ELED 4310 course and one post-condition survey given upon completion of the ELED 4310 course. The quantitative part of the study attempted to answer the following research question:

Q1: Do pre-service elementary teachers' mathematical self-efficacy change after enrolling in a reform-based university elementary mathematics methods course?

The first step in the quantitative analysis was to assess the reliability and validity of the data produced from each portion of the survey instrument. The Cronbach's alpha for the overall scale (MTEBI) was 0.83, which indicates a high level of reliability. The Cronbach's alpha for the two subscales were 0.83 for PMTE and 0.74 for MTOE. The analysis of the results was conducted to explore if there was a significant difference between the pre-test and post-test scores on PMTE and MTOE subscales from paired sample t-test. Mean scores and standard deviations were calculated, and *t*-tests were used to determine significant differences from pre-test to post-test.

The qualitative part of the study attempted to answer the following research questions:

Q2: How do pre-service elementary teachers who have completed a reform-based university elementary mathematics methods course describe their beliefs?

Q3: How do pre-service elementary teachers who have completed a reform-based university elementary mathematics methods course describe their classroom learning experience?

Qualitative data were analyzed using structural coding to determine factors that contributed to improving participants' math self-efficacy beliefs. The data were coded and matched to quantitative responses on the pre-test and post-test surveys. For research question three, all responses were free-response narratives. The qualitative data were coded for themes, and participant responses were matched to responses on the MTEBI survey.

This chapter first reports the results of the quantitative analyses, followed by the results of the qualitative analyses. The quantitative data findings along with the qualitative findings were combined to answer the mixed methods question:

Q4. Do quantitative findings on teacher self-efficacy constructs relate to the qualitative findings obtained from the four case-study interviews?

The combination of findings is presented in section 5.2.

5.1 Quantitative Findings

The first research question Q1: Do pre-service elementary teachers' mathematical self-efficacy change after enrolling in a reform-based university elementary mathematics methods course? Quantitative data were analyzed to assess whether pre-service teachers' beliefs changed after being enrolled in a math methods course. Such are reported below.

The pre-service teachers' efficacy beliefs scores reveal positive changes on every item on the MTEBI (Table 4.1). Many participants changed their responses on the pre- and post-surveys from "Uncertain" to "Agree" and "Agree" to "Strongly Agree," particularly for the items about

effective teaching of mathematics concepts and understanding enough to teach them. The data indicate that the pre-service teachers increased their PMTE and MTOE as result of taking the math methods class (Table 4.2). A significant number of participants changed their responses on the pre- and post-surveys from “Uncertain” to “Agree” and “Agree” to “Strongly Agree,” particularly for the items about effective teaching of mathematics concepts and understanding enough to teach them.

The quantitative data on the students from the MTEBI indicated insignificant ($p > .05$) positive change on the PMTE subscale [pre-test ($M = 3.73$, $SD = 0.91$) and post-test ($M = 3.91$, $SD = 0.95$)] and on the MTOE subscale [pre-test ($M = 3.55$, $SD = 0.93$) and post-test ($M = 3.88$, $SD = 0.95$)] and on the MTOE subscale [pre-test ($M = 3.55$, $SD = 0.93$) and post-test ($M = 3.88$, $SD = 0.95$)] the data indicates that there is an appreciable improvement on the PMTE and MTOE subscales for some items. Explicitly, the results indicate that the math teaching outcome efficacy (MTOE) beliefs of pre-service elementary teachers improve after enrolling in a math methods course. The difference between scores implies that math methods course had a positive effect on the teaching efficacy beliefs of elementary pre-service mathematics teachers. The mean scores increased appreciably at the completion of the course indicating a predisposition toward a progressive view of teaching. A progressive view of teaching is characterized by those who emphasize learning by doing, hands-on projects, understanding, and action on the goals of learning as opposed to rote memorization.

Taken as a whole, the findings of the study indicate that completion of a math methods course has a positive influence on the mathematics teaching efficacy beliefs of pre-service elementary teachers. Because of participating in Math Methods course for a semester, the pre-service teachers’ PMTE and MTOE beliefs have improved appreciably. These results are in agreement with earlier studies on the effects of mathematics methods courses and teacher

education courses, mainly on the efficacy beliefs of pre-service teachers (Cakiroglu, 2000; Cone, 2009; Huinker & Madison, 1997; Liang & Richardson, 2009; Moseley & Utley, 2006; Richardson & Liang, 2008; Swars, 2005; Swars & Dooley, 2010; Woolfok Hoy & Spero, 2005). It is suggested that those pre-service teachers who were part of the study have the predisposition to use more inquiry-based instruction, learner-centered and teaching approaches that are aligned with the NCTM standards, and to develop into effective teachers (Czerniak, 1990; Swars, 2005; Riggs & Enochs, 1990). Using manipulatives to teach and learn mathematics made a significant impact on the four pre-service teachers interviewed, they all agreed that this was one the most critical learning experience. One of the pre-service teachers said, “I am going to make sure to incorporate as many hands-on experiences as possible.” Others say that during the class they finally were able to understand one or more concepts of mathematics that they previously “did not get.” They realized the benefit of using manipulatives to teach math.

Furthermore, they hold the belief that they can influence student achievement and motivation (Tschannen-Moran et al., 1998) and therefore become a determining agent of change to improve students’ performances even if the students experience adverse situations. Teachers with a high sense of efficacy believe that their work with students is significant and meaningful; they feel that they truly have a positive effect on student learning. While, teachers with a low sense of efficacy feel unenthusiastic and discouraged about teaching. They believe that they are not making a difference in their students' lives and doubt the value of their work (Ashton, et al., 1982)

One of the pre-service teachers said, “Before taking this class, I always viewed learning math as memorization of formulas and completing worksheets. I discovered that there are so many different ways to integrate concrete materials in any lesson so that any student regardless

of their ability will gain a better understanding of any concept taught.” Though the pre-service teachers experienced substantial increases in beliefs about their capabilities to teach mathematics effectively, they did not have significant increases in beliefs that their teaching would affect student learning in the classroom (e.g., Items # 3, 17, 21).

The results from the quantitative part of the study suggest that enrolling in math methods course increases efficacy beliefs in general. Though the quantitative part of the investigation reveals interesting, significant results, the analysis does not identify which are the areas of the course that might have brought about those changes, and it does not determine if those changes resulted solely from the course by itself. At the completion of the quantitative analysis, eight participants were identified who scored at opposite ends of the range of the mean scores on teacher efficacy. Two high efficacy and two low efficacy pre-service teachers participated in the interviews.

5.2 Qualitative Findings

While the survey provided a general idea of changes in beliefs, qualitative analysis of questionnaire responses, interviews provided a more productive and a more comprehensive picture. The quantitative instrument constrained the pre-service teachers to respond to predetermined statements that may not be easy to understand or may be confusing. On the other hand, the qualitative data sources captured participants’ beliefs about teaching and learning in their voice. The analysis offered insight into how pre-service teachers’ efficacy beliefs changed over time to answer the second research question: How do pre-service elementary teachers who have completed a reform-based university elementary mathematics methods course describe their beliefs?

