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UNIVERSITY OF CALIFORNIA, SAN DIEGO
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Sources of Elementary Teachers' Mathematics Efficacy and Mathematics Teaching
Efficacy

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Education

in

Educational Leadership

by

Ignacio Ramirez

Committee in charge:

University of California, San Diego

Professor Amanda Datnow, Chair

California State University, San Marcos

Professor Katherine Hayden

Professor Brian Lawler

2015

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Chair

University of California, San Diego
California State University San Marcos

2015

DEDICATION

To my wife Angelica, who has been my biggest supporter and fan through this journey. I love you more than words can ever express. I dedicate my all to you.

To my children Miguel Angel “El Guapo” and Alexandra Isabella “Princess” for inspiring me to achieve more than I ever thought I would. You are my life’s work.

To my parents Doña Juana and Don Daniel: The education you provided me at home was more than you ever needed to encourage me and my siblings to reach higher. Your support in my educational journey has been second to none. You will forever have my love, respect, and admiration.

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ABSTRACT OF THE DISSERTATION

Sources of Elementary Teachers' Mathematics and Mathematics Teaching Self-Efficacy

by

Ignacio Ramirez

Doctor of Education in Educational Leadership

University of California, San Diego, 2015

California State University, San Marcos, 2015

Professor Amanda Datnow, Chair

The purpose of this study was to investigate the contributing factors to a high level of mathematics and mathematics teaching self-efficacy beliefs of 10 elementary school teachers in a rural school district. Semi-structured interviews were conducted with a subgroup of teachers, identified as having high mathematics and mathematics teaching self-efficacy, to investigate how the theorized four sources of efficacy have influenced the 10 participants who possess a high level of efficacy in both areas as measured by a Mathematics and Mathematics Teaching Self-Efficacy Beliefs Survey. According to Bandura's (1977, 1986) social cognitive theory, individuals derive self-efficacy beliefs from four different sources: Mastery experiences, vicarious experiences, social persuasions, and physiological states. This study found that vicarious experiences, social

persuasions, and physiological states were the most impactful factors in the formation of mathematics efficacy beliefs. Vicarious experiences were by far the most influential factors in the formation of mathematics teaching efficacy beliefs. Results of this study also inform school districts and teacher preparation programs on the type of professional development and training that contributes to an increase in mathematics and mathematics teaching self-efficacy beliefs as experienced by the 10 participants in this study.

CHAPTER ONE: INTRODUCTION

“With me, everything turns into Mathematics.”

Rene Descartes

Mathematics has always been an icon of genius for those who are successful at it, but has also been the source of anxiety, phobia, and fear for children and adults alike. In fact, admitting math failure and acknowledging math anxiety and phobia has become perfectly acceptable in our society (Burns, 1998; Paulos, 1988; Fennell, 2007). In California, all middle school students are expected to complete Algebra 1 by the end of eighth grade regardless of their competency or attitude towards mathematics (State Board of Education, 2008). Quality mathematics education in grades two through six is critical in getting students prepared to meet state established math competencies as well as preparing students for high school and beyond. With the adoption of Common Core State Standards in California and the Standards for Mathematical Practice (California Department of Education, 2010), it is critical that mathematics instruction in grades K-6 be adequate to meet the new expectations.

According to data collected by Benbow and Arjmand (1990), high achievement in mathematics at the middle school level opens the doors of opportunity for students wanting to pursue an education beyond high school. Studies have shown that students who find mathematical success in the early years of learning are likely to find success as they go on because mathematics performance is directly related to previous achievement, which in turn impacts academic self-concept and self-efficacy in a positive manner (Hackett, 1985; X. Ma, 1999; Marsh, 1993; Wang, 2003). In order for students to

successfully complete Algebra 1 in middle school, they must receive effective instruction in the elementary grades that will prepare them to meet the challenge. This is particularly true for students who come from high poverty households and lack the resources to hire private tutors or receive additional help at a cost.

Statement of the Problem

There is an abundance of evidence indicating that students in the elementary grades (K– 5th) are not receiving the appropriate mathematics instruction. According to statistics provided by the California Department of Education (CDE, 2014) only 65% of all second graders in California were proficient or advanced in the California Standards Test (CST) general math test, regardless of race, ethnicity or socio-economic status. The level of proficiency increases to 66% in third grade and 72% in fourth grade but drops to 65% in fifth grade, 55% in sixth grade, and 52% in seventh grade for all students. At the national level, only 40% of fourth grade students scored proficient or above in the 2012 National Assessment of Education Progress mathematics assessment, which was administered to 209,000 students (NCES, 2012). The statewide math proficiency rate across all grade levels for minorities (Black or African American, American Indian, Hispanics), socioeconomically disadvantaged students, English learners, and students with disabilities shows a math proficiency performance well below that of the overall student population (CDE Dataquest, 2013).