After determining the levels of pre-service teacher's efficacy beliefs, the qualitative portion of the study looked at why some of the pre-service teachers have high efficacy beliefs while others have a low-level of efficacy beliefs. The factors behind the lower or higher level of efficacy beliefs were investigated by interviewing four pre-service teachers with differing levels of efficacy beliefs. Bandura (1977, 1986) theorized that efficacy beliefs are shaped by an individual's previous performance and experiences. Given that, past experiences of pre-service teachers, for example, positive or negative experiences in mathematics and mathematics lessons might be the prime reasons for shaping efficacy beliefs. Semi-structured interviews were conducted with four participants from the quantitative pool to answer the qualitative research questions. The researcher designed the interviews in a way to gain more insights on each of the aspects that potentially could influence teacher efficacy.

The pre-service elementary teachers who volunteered in this phase of the study were asked about how they felt about being an effective classroom teacher. Some questions addressed participants' beliefs about their abilities to make students believe they can be successful in math, to encourage and motivate students who show low interest in mathematics and to implement strategies to provide alternative explanations or examples when students are struggling. Additionally, interview questions provided participants the opportunity to talk about their past experiences in mathematics during their elementary school years and how these experiences affected their personal beliefs about mathematics.

The pre-service teachers who participated in the second phase of the study stated that working with a small group created a safe environment and that was extremely efficient for their learning experience. One the pre-service teacher acknowledged that the support of the group encouraged her and reinforced her desire to be a teacher. Those teachers who reported a high

level of mathematics teaching efficacy developed a sense of confidence and believed that they are capable of teaching mathematics. Additionally, they believed the math methods course had provided them with opportunities to become effective math teachers. They also reported they have become more comfortable to use a wide variety of teaching tools so that they are capable of addressing the needs of all their students. Being able to use manipulatives to teach and learn mathematics was a real eye-opener for them. They were genuinely excited; they could not believe that something so simple can be useful in explaining complex math concepts; they realized the effectiveness of using manipulatives to teach mathematical concepts. One of the participants mentioned that the use of manipulatives in the class had helped her finally comprehend some concepts of mathematics that they previously did not understand. She goes on saying:

I always perceived math as a set of rules to memorize and pencil and paper assignments. I learned in this class that there are several ways to use concrete materials to teach math. I will without a doubt incorporate them into my lessons to help students reach a better comprehension of the concept.

Participants who were part of this phase of the study mentioned that they gained more confidence. One of the pre-service teachers said:

Math has definitely never been my strongest subject. I can say that this class helped me improve my confidence by presenting my ideas and concepts to teach math in a variety of ways.”

The math methods course objective is designed to facilitate pre-service teachers’ learning so that they increase their confidence as mathematics teachers. All four pre-service elementary teachers interviewed for this study, developed a strong belief that they will be effective mathematics teachers. The findings of this study were consistent with the research conducted by Bates, Latham, and Kim (2011). Two of the four pre-service elementary teachers did, however, mention that their limited math content knowledge might be a handicap when they enter the classroom.

However, they feel confident that over time, given more training in the content they will overcome that handicap. One of the preservice elementary teachers stated she has a fear of not knowing how to teach the material when it comes time to teaching but feels that she will be well prepared before she teaches the material. She goes on saying:

Before this class I was terrified of math, it has never been my favorite subject. I have wondered if I can teach young students a subject at which I struggled with in school. I think that I gained a greater sense of confidence from this class.

Overall the pre-service teachers feel that given enough time, they can become effective mathematics teachers. They believe that they might be struggling for the first or second year, but with more exposure to the material, and understanding how students learn, they think it will be possible for them to be effective mathematics teachers notwithstanding their low level of mathematics self-efficacy (Swars, 2004). These results are congruent with prior findings; each of the participants interviewed mentioned that their sense of efficacy to teach mathematics is affected by their content knowledge of mathematics (Esterly, 2003).

The pre-service elementary teachers interviewed in this study consistently expressed their desire to find new ways to teach students who were not being successful. All the pre-service elementary teachers interviewed indicated they had acquired confidence using manipulatives in their classroom when they begin teaching. Participants intend on using manipulatives in their future classes because they believe the use of these teaching tools are essential in developing students' understanding of mathematics and in building their confidence. The use of manipulatives is supported by a large body of literature stating that manipulatives are very effective in teaching and learning of math concepts (Freer-Weiss 2006; Moyer 2001). The advantage of using manipulatives is that they address the different learning styles of students who are kinesthetic or visual learners. This approach helps students visualize and understand a concept

that they might have difficulty comprehending otherwise. All four pre-service teachers stated that they are confident implementing a variety of alternative approaches in their future classrooms.

These findings are consistent with the quantitative findings that reflect a positive change on some items of the MTEBI scale. They appear to address research question Q4:

Do quantitative findings on teacher self-efficacy constructs relate to the qualitative findings obtained from the four case-study interviews?

This way the quantitative results are explained in more detail through the participants' responses from the interviews to understand how the personal experiences of individuals match the instruments results (see Table 5.1)

Table 5.1: Items Indicating Positive Change in Pre-service Teachers' Self-efficacy

Item #	Mean Diff	Item Description	Participants Responses		
			Interview	Survey Pre	Survey Post
17*	-.57	<ul style="list-style-type: none"> <i>I wonder if I have the necessary skills to teach mathematics*</i> 	<ul style="list-style-type: none"> Brenda stated, "First I think I need to make an extra effort into mastering the subject in creating great mathematics" Laura: I am not sure I can teach math effectively beyond third grade...Maybe in the future when I acquire more experience. 	A	U
21*	-.44	<ul style="list-style-type: none"> <i>I do not know how to turn children on to mathematics*</i> 	<ul style="list-style-type: none"> Pam: I think I can motivate those students because I used to be one of those who was always struggling 	D	SD
19*	-.31	<ul style="list-style-type: none"> <i>When a student has difficulty understanding a mathematics concept, I usually am at a loss as to how to help the student understanding better*.</i> 	<ul style="list-style-type: none"> Sometimes, I feel like I will not be able to teach those kids and not be able to offer them any help.. 	A	D
20	.30	<ul style="list-style-type: none"> <i>When teaching mathematics, I usually welcome students' questions</i> 	<ul style="list-style-type: none"> Brenda: If some students are still struggling, I will use a variety of approaches so that everyone will get it... that would include using manipulatives or different types of visuals. 	A	SA

* Negatively worded items

Table 5.1: Continued

Item #	Mean Diff	Item Description	Participants Responses			
			Interview		Survey Pre	Post
1	.72	• <i>When a student does better than usual in mathematics, it is often because the teacher exerted a little effort.</i>	• Pam: I think I can motivate those students because I used to be one of those who was always struggling... I will give them more of my attention.		U	SA
7	.39	• <i>If students are underachieving in mathematics, it is most likely due to ineffective mathematics teaching</i>	• Josh: The teacher is of course the most important factor in this. A good teacher should have a feel for where his students are		A	SA
10	.33	• <i>When a low-achieving student does better than usual in mathematics, it is due to extra attention given by the teacher.</i>	• All: When students react positively to me, it is an indication that I am doing something right. It is a sign that they are learning and math is making sense to them as a result of my teaching. It gives me more confidence in what I am doing.		A	SA
			• Josh: I think I will be able to teach mathematics effectively because I owe it to my students to be the best teacher possible.		A	SA
4	.30	• <i>When the mathematics grades of students improve, it is often due to their teacher having found a more effective teaching approach.</i>	• Josh: First, I have to become more confident, it is something I will work on developing my knowledge of the math content... I believe it is going to help me become a good teacher.		A	SA

5.3 Discussion and Conclusion

Bandura (1986) contended that efficacy beliefs are primarily influenced by an individual's previous experiences. Past experiences with mathematics including negative experiences in the classroom, mainly where math is taught as an inflexible set of rules in non-participatory classrooms. The preservice teachers' past experiences with mathematics may have contributed to their degree of mathematics apprehension and significantly molded their levels of

mathematics teacher efficacy. The preservice teachers with positive past experiences with mathematics may have developed higher mathematics teaching efficacy. In contrast, the preservice teachers with negative past experiences with mathematics may have produced a lower sense of mathematics teaching efficacy.