Existing research points to many factors affecting mathematics student achievement including socio-economic status and attitude towards math (Keith & Cool, 1992; Secada, 1992). Mathematics beliefs (Schoenfeld, 1985), teacher self- efficacy

(Bandura, 1993; Gibson & Dembo, 1984; Knapp, Copland, & Talbert, 2003), and teacher math competency (Ball, 1990a; Charalambous, Philippou, & Kyriades, 2008; Hill, Rowan, & Ball, 2005; Glidden, 2008) have also been identified as having an impact on student performance. Mathematics teaching efficacy (Bates, Latham, & Kim, 2011; Swars, Hart, Smith, Smith, & Tolar 2007) and student efficacy expectations (Bandura, 1986; Maddux, Norton, & Stoltenber, 1986; Pajares, 1996; Schunk, 1991) align with Bandura's social cognitive theory of efficacy beliefs.

Of all the factors involved in student achievement, high quality teacher instruction and teacher self-esteem and enthusiasm for the subject taught, which is identified as teaching efficacy, are identified as potential reasons for improved student achievement (Knapp et al., 2003). This leads to question the quality of mathematics instruction for students at the elementary grades given their low mathematics performance. Research indicates that the quality of mathematics instruction, the methods used, and the resourcefulness of a teacher is associated to the level of teaching efficacy, mathematics efficacy, and mathematics teaching efficacy beliefs of school teachers (Borton-Kahle, 2008). Furthermore, teacher self-efficacy affects teachers' behavior in the classroom, the classroom environment they create, the choice of teaching techniques, and the achievement of their students (Bandura, 1993; Ross, 1994; Pajares, 1996). Based on the existing research mentioned above, if there are desirable qualities a mathematics teacher should have to improve student achievement, high mathematics efficacy and high mathematics teaching efficacy rank high.

Two studies conducted with graduate students attending teacher certification programs indicate that roughly half of these students show and express a dislike of mathematics and over a third indicated they were not good at mathematics (Ball, 1990a; Cornell, 1999). Despite finding a high percentage of teachers expressing a dislike for mathematics or admitting to their incompetence in mathematics, there are prospective teaching candidates enrolled in teacher preparation programs or current teaching practitioners who are found to have a high sense of mathematics efficacy and or a high sense of mathematics teaching efficacy (Borton-Kahle, 2008). Most of the studies focus on the deficit in efficacy, and on the positive aspects of high sense of efficacy (Bates, Latham, & Kim, 2011, Haney, Lumpe, Czerniak, & Egam, 2002). Existing research does not explore the factors, sources, or origins of practicing teachers' high mathematics self-efficacy or mathematics teaching self-efficacy with current practicing elementary school students. The existing and latest studies have been conducted with pre-service teachers or with participants outside the field of education (Newton et al., 2012; Lent, Lopez, & Bieschke, 1991).

Conceptual Framework

The conceptual framework for this study is based on the concept of self-efficacy expectations, which originates in Bandura's (1977, 1986) social cognitive theory of behavior. According to Bandura, self-efficacy is a person's belief in regards to their ability to perform a given task or take certain action. The level of efficacy towards the specific task or action determines whether the person will perform the task or action, the amount of effort spent on the task or action, and the amount of persistence invested to overcome any

challenges (Bandura, 1977, 1986). Bandura cites four major sources of information that have an effect on a person's level of efficacy:

1. Performance accomplishments: Having successfully performed a task or being unsuccessful at a task.
2. Vicarious experiences: Observing another person successfully completing the task or fail at the task.
3. Verbal persuasions: Feedback in regards to performance of the task which may be positive or negative.
4. Physiological States/Emotional Arousal: Emotional response to the task, which may be positive or negative.

These four theoretical sources of efficacy increase or decrease a person's expectation of mastery and influence the way people feel about a specific task and their performance on the task (Bandura, 1977, 1986).

In a similar manner, mathematics efficacy, teacher efficacy, and mathematics teaching efficacy are impacted by different factors associated with the four major sources of efficacy cited above. As with all efficacy constructs, they are content related or task-specific and must be measured with the level of specificity necessary to make the level of efficacy measure valid. In this section, I will expand on the concept of efficacy, which will guide my study through the previously mentioned sources of efficacy.