The quantitative part of the study has applied a single-group pre-experimental design to investigate the effects of a math methods course on the teaching efficacy beliefs of elementary pre-service mathematics teachers. The findings of the study suggests that elementary pre-service mathematics teachers attending a math methods course changed their mathematics teaching efficacy beliefs in a positive manner. As the pre-service teachers participated in a math methods course during a semester, their PMTE and MTOE beliefs increased appreciably. These findings were consistent with the previous findings related with the effects of methods and special teacher education courses on the efficacy beliefs of pre-service teachers (Cakiroglu, 2000; Cone, 2009; Huinker & Madison, 1997; Liang & Richardson, 2009; Moseley & Utley, 2006; Richardson & Liang, 2008; Swars, 2005; Swars & Dooley, 2010; Woolfok Hoy & Spero, 2005).

A qualitative part of the study took in consideration the syllabus and the interviews. The syllabus was instrumental in identifying characteristics of the course and methods that were used by the instructors in the course to incorporate the elements of a reform-based curriculum. The

The four participants interviewed acknowledged that past experiences with mathematics played a significant role in their mathematics teaching efficacy beliefs. The preservice teachers with the lowest degree of mathematics teaching efficacy both reported negative past experiences with mathematics in school, which lead to a dislike of mathematics. Such experiences motivated those preservice teachers to be determined to become effective mathematics teachers, recognizing that teaching mathematics more effectively would take more time, work, and effort.

Bandura (1986) declared that efficacy beliefs are influenced as a result of an individual's previous performance and experiences. He said that individuals perform tasks and activities, explain the results of their actions, use them to develop beliefs about their aptitude to carry out subsequent tasks or activities and take action corresponding to the beliefs created. Usually, outcomes interpreted as successful increase self-efficacy and those perceived as failures tend to decrease self-efficacy. The preservice teachers' experiences of failure with mathematics in elementary school may have been a contributing factor in lowering their sense of mathematics teaching efficacy. Two of the preservice teachers with the highest level of mathematics teacher efficacy reported positive experiences with mathematics in their early years of schooling. These positive experiences in school helped them become more comfortable with mathematics that produced high mathematics teacher efficacy. The pre-service teachers' prior experiences with mathematics and their resulting level of mathematics self-efficacy corroborate Bandura's (1986) contention that efficacy beliefs are formed mainly by past performances and experiences. It is expected that those pre-service teachers who participated in the study have a predisposition to use innovative more inquiry learner-centered approaches to teaching mathematics. But, they admit that they need to expand their math content knowledge to be more effective teachers.

Regarding instructional strategies, all four participants concurred on the importance of using "real world" examples to motivate students to learn mathematics. The participants, particularly those with the lowest level of mathematics teaching self-efficacy, felt that their past learning experiences did not emphasize the relevance of mathematics, even though, NCTM (2000) stressed the importance of focusing on math topics that are stimulating to student learning. NCTM (2000) offers a view of mathematics curriculum that "should offer experiences that allow students to see that mathematics has powerful uses in modeling and predicting real-

world phenomena" (p. 16). Moreover, research has indicated the learning occurs best when students have a meaningful context for mathematical knowledge (National Research Council, 1999). All four pre-service teachers' positions on the importance of "real world" situations in mathematics are congruent with the reform vision of NCTM. Also, they mentioned that they were ready to embrace the use of manipulatives as a tool to facilitate learning mathematics in their classroom. The disposition of using manipulatives is consistent with the reform vision of NCTM (2000), which emphasize the use of concrete models to present and explain complex mathematical concepts and procedures.

The four participants in this part of the study reported similar math experiences during their early schooling. They experienced math as getting the right answer and had misconceptions about math that remained with them throughout their school years. Their educational experiences in math instruction was a succession of procedures to be learned, without understanding the underlying mathematics concepts (Kazemi & Stipek, 2001). As early learners, they solved math problems without understanding what the answers meant. The focus of instruction has been on getting the right answer (Pajares, 1992; Stuart & Thurlow, 2000)).

This study concluded that pre-service teachers' initial attitudes towards mathematics, which were for the most part shaped by past experiences, changed as a result of increasing their self-efficacy beliefs. They reported positive experiences in mathematics methods course that increased mathematics teaching efficacy. The data revealed pre-service teachers' comfort and confidence in teaching; all four pre-service teachers expressed greater self-efficacy in teaching math after completing the ELED 4310 course. They stated the course helped them build the confidence to teach math conceptually in their future classroom, but two of the participants felt that they still need to acquire more mathematics content knowledge to be efficacious. The two

participants with low self-efficacy in math reported an increase in self-efficacy in math after completing the course. They stated that before the math methods course, math was challenging and there was no assistance from anyone. Participants with the high math self-efficacy also reported lack of support but also reported that they decided to be responsible for their learning.

The findings in this study suggest a promising beginning in achieving the goals of teaching math conceptually. Teaching math conceptually should become standard practice in pre-service elementary teacher preparation programs. The increases in pre-service teachers' self-efficacy beliefs for teaching conceptual, as well as procedural math in elementary classrooms, are evidenced by the pre-service teachers' increased understanding of teaching math as a result of the ELED 4310 course. Developing self-efficacy in pre-service teachers' abilities in teaching math are a vital part of teacher education. Teacher preparation programs must connect between preservice teachers' beliefs and self-confidence and proficiency to become effective teachers in math (Wilkins & Brand, 2004).

Many researchers have recognized teachers' self-efficacy in math as a significant predictor of motivation to perform tasks and persistence in completing them with success (Albion, 1999; Bandura, 1996; Bandura, 1997; Gist & Mitchell, 1992; Hackett & Betz, 1989; Pajares & Miller, 1994; Pajares & Miller, 1995; Pajares & Graham, 1999). The ELED 4310 math methods course was effective in improving the self-efficacy of preservice teachers in teaching math. The course experiences contributed to their perception and beliefs of competence in teaching math. Hackett and Betz (1989) said, those who believe they can accomplish a goal will spend more time and energy to ensure that they do. An important finding of this research is that the number of activities, as describe in the syllabus, used by the instructor to create challenging problems for the purpose of arousing the preservice teachers'

beliefs have a positive effect on the pre-service teachers' efficacy beliefs transformation to become more aligned with reform-oriented beliefs about the learning and teaching of mathematics. Nurturing elementary pre-service teachers' positive attitudes toward math and their disposition to teach it are the first steps in preparing effective teachers and positively affecting student learning.

5.4 Implications of the Study

The increases in self-efficacy of participants on some items on the subscales are evidence of preservice teachers' growing understanding of teaching math as a result of the ELED 4310 course. A survey carried out by Battista (1986) on the relationship of mathematical anxiety and mathematical knowledge to the learning of mathematical pedagogy by preservice elementary teachers, revealed a correlation between the quality of mathematics instruction at the elementary school level and the competence of pre-service to teach the subject. He observed that poor content knowledge and poor attitudes towards mathematics might hinder pre-service teachers' learning and later use of effective methods for teaching mathematics. Additionally, Vinson (2001) stated, 'negative attitudes toward mathematics can produce negative results in mathematics' and low confidence in mathematics, teachers, may replicate mathematics anxiety among their students. Although this study revealed that participants had past negative elementary school experiences that had an initial adverse influence on their ability to teach math, they became confident that they will be capable teachers. Because of what they had experienced during their elementary school years, they believed they would be able to relate to the students who seem to have difficulties learning mathematics. Research (National Mathematics Advisory Panel, 2008; Van de Walle, 2001) suggests that preservice elementary teachers who expressed

strong beliefs in their efficacy to teach mathematics were more likely to have more confidence in knowing and doing mathematics. All of them declared that they did not want to see their students experience similar situation; they vowed that they would be effective teachers despite those negative experiences.

The most important element that an elementary pre-service teacher must possess is mathematics teaching efficacy; it is the belief in teaching mathematics effectively. Some researchers (Swars et al., 2007) have shown that elementary pre-service teachers can increase their mathematics-teaching efficacy after enrolling a reform-based Math Methods course in a teacher education program. Many studies (Hart, 2002; Steele & Widman, 1997; Swars et al., 2007; Wilkins & Brand, 2004) documented that changes in mathematical beliefs occur when methods course is based on constructivist principles. Given such opportunities, pre-service teachers develop beliefs that align with the vision of the NCTM's *Principles and Standards*. Pre-service teachers' reflections on their experience in a constructivist classroom about their mathematics beliefs can have the potential to lead to a significant change in their mathematics self-efficacy beliefs, and mathematics teaching efficacy, which can have a lasting change on their style of instruction. In doing so, preservice teachers' beliefs can be more aligned with current reforms and mathematical goals for students through instructional practices learned in teacher preparation courses (Hart, 2002; Wilkins & Brand, 2004).

Although, the math methods course was not intended to deliberately influence the pre-service teachers sense of self-efficacy, participants' experiences in this study indicated that mastery experiences, as well as physiological states, were the two most significant source of efficacy. The results of this study support several findings. Experiences reported by the pre-service teachers in the class highlighted that the microteaching of peers, an important component

of this reform-based course, had a positive effect on preservice teachers' beliefs. Another element of the course that influenced preservice teachers' efficacy was the opportunity to practice teaching in an authentic classroom in an elementary school. The belief statements confirm that teaming up with an in-service teacher can provide preservice teachers with the vicarious experiences needed to change their beliefs.

At the end of the semester, the four pre-service teachers stated that their efficacy beliefs in their abilities to teach math have improved tremendously. For example, at the end of the course one preservice teacher said, "Before this class I was terrified of math, it has never been my favorite subject ... I think that I gained a greater sense of confidence from this class." According to Palmer (2006), several factors such as hands-on activities, group investigations, relation of concepts to the real world, and microteaching have the potential to increase efficacy in a reformed-based course. Practices such as those modeled in reform-based mathematics methods courses led to positive changes in beliefs. Based on the results, it appears that the pre-service teachers in the case study experienced transformation in their mathematical identity, which affected their self-efficacy as mathematics teachers (Gonzalez, 2009; Martin, 2000) evidenced in the pre-service teachers' increased confidence to learn and teach mathematics. The question, however, is whether or not this will be continued throughout their teacher career.

An area that needs to be studied is the long-term effects of the methods course on the practices of elementary mathematics teachers. It is one thing to produce an effect on their efficacy beliefs, but it is uncertain to address their long-term practice. Therefore, there is a need for a longitudinal study extended to their in-service years to determine the teaching practices of the students after several years in the school. In order for any changes to be extended throughout

the student teaching experience, the contact between the methods course instructor and the preservice teacher needs to be extended through this critical time.

5.4 Limitations of the Study

Despite the fact that the researcher strived to reduce the shortcomings of this study, there are still some limitations that might affect the perception of trustworthiness. These limitations are described as the characteristics or methodology that might influence the application or interpretation of the results (Merriam, 2009).

The first limitation of the study is that the researcher was responsible for data collection, both during the quantitative and qualitative phases. To address this limitation, the researcher was all the time aware of susceptibility to bias and worked to minimize that bias by striving to understand scenarios and situations through the eyes of the participants.

In this study, participants were a convenience sample of elementary pre-service teacher from one university enrolled in a math methods course in one semester. The small sample size of participants (4 participants) in the qualitative part of the study limits the findings to a larger population, therefore, the generalizability of the findings is limited. Further, the demographics of the participants in this study may limit generalizability to participants with of different ages, ethnicities, certification areas, and/or educational levels. Finally, the data collection instrument was a survey, and, though the participants remained anonymous, the self-reporting nature of survey research is a limitation in itself.

The combination of the lack of ethnic and gender diversity and the small number of participants in the second phase of the study mean that the grounded theory that emerged from this study should not be generalized to other populations or settings that are not similar to the

study's sample. Generalizations cannot be extended to other populations that are not comparable to the southwestern university from which the sample was selected.

Therefore, the findings should be inferred with precaution. Furthermore, the mathematics self-efficacy beliefs of this convenience sample of pre-service teachers should not be construed as representative of pre-service teachers as a whole. Generalizations cannot be extended to other populations that are not comparable to the southwestern university from which the sample was selected.

5.5 Future Research

In consideration of the findings of this study, one cannot assert that the changes that occurred over the span of one semester in a math methods course will carry over as these pre-service teachers enter the profession of teaching.

Although a significant amount of research has been conducted regarding the mathematical self-efficacy of pre-service elementary teachers, there is still a need for further research on the math methods course effects on pre-service teachers' perception of self-efficacy. Adding to the collective knowledge of this topic will help all stakeholders, policymakers, university teacher preparation programs, and teachers themselves to understand how these math methods courses bring about student learning.

Future research on this topic should be undertaken with a larger more diverse sample of pre-service elementary teachers to gain a deeper understanding of this important component of teacher preparation. A larger sample including participants from both genders, diverse educational, and ethnic backgrounds would make it possible for researchers to develop a better, and possibly a deeper, understanding of the math methods course's impacts on pre-service

teachers' journey from students to prospective teachers. Also, future research should focus on participants' levels of mathematics content knowledge and how it might influence their mathematics teaching efficacy. Another topic of research would be to evaluate if the math methods improved the mathematical pedagogical content knowledge of pre-service teachers in relation to their level of self-efficacy. A longitudinal study with the same participants should be conducted to examine the evolution of mathematics teacher efficacy during their journey from student teacher to classroom teacher after their first year of teaching. An extension of such study could be to explore the connections between pre-service teachers' math content knowledge, self-efficacy, and student performance.

Future investigations of pre-service elementary teachers' mathematics self-efficacy should be conducted using various data collection measures, such as direct classroom observations and interviews, to validate the data and using a large sample of participants would enhance findings. Further research that links pre-service teachers' mathematical self-efficacy to the academic achievement of students would be very valuable, since teachers' self-efficacy belief toward their mathematics teaching is directly associated with the increase of students' achievement in mathematics (Nurlu, 2015).

5.6 Concluding Remarks

Beliefs are critical in shaping behaviors of an individual's course of action. Different levels of mathematics efficacy beliefs of teachers may affect the teacher's effectiveness in a mathematics classroom. Existing research has already confirmed a significant difference in teaching effectiveness between teachers with high mathematics teaching efficacy beliefs and those with low mathematics teaching efficacy (Gibson & Dembo, 1984).