Self-Efficacy

Self-efficacy has been defined as perceived ability or a belief in one's personal capabilities or performance at a particular future task (Bandura, 1977). This perceived abilities or capabilities are based on past actions or experiences on the same or similar task. Self-efficacy is not static and the level of an individual's efficacy may change based on new experiences or actions (Bandura, 1986).

Teacher Efficacy

Teacher efficacy has been studied extensively since the early 1970s. It has been defined as the extent to which a teacher believes his/her effort will have a positive effect on student learning and achievement. Teacher efficacy and varying levels of teacher efficacy accounts for differences in teaching effectiveness, influences student outcomes as well as teachers' choices of teaching methods and strategies (Gibson & Dembo, 1984; Ross, 1994).

Mathematics Self-Efficacy

Mathematics self-efficacy, following on the definition of self-efficacy, is a person's perceived ability in the context of mathematics (Pajares, 1996). Hacket and Betz (1989) define it as a situational (specific) self-assessment of confidence in an individual to perform a particular mathematics task or solve a math problem. It is different from a person's attitude, self-concept, or belief towards mathematics. The difference is very important and it can be illustrated by two people making a statement such as, "I'm good at math" and "I can solve algebraic equations." Math efficacy is task specific and the person

stating “I can solve algebraic equations” is displaying a high sense of efficacy towards solving algebraic equations while the first person is stating their self-concept towards mathematics in general. It does not mean that the person stating their self-concept will not be able to solve algebraic equations, but their statement is not specific to it and therefore not considered an efficacy expectation.

Mathematics Teaching Self-Efficacy

Mathematics teaching self-efficacy is an individual’s perception of his/her own ability to teach others mathematics. It is not an attitude towards mathematics teaching, but a conviction that a teacher can help students learn mathematics. This is an extension and far more specific construct than teacher efficacy because it refers to mathematics teaching in particular.

According to Sanders and Rivers (1996), students who receive effective instruction for repeated years show significant gains in achievement. Effective instruction and teaching practices, particularly in mathematics, is impacted by the teachers’ attitude towards math (Bush, 1989; Guskey, 1988) as well as their understanding of mathematics content (Ball, 1990b). In the self-contained elementary classroom, the teacher holds the responsibility of teaching all academic subjects. According to Bandura (1997), elementary teachers enjoy and prefer teaching some academic subjects while disliking others. Mathematics appears to be a subject, according to Ball’s (1990a) study about feelings towards mathematics of pre-service teachers, which only about one-half of the subjects in the study enjoyed.

The results of Ball's (1990a) study beg the questions: What if we could figure out what generates positive feelings towards a subject such as mathematics? Where do half of the subjects in the study originate their positive feelings and beliefs towards their mathematics abilities? What factors affect mathematics teaching efficacy beliefs? Seeking answers to these questions led to the formation of the research questions for this study.

Research Questions

The following overall research question and sub-questions guided this study: What are factors that contribute to the formation of a high level of mathematics self-efficacy and mathematics teaching self-efficacy for teachers in grades K-5th?

- a. What role has site and district leadership had in providing experiences and opportunities for teachers to improve their level of mathematics teaching efficacy?
- b. What role do teacher preparation programs have in fostering high levels of mathematics and mathematics teaching efficacy?

By addressing these questions, this study provided new insights into the factors contributing to teachers' high level of mathematics efficacy and mathematics teaching efficacy of which there is limited research.

I conducted a mixed methods study investigating the level of math efficacy and math teaching efficacy of K-5th grade teachers, as well as the factors affecting high mathematics efficacy and high mathematics teaching efficacy of teachers in the Bella Unified School District (BUSD), a rural district in Southern California. The study utilized

a Mathematics and Mathematics Teaching Self-Efficacy Survey (MMTSES) to find out the level of mathematics self-efficacy and mathematics teaching self-efficacy beliefs of teachers in BUSD who voluntarily took the MMTSES. Using results of the MMTSES, interviews were conducted with selected teachers, who were identified as possessing high mathematics self-efficacy and high mathematics teaching self-efficacy, to investigate the sources or factors that led to the high levels of efficacy beliefs in participants.