Elementary teachers as a group are viewed as people who aspire to do what is best for children. Unfortunately, too many of them are not well prepared to do so, because of their previous mathematics experiences. A significant number of those students preparing to become elementary teachers have been, in most instances, not very successful as mathematics students, and even those with positive experiences sometimes were not confident about their capability. Research (Newton et al., 2012; Swars, 2005), linking pre-service elementary teachers' mathematics content knowledge and self-efficacy, infers that elementary preservice teachers' mathematics teaching self-efficacy and their prior mathematics learning experiences may have close relationship.

In most instances, the first year of teaching is the most challenging, but math methods course has the potential to give the pre-service teachers an opportunity to hone their teaching skills connecting theory to practice before their first year out in the real world of education. They will enter the teaching profession with a higher level of confidence and will be able to teach with concrete context knowledge. As pre-service teachers are preparing to become a full-time classroom teacher, it is critical that the foundations of a math methods course provide them with a practical process of teaching to effectively prepare them to teach mathematics. Affecting the pre-service teachers' beliefs during a math methods course is necessary but not sufficient to address their practice once they enter the classroom.

Pedagogy in the reform-based methods course described in this study engaged preservice teachers in inquiry-based activities in order to enhance their conceptual knowledge and mathematical understanding. There are claims that reform-based mathematics instruction has the potential to produce elementary teachers of urban students with a high self-efficacy beliefs (Hill, Rowan, and Ball, 2005). Improving successfully these constructs for pre-service teachers who are called to work with diverse populations should lead to improved mathematics learning and

achievement among poor and minority students, by making teachers conscientious about these students' learning styles and cultures (Leonard, 2007; Martin, 2007).

A study such as this one is only the beginning of the research needed to examine the effects of reform-based methods courses on the teaching practices of teachers once they are in their own classrooms where they are no longer observed by college instructors. Additional studies are needed to determine whether beliefs toward mathematics learned in reformed-based mathematics methods courses are sustained across time. This is a challenging quest, but one that is well worth the journey if we are to ensure that all children receive a mathematics education that will meet the needs of our students, teachers, schools and society.

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Appendix A

Demographic Form

Name: _____

Number: _____

Phone #: _____

Email: _____

Demographic Information

Gender ☐ Male

☐ Female

Age: _____ years

Major: _____

Minor: _____

Ethnicity:

☐ Native American

☐ Caucasian

☐ Hispanic

☐ Asian/Pacific Islander

☐ African American

☐ Other (please specify)

Place an X beside each Mathematics course listed below that you took in high school

☐ Algebra 1

☐ Pre-Calculus

☐ Algebra 2

☐ Calculus

☐ Geometry

☐ Statistics

Place an X beside each Mathematics course listed below that you took in college

☐ Intermediate Algebra

☐ Analysis

☐ College Algebra

☐ Calculus

☐ Linear Algebra

☐ Statistics

☐ Pre-Calculus

☐ Other (please specify)

Appendix B
Mathematics Teaching Efficacy Beliefs Instrument (MTEBI)
(Used with permission from Dr. Huinker D.M.)

Item #	Items	SD	D	U	A	SA
1	When a student does better than usual in mathematics, it is often because the teacher exerted a little effort.	1	2	3	4	5
2	I am continuously finding better ways to teach mathematics.	1	2	3	4	5
3	Even if I try hard, I will not teach mathematics as well as I will most subjects*	1	2	3	4	5
4	When the mathematics grades of students improve, it is often due to their teacher having found a more effective teaching approach.	1	2	3	4	5
5	I know how to teach mathematics concepts effectively	1	2	3	4	5
6	I am not very effective in monitoring mathematics activities*	1	2	3	4	5
7	If students are underachieving in mathematics, it is most likely due to ineffective mathematics teaching	1	2	3	4	5
8	I generally teach mathematics ineffectively*	1	2	3	4	5
9	The inadequacy of a student's mathematics background can be overcome by good teaching	1	2	3	4	5
10	When a low-achieving student does better than usual in mathematics, it is due to extra attention given by the teacher.	1	2	3	4	5
11	I understand mathematics concepts well enough to be effective in teaching elementary mathematics.	1	2	3	4	5
12	The teacher is generally responsible for the achievement of students in mathematics.	1	2	3	4	5
13	Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching.	1	2	3	4	5
14	If parents comment that their child is showing more interest in mathematics at school, it is probably due to the performance of the teacher	1	2	3	4	5
15	I find it difficult to use manipulatives to explain to students why mathematics work*.	1	2	3	4	5
16	I typically am able to answer students' questions about mathematics.	1	2	3	4	5
17	I wonder if I have the necessary skills to teach mathematics*	1	2	3	4	5
18	Given a choice, I will not invite the principal to evaluate my mathematics teaching*	1	2	3	4	5
19	When a student has difficulty understanding a mathematics concept, I usually am at a loss as to how to help the student understanding better*.	1	2	3	4	5
20	When teaching mathematics, I usually welcome students' questions	1	2	3	4	5
21	I do not know how to turn children on to mathematics*	1	2	3	4	5

Appendix C

INTERVIEW PROTOCOL

You have been asked to participate in this interview to help me better understand what made it possible for you to feel the way you feel about mathematics in general and about mathematics teaching and learning.

1. I would like you to recall your earlier mathematics experiences, whether they were good or bad experiences. and how you felt about them?
2. Do you remember the person who was involved in the experience?
3. In your opinion, what do you think are the main reasons that made the experience possible?
4. Did that person gave you feedback such as verbal encouragement?
5. Can you remember anyone who you consider as a role model among peers or teachers in your math experience?
6. How do you feel about mathematics in general and about any specific areas in mathematics?
7. Is there a positive experience that you can remember as a student or as a student-teacher, such as teaching a mathematics lesson?
8. Can you specifically, share the experience and describe what part of the experience had a positive influence on your mathematics teaching capability? When do you think that happen (classroom or field experience)?
9. Did you get the idea of the lesson by yourself or did you see it modeled by someone else (peer or teacher)?
10. Did you get any feedback from teacher, peers, or students that made you feel that it was good lesson? What was the indicator that you felt it was a positive teaching experience?
11. How do you think those experiences contributed to you feeling positive about math in general and math teaching in particular?
12. Is there anything you can share about the math methods course that made some of the experiences possible?

Appendix D

MATHEMATICS COURSES REQUIRED IN ELEMENTARY TEACHER PROGRAM

FRESHMAN YEAR	<p>STAT 1380. Descriptive & Inferential Stat. Basics of Descriptive and Inferential Statistics (3-0) A course in statistical literacy. Emphasis will be on standard descriptive measures of location, spread, and association. Regression, probability and sampling, and Binomial distribution. Interpretation of data which occur in daily life (polls, weather forecasting, surveys, quality control, etc.) will be stressed.</p>
SOPHOMORE YEAR	<p>MATH 2303. Number Concepts. This course focuses on numbers and operations for prospective elementary and middle school teachers. Topics include place value, whole numbers, rational numbers, signed numbers, arithmetic operations and algorithms, divisibility tests, multiples, and factors. The focus is on conceptual understanding, quantitative reasoning, number sense, multiple representations and ways of thinking, mathematical justification and communication, problem-solving, connection making and addressing students' common misconceptions and errors.</p> <p>MATH 2304. Geometry & Measurement. This course focuses on geometry and measurement for prospective elementary and middle school teachers. Topics include measurement as a process of units of measurement for quantities such as length, area, volume, angle size, and speed; conversions of units of measurement; properties and formulas for basic geometrical shapes such as polygons, circles, polyhedra, and cones; transformations such as translations, rotations, reflections, and dilations to geometric relationships and constructions using straight edge, compass, and technology. The focus is on spatial reasoning, logical reasoning, and making connections among geometric ideas and measurement, number concepts, and algebra.</p>
JUNIOR YEAR	<p>MATH 3305. Proportion and Algebra. This course focuses on proportional and algebraic reasoning for prospective elementary teachers. Topics include ratios as measures, ratios as multiplicative comparisons, proportions, rates of change, patterns, linear functions and solving linear equations, inequalities, and systems. The focus is on identifying relationships between quantities in contextualized problems, using inductive reasoning to identify patterns and express them algebraically making connections among verbal, graphic, numeric and symbolic representations, solving problems, using concrete numeric, tabular, graphic and algebraic methods, and addressing student's misconceptions and errors.</p>
SENIOR YEAR	<p>ELED 4310. Teaching Math in Elem Schools. Methods for teaching mathematics in elementary schools. Emphasis on the equity principle (mathematics for all) and development of conceptual understanding on topics such as number sense, patterns, and basic algebra, geometry and measurement, data analysis and probability.</p>

Appendix E

Syllabus

BED 4310 (CRN#: 13658) & ELED 4310 (CRN#: 13659)
Teaching Math in Primary Grades/Dual Language Classroom
(Used with permission from Dr. Asing-Cashman)

COURSE DESCRIPTION:

Based on a vision articulated by the National Council of Teachers of Mathematics (NCTM) and Texas Education Agency (TEA), this course introduces pre-service teachers to pedagogy methods, strategies, and materials for teaching mathematics in elementary dual language classrooms. Emphasis on dual language learners, the equity principle (mathematics for all) and development of conceptual understanding on topics such as: number sense, patterns and basic algebra, geometry and measurement, data analysis and probability.

This course will be an integrated minds-on/hands-on activities and discussions in which you will have the opportunity to:

1. Combine theory with experience in creating and implementing culturally inclusive curriculum and teaching strategies
2. Plan and participate in hands-on exploration
3. Practice reflective teaching using theoretical and practical implications of these experiences
4. Demonstrate knowledge and skill in TExES Elementary Comprehensive (EC) Competencies (Mathematics, Domain II) and Pedagogy and Professional Responsibility (PPR) Competencies. The TExES standards and competencies will be integrated in this course and all related assignments.
5. Understand the role that technology holds in the profession of teaching.

REQUIRED TEXTS/RESOURCES/SOFTWARE:

Van de Walle, J. A. (2007). Elementary and middle school mathematics: Teaching developmentally. 7th Edition. Longman.

http://wps.ablongman.com/ab_vandewalle_math_6/

ALIGNMENT WITH TEACHING STANDARDS:

1. State Board for Educator Certification: EC – Grade 6 Educator Standards
 - [TEA Classroom Teaching Certificate Standards](http://www.tea.state.tx.us/index2.aspx?id=5938&menu_id=2147483671&menu_id2=794)http://www.tea.state.tx.us/index2.aspx?id=5938&menu_id=2147483671&menu_id2=794
2. Comprehensive Testing Information and Preparation Manuals
 - <http://www.texas.ets.org/http://www.texas.ets.org/>
3. Revised Texas Essential Knowledge and Skills (TEKS)
 - [TEKS for all subject areas](#)
 - [Revised TEKS for Mathematics](#)
4. English Language Proficiency Standards: [English Language Proficiency Standards](#)
 - English Language Proficiency Standards for English Language Learners (ELLs) in order to provide strategies for language acquisition and academic success in all

content areas for students at different levels (beginning, intermediate, advanced, and advanced high) in the domains of listening, speaking, reading and writing.

TECHNOLOGY PROFICIENCY:

Gmail: You are required to have a gmail account to access Google Drive. Google drive is a great collaboration tool. You will utilize google doc and google slides to accomplish individual and group assignments. Please share your google doc and/or google slides with me:
jasingcashman@gmail.com

Blackboard: Make sure your Blackboard is activated and you can see this course and its content. Any log in problems should be taken care on the first week of the class. **Plan to visit Blackboard regularly. Check the course homepage regularly for announcements. Please also check your email regularly (at least twice a day). Remember to log out when finished.**

CD/Flashdrive: You need a CD or a USB flashdrive to store your video and/or pictures of your teaching for submission.

SUGGESTED RESOURCES WEBSITE:

- National Council of Teachers of Mathematics: Illuminations. Resources for Teaching Mathematics: <http://illuminations.nctm.org/http://illuminations.nctm.org/>
- Teaching and Learning Elementary Mathematics:
<http://facultystaff.richmond.edu/~pstohrhu/urclasses/math/math.htmlhttp://facultystaff.richmond.edu/~pstohrhu/urclasses/math/math.html>
- McGraw Hill Mathematics:
<http://www.mhschool.com/math/2003/student/index.htmlhttp://www.mhschool.com/math/2003/student/index.html>
- Internet Resources for Use in Mathematics Classroom:
http://www.internet4classrooms.com/math_elem.htmhttp://www.internet4classrooms.com/math_elem.htm
- Teacher Tube: <http://www.teachertube.comhttp://www.teachertube.com/>
- NSA Elementary Math Units:
<http://www.nsa.gov/teachers/teach00007.cfmhttp://www.nsa.gov/teachers/teach00007.cfm>
- PBS Teachers: Math:
<http://www.pbs.org/teachers/math/http://www.pbs.org/teachers/math/>
- Standard for TEXES (Test Framework):
 - Generalist EC-6 (191): [Linkhttps://www.dropbox.com/s/mjp5qvv1b70p4jp/TestFramework191GeneralistEC-6.docx](https://www.dropbox.com/s/mjp5qvv1b70p4jp/TestFramework191GeneralistEC-6.docx)
 - Generalist Bilingual EC-6:
[Linkhttps://www.dropbox.com/s/uofkc0gl0bmxx3/TestFramework192BilingualGeneralistEC-6.docxhttps://www.dropbox.com/s/uofkc0gl0bmxx3/TestFramework192BilingualGeneralistEC-](https://www.dropbox.com/s/uofkc0gl0bmxx3/TestFramework192BilingualGeneralistEC-6.docxhttps://www.dropbox.com/s/uofkc0gl0bmxx3/TestFramework192BilingualGeneralistEC-6.docx)

- Educational Technology Standards for Teachers, (ISTE/NETS-T)
 - Defined the fundamental concepts, knowledge, skills, and attitudes for applying technology in educational settings.
 - <http://www.iste.org/standards/nets-for-teachers.aspx><http://www.iste.org/standards/nets-for-teachers.aspx><http://www.iste.org/standards/nets-for-teachers.aspx>

LEARNING AND TEACHING PHILOSOPHY:

Constructivist approach along with the development of **learning community** is the foundation for our learning in this class. Together, we are active participants in this class. The role of the student is as active learners and involves facilitating as well as learning. The roles of the instructor are facilitating, leading, learning, and teaching; they are co-investigators in the learning process. A personalized approach to constructivist/situated learning theory encourages participants to co-design learning experiences so that individual interests, talents, and needs related to the course outcomes/goals are better addressed.