Significance

Research focusing on the sources or factors that led to a high level of mathematics and mathematics teaching self-efficacy of elementary school teachers is limited at best. Most of the existing research on efficacy has been done with middle and high school students, pre-service teachers, or college students, and it has been carried out by using quantitative methods (Lent et al., 1991; Lent et al., 1996; Usher, 2009). By using interview inquiry to identify the factors affecting or generating efficacy beliefs, as theorized by Bandura (1977, 1986), this study added to existing research the self-reported sources of efficacy of the studied population in a manner that has not been done with active elementary school teachers. It provides an insight into how mathematics self-efficacy and mathematics teaching self-efficacy develops across the years of education. It informs current teacher preparation programs as to the role of previous teacher education programs' practices, as experienced by participants, that enhanced their mathematics teaching self-efficacy beliefs. The results of this study also provide school districts with information on the type of professional development that will enhance teachers' self-

efficacy in the areas of mathematics and mathematics teaching. The implications are discussed in more detail in chapter five.

CHAPTER TWO: REVIEW OF LITERATURE

This chapter provides a review of literature on efficacy theory, and focuses on existing research on mathematics self-efficacy, and mathematics teaching self-efficacy. A synthesized description of each construct will be presented as it relates to general human behavior and academic settings. A synthesis of the current research on the sources of efficacy: Performance accomplishments, vicarious experiences, verbal persuasions, and physiological states, as described in Bandura's (1977, 1986) social-cognitive theory will conclude this literature review.

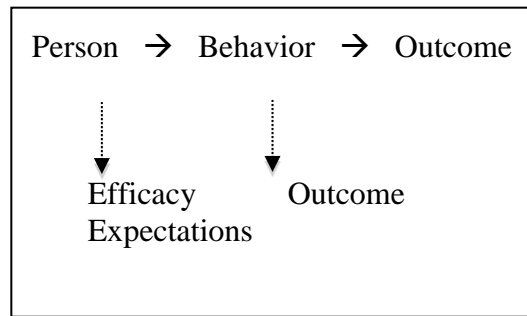


Figure 1. Representation of the difference between efficacy and outcome expectations.

Self-Efficacy

The construct of self-efficacy began with Bandura's (1977) social cognitive theory of behavioral change. Self-efficacy beliefs are a person's perceived capability or conviction that the person can successfully perform the given task. Self-efficacy beliefs determine the amount of effort individuals will exert on a task or if they will attempt the task at all. Efficacy beliefs also influence emotions and cognitive processes of individuals when faced with a task. For example, people with low self-efficacy for a particular task

may believe that the task is more difficult than it really is. Such beliefs will foster stress, fear, and disrupt the person's cognitive process in finding a solution to the task.

There is a tendency to confuse efficacy expectations with outcome expectations. Bandura (1977) made a clear distinction between the two constructs. Outcome expectancy is a person's assessment of what behavior is needed to produce a desired outcome. An efficacy expectation is the belief that one can execute the behavior needed to produce the desired outcome. For outcome expectancy individuals can identify the course of action needed to produce the desired outcome. However, if the individuals don't believe they can perform the course of action, knowing the course of action does not influence their behavior toward performing the action. Efficacy expectations will determine a person's behavior toward performing the action, the amount of effort, and even the amount of time spent to perform the course of action. Bandura (1977) presents a diagram similar to Figure 1 to show the difference between the two constructs and how efficacy influences behavior and outcome expectancy does not.

Self-efficacy beliefs differ from self-concept and other expectancy or outcome belief constructs in that self-efficacy beliefs are task specific, situational, and goal oriented (Bandura, 1986, 1989; Pajares, 1996). Self-concept is a broader construct that includes self-efficacy beliefs, confidence, and self-worth, but lacks the specificity (context-specific) of self-efficacy. For example a person can express feelings of doing well in a math class, which shows high expectancy beliefs and confidence in mathematics. However, that same person may acknowledge difficulty in solving fractions which indicates low self-efficacy

beliefs with solving fractions. The specificity of the task is what distinguishes other expectancy beliefs from self-efficacy.

Self-efficacy beliefs can be changed or produced by performance accomplishments, vicarious experiences, verbal persuasion, and physiological states (Bandura 1977, 1986). This means that if a student has success in a particular task (performance accomplishments), sees a peer or model successfully accomplish a task (vicarious experiences), is encouraged by peers and adults (verbal persuasion), and is excited about the task or the task is presented in ways that puts the student in a positive frame of mind (physiological states), the student's self-efficacy beliefs may be enhanced. The opposite effect may hold true if the student fails repeatedly, sees models failing at the task, receives no positive feedback or is discouraged, and experiences stress or fear as part of the task.