Students will frequently work in teams for reflective and learning experiences. In collaborative learning environments, students are responsible for their own learning, as well as the learning of their colleagues. **Individuals are responsible for all course assignments, however.** Self- and peer-assessment are as important as assessment of progress by the instructor. Responsible and respectful interactions are expected. Respectful sharing of diverse points of view may enhance learning of the participants. Students will focus on establishing the groundwork of principles, essential skills, and habits of mind. The use of inquiry, community building, collaboration, curiosity, information literacy, dialogue, and technology skills are important tools for learning and professional development. Students are expected to come with the dispositions to examine, use, and improve their knowledge and skills, with a commitment to seeking excellence. Expectations for performance are high. Students and the course instructor will work together to support each other with the expectations.

Take time to think reflectively about the readings and discussions. You all have a lot of experience as learners that you can use to help you make sense of the ideas, techniques, and standards covered in this class. In fact, I will often specifically ask you think back over your experiences. So, take time to go beyond just reading the text. Explore, discover, and look for connections that are important to you, and that will help you in your future teaching. If you find yourself getting lost and confused, take some time to reflect, and ask for help if necessary.

STUDENT LEARNING OUTCOMES

Upon completion of this course, students will be able to:

1. Analyze research-based practices for improving mathematics instruction	Discussions; projects assessed through the use of a rubric; oral presentations assessed through the use of a rubric; lesson plans; thematic units; and review questions.
2. Design effective standards-based classroom activities for EC-6 students and reflect on student outcomes.	Discussions; leading facilitators, lesson plans; and final project (thematic unit/lesson plans).
3. Develop varied formative assessment practices and assess mastery of the same essential math concepts in different ways	Teaching and learning theories activities, thematic units, oral presentations, leading facilitators and lesson plan, and online discussions.
4. Apply instructional strategies and appropriate practices for analyzing student work and modify lessons based on assessment information.	Online and in-class discussions, final project (thematic unit/lesson plans); teaching and learning theories activities, oral presentations, inquiry lesson presentation assessed through the use of a rubric; lesson plans; 15 hours classroom observation and teaching a math lesson in the classroom.
5. Apply instructional strategies to promote mathematics learning among students of a wide range of academic diversity including ESL and special needs students.	Learning/Instruction theories activities; online and in-class discussions, final project; thematic units, oral presentations, inquiry lesson presentation; lesson plans; teaching a math lesson in the classroom.
6. Differentiate math instruction based on students' learning styles, interests, and readiness levels; and modify lessons based on the synthesis of the relationship between problem solving and communication.	Learning/Instruction theories activities; online and in-class discussions, final project; thematic units, oral presentations, inquiry lesson presentation assessed through the use of a rubric; and lesson plans; teaching a math lesson in the classroom.
7. Align math classroom environments with real world environments by infusing problem-solving strategies; and apply technology tools in classroom instruction and connect math activities to everyday experiences and the real world.	Learning/Instruction theories activities; online and in-class discussions, final project; thematic units, oral presentations, inquiry lesson presentation assessed through the use of a rubric; lesson plans; 15 hours classroom observation and teaching a math lesson in the classroom.

8. Modify lessons based on the synthesis of the relationship between problem solving and communication.	Learning/Instruction theories activities; online and in-class discussions, final project; thematic units, oral presentations, inquiry lesson presentation assessed through the use of a rubric; lesson plans; observations in the classroom/teaching a math lesson and observation/teaching report.
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PROFESSIONAL RESPONSIBILITIES:

1. **Mathematics Autobiography (15 points)**

Take some time to reflect on your mathematical journey in life. Where have you been? How do you feel about math? How does this affect you as you come to be a teacher of mathematics? Write a 2-page paper (excluding title cover page) on google doc. Share your paper with me (set as "Can Comment"): jasingcashman@gmail.com. Please make sure that your paper has a title cover page, use a 12-font size and double-space line spacing.

2. **Online Activities (30 points)**

You will complete the following activities for the weeks that we don't meet face-to-face:

I. Online Discussions #1 and #2

Online discussion contributions will be graded based on the rubric that we will review during the initial class. In general, discussions will run from **Tuesday-Monday**, though posting in advance of the week is permitted. Posting after Monday will not count toward your grade.

- Online Participation - 2 Discussion sessions @ 6 points each = 12 points)

IMPORTANT: Your reflection to the question(s) posted is due on Tuesday at 11:59PM. Therefore, you have to complete your readings and post your reflection on the question(s) by the indicated day above (Tuesday @ 11:59PM) on the week we are doing online discussion. From Wednesday through Monday (by 11:59PM), you will respond to two other postings.

II. Reaction Paper

Topic: Assessment

You will write a 2-pages reaction paper to replace Discussion #2. The readings for this assignment are as follow:

- a. Chapter 5: Assessment (Van de Walle)
- b. [Formative vs Summative Assessment](#)
- c. [Mathematics Assessment Project - Assessing 21st Century Math](#)

Refer to the tab on Blackboard for more information on this assignment.

III. Collage

Topic: Mathematics for all children

You will create a "collage" of images and/or words (10 or more items, each different) that reflects the main ideas presented in these readings:

- Van De Walle, Chapter 6
- [Reaching all Students](#)
- [Teaching Mathematics to all Learners](#)

It might be smart to start with the title to organize your ideas before you begin the collage. Your collage must be on a poster board, 22" x 28". Please be creative.

Your collage must reflect:

1. The meaning of teaching mathematics for all children;
2. The strategies/models you can use to engage all children in learning mathematics;
3. Instructional and/or physical adaptations to help engage all children in learning mathematics

Submit your completed collage in the next class meeting.

IV. Web Research

Topic: Technology in the classroom

You are going to research and evaluate three mathematics education websites: **two** resources website (that offer lesson plans and other resources for teachers/students) and **one** interactive learning website (that offers games, apps, etc.):

1. You must include the URL of each website.
2. Describe in 100 words for each website that includes:
 - a. Why you like the chosen website?
 - b. The main features or attributes the website offer?
 - c. How it helps you provide a meaningful teaching and learning experience in your future mathematics classroom?

Post your research findings and description in the "Technology in the Classroom" thread on the Discussion Board in Blackboard.

****You will also use this day/time (where we don't meet face-to-face) to do your observations in PreK - 6 classrooms with your assigned cooperating teacher.**

3. **Class Participation/Discussion/Attendance (40 points)**

Advanced preparation for class meetings is particularly important for participation so that you can engage the content and ideas in the readings. Points are not earned by simply coming to class. Full credit for attendance requires arriving to each class session on time, active participation in all class activities, and staying until the session ends. If you arrive 30 minutes or more it will be consider an absence rather than a tardy. The expectations are (please also refer to the provided rubric):

- Come to class prepared and ready to contribute to the educational experience and the learning community.
- Engage in public dialogue with course concepts and materials, not just opinion and individual experience.
- Engage in reading and discussion.
- Collaborate with diverse students throughout the course of the semester.

If you will be missing or miss a class, immediately contact a classmate to find out what you missed. Excused and unexcused absences will both result in deduction of your per class points. We will begin on time. Being tardy disrupts the flow of the class. **Two tardies will equal one absence**. The Department considers that missing two weeks of class is excessive. The student may be dropped for lack of attendance. If you miss two-weeks of class, contact your professor immediately.

4. **Leading Facilitators (40 points)**

Students in a group of two or three will present ideas and facilitate activities of assigned topics in the textbook with fellow classmates and 4-8 learners. Group assignments will be determined in Week 1. There are two parts of this assignment that you have to prepare:

- I. Prepare a presentation slides using google slides on google drive. You are not allowed to use MS Powerpoint. Your presentation must be less than 10 slides that present the main ideas of the assigned topic (> 10 slides will result in point deduction/1 point per additional slide. Make your presentation clear, succinct and less wordy. You will only have 10 minutes to present your slides to the class.
- II. Prepare a lesson plan based on your group's assigned topic (10 points – refer to rubric). Facilitate activities described in the group's lesson plan with 4-8 learners. Each group will prepare a 30 – 45 minutes lesson plan for the chapter assigned. The lesson plan should include the following but not limited to:
 - o Objectives/Goals
 - o TEKS addressed
 - o Activities – at least 6 activities from the chapter and/or recommended websites. Step-by-step procedures must be described clearly. **Make your activities fun and engaging.**
 - o Assessment
 - o Materials
 - o Closure

This lesson plan will be executed on the day your group are leading the presentation and activities. Please submit to me in class:

1. A copy of your slides (print 4 slides per page)
2. Your lesson plan including all handouts/materials use in your lesson presentation.
3. Each group members must print and complete the “Group Members Evaluation Form” located in the “Module 3” folder in the Blackboard. If you want your evaluation to be confidential, place it in an envelope. You must also evaluate your contribution in completing this assignment.

Please refer to the attached “Grading Rubric for Lesson’s Presentation” and “Chapter’s Presentation Guideline” to guide you to complete this assignment.

5. Review Questions (RQs) (70 points)

There will be 7 review questions worth 10 points each that I will give throughout the semester. The goal of this assignment is to make sure that you acquire the knowledge or ideas presented in the chapters’ readings and you actually did your readings when other groups do their presentation on the assigned chapters. This will also assess your content knowledge of the concepts covered in this class. The due date for this assignment is indicated in the column 3 of the course schedule.

6. Field Experience: Observation and Teaching a Math Lesson (25 points)

You are required to complete 14 hours observations in the classroom (10 hours of Math instruction, and 4 hours in other subject areas instruction and/or attending professional learning community meetings, tutoring, parents teacher conference, ARD/IEP sessions), and 1 hour teaching a Math lesson (Math lesson that you develop for your final project). At the beginning of the semester you will be assigned a cooperating teacher to accomplish this assignment. Please print and study this instruction: [Observations and Teaching Instruction](#). You will do your observation when we don’t meet face-to-face (during online discussion week).

- There will be a log-in sheet to record (print this out: [Observation Log](#)) your observation time that will be verified and signed by the cooperating teacher; and observation notes form ([Classroom Observation Notes](#)) where you will take notes every time you do your observation, based on the observation guidelines stated in this form (must be verified and signed by the cooperating teacher) - 10 points
- At the end of your 14 hours observation, you will write a 2-page summative reflections of your observations in the classroom (please refer to the rubric) - 15 points

7. Final Project: Interdisciplinary Curriculum Unit and Field Experience (120 points)

Since this is a teacher preparation course, one of the most important skills to practice is the art of planning. Planning lessons, activities, and student assessments that increase student mastery of the content taught while attending to the myriad other issues teachers in the classroom face is difficult. This assignment will increase that planning experience and confidence level. This is a team project (team of two).

For this project, plan an interdisciplinary thematic unit for five lesson plans (five different subject areas). In your unit, **four of these lesson plans must be mathematics, science, social studies and language arts. The fifth lesson plan can be from one of these curricular areas: art, music, health, or physical education.** Please refer to the rubric to help you complete this project. Both the unit plan and five lesson plans have to be described extensively and concisely. You are strongly encouraged to use teaching strategies learned from your this class and other educational courses, and utilize other special strategies developed for teaching mathematics (constructivist, problem-solving, seeking multiple solutions, etc.). Please refer to the rubric to help you complete this project. You will also **teach** the mathematics lesson of your unit plan:

- Plan with your cooperating teacher to teach the mathematics lesson in the classroom from your week unit. These lessons will have to fit into the teacher's planned curriculum;
- Plan for a time block of between 50-60 minutes per day for five days;
- Include grade level and lesson topic;
- List the main contain/skills students should acquire before beginning this week's topics (accessing prior knowledge);
- List all resources used throughout the week;
- Examples of warm-ups/kickers/starters should be included;
- You are expected to integrate specific technology tools and processes to create meaningful learning experience that address relevant educational/professional standards;
- Write all Standards /Strands/Benchmarks for each lesson. If more than 1 is covered, list most appropriate. Include all numbers and letters;
- Evaluate each lesson using Bloom's Taxonomy-list skills addressed (Use variety of skills levels);

At the end of the semester, turn in the following (in a manila folder, please):

1. One (1) set of hard copy of your thematic unit and the respective 5 lesson plans including all handouts, rubrics, etc., and a completed and signed-teaching verification/evaluation form by your cooperating teacher – 100 points
2. Final project reflection paper: A 2- page paper of knowledge insights, change of perspectives, etc. gained from this final project. Explain how the planning (thematic unit and lesson plans), implementation in the classroom (teaching your math lesson), and reflection would perhaps change (or not) future instruction (refer to the rubric) – 15 points
3. Video clips and pictures of you teaching the Math lesson (saved in a CD). – 5 points

Mathematics Generalist EC-6 Standards

MATHEMATICS STANDARD I:

Number Concepts: The mathematics teacher understands and uses numbers, number systems & their structure, operations and algorithms, quantitative reasoning and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.

MATHEMATICS STANDARD II:

Patterns and Algebra: The mathematics teacher understands and uses patterns, relations, functions, algebraic reasoning, analysis and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.

MATHEMATICS STANDARD III:

Geometry and Measurement: The mathematics teacher understands and uses geometry, Spatial reasoning, measurement concepts and principles and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.

MATHEMATICS STANDARD IV:

Probability and Statistics: The mathematics teacher understands and uses probability and statistics, their applications and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.

MATHEMATICS STANDARD V:

Mathematical Processes: The mathematics teacher understands and uses mathematical processes to reason mathematically, to solve mathematical problems, to make mathematical connections within and outside of mathematics and to communicate mathematically.

MATHEMATICS STANDARD VI:

Mathematical Perspectives: The mathematics teacher understands the historical development of mathematical ideas, the interrelationship between society and mathematics, the structure of mathematics and the evolving nature of mathematics and mathematical knowledge.

MATHEMATICS STANDARD VII:

Mathematical Learning and Instruction: The mathematics teacher understands how children learn and develop mathematical skills, procedures and concepts; knows typical errors students make; and uses this knowledge to plan, organize and implement instruction; to meet curriculum goals; and to teach all students to understand and use mathematics.

MATHEMATICS STANDARD VIII:

Mathematical Assessment: The mathematics teacher understands assessment and uses a variety of formal and informal assessment techniques appropriate to the learner on an ongoing basis to monitor and guide instruction and to evaluate and report student progress.

MATHEMATICS STANDARD IX:

Professional Development: The mathematics teacher understands mathematics teaching as a profession, knows the value and rewards of being a reflective practitioner and realizes the importance of making a lifelong commitment to professional growth and development.

Vita

Abdelghani Setra

Teacher Education

Abdelghani Setra earned his Bachelor of Science and Master of Science Degree in Geology and a Master of Art in Math Education from the University of Texas at El Paso. In 2009, he joined the doctoral program in Teaching Learning and Culture at the University of Texas at El Paso.

While pursuing his degree, Dr. Setra worked as a math instructor with a local school district.

Dr. Setra's dissertation entitled, "Investigating the Math Efficacy Beliefs of Pre-service Elementary Teachers enrolled in a Reform-based Math Methods Course," was completed under the supervision of Dr. David J. Carrejo.

This dissertation was typed by Abdelghani Setra.