The construct of self-efficacy has been tested in different fields including medicine, clinical treatments of phobias, depression, pain control, and athletic performance over the last 30 years (Pajares, 1996). In academic settings, self-efficacy beliefs have begun to receive much more attention and in particular, the constructs of teacher efficacy (Ashton & Webb, 1986; Bandura, 1986; Guskey & Passaro, 1994), mathematics self-efficacy (Hackett, 1985; Hackett & Betz, 1989; Pajares, 1996; Pajares & Miller, 1994; Kranzler & Pajares, 1997), and mathematics teaching efficacy (Bates, Kim, & Latham, 2011; Enochs, Smith, & Huinker, 2000; Swars, 2005). In all of these settings, self-efficacy beliefs have been identified as major factors influencing behavior and performance. In academic settings, the performance and behavior of educators can have a

serious impact on student achievement and students' own formation of self-efficacy beliefs.

Teacher Efficacy

The construct of teacher efficacy was first introduced to the field of educational research as a result of two studies carried out by researchers from the Rand Corporation (Armor, Conroy-Oseguera, Cox, King, McDonnell, Pascal, Pauly, & Zellman, 1976; Berman, McLaughlin, Bass, Pauly, & Zellman, 1977). Based on Rotter's (1966) social learning theory, the Rand researchers added the following two items to an existing survey:

Item 1: *"When it comes right down to it, a teacher really can't do much because most of a student's motivation and performance depends on his or her home environment."*

Item 2: *"If I really try hard, I can get through to even the most difficult or unmotivated students."*

The results from these two items, which were scored by using a five-choice Likert Scale, provided the Rand researchers with data to assess the impact of teacher efficacy, which was defined as "the extent to which the teacher believes he or she has the capacity to affect student performance" (Berman, et al., 1977, p. 137). Teacher efficacy was later defined as "teachers' beliefs or conviction that they can influence how well students learn, even those who may be difficult or unmotivated" (Guskey & Passaro, 1994, p. 4).

The Rand studies took teachers' responses to the two items above and combined them to determine the extent to which teachers believed that results in student learning,

motivation, and impact of teaching was primarily at the hands of the teacher. The Rand researchers found teacher efficacy to have a strong positive effect on student performance, a similar effect on the achievement of project goals, and a strong predictor of longevity and continuity of projects beyond their funding cycle (Armor et al., 1976; Berman, et al., 1977). Later on, a distinction was made between Item 1 in the Rand studies and Item 2 due to the difference in internal and external factor associated with both items. Item 1, which deals with the influence of external factors on student performance and motivation and has been labeled general teaching efficacy (Ashton, Olejnik, Crocker, & McAuliffe, 1982; Ashton & Webb, 1986). Item 2, which focuses on teachers' level of confidence in their abilities to overcome environmental factors that impact student motivation to learn and performance has been labeled personal teaching efficacy due to it being a reflection of a teachers belief that they can reach students despite external factors (Ashton & Webb, 1986).

At the same time, Albert Bandura (1977) identified teacher efficacy as a specific type of self-efficacy or a teachers' belief about their capacity to perform at a particular level (low or high). The level of efficacy of the teacher determines the amount of effort put forth, the amount of time facing obstacles, the level of resilience in dealing with failures, and the level of stress or depression experienced as the teachers faces difficult or demanding situations (Bandura, 1977; Ashton & Webb, 1986). Teachers with a low sense of teaching efficacy or low sense of personal teaching efficacy expect students to fail, react negatively to their teaching efforts, and look for explanations targeting students' ability, background, motivation, and attitude when students fail (Gibson & Dembo, 1984).

Teachers with a high sense of teaching efficacy have firm beliefs they can reach difficult students, that effective teaching and family support can overcome negative influences, and take personal responsibility for student learning (Bandura, 1997; Gibson et.al., 1984; Ashton & Webb, 1986).

This section focuses on Bandura's construct of teacher self-efficacy, which is based on Bandura's social cognitive theory, and not on Rotter's social learning theory of locus of control, which was the basis for the Rand study. There is a clear distinction between Rotter's (1966) social learning theory of internal-external locus of control and Bandura's concept of self-efficacy. Rotter's theory of locus of control is based around an individual's beliefs about whether his or her actions affect outcomes. Bandura's construct of self-efficacy beliefs is about whether one can produce certain actions. It is an individual's assessment of whether he or she can produce certain actions (i.e. teach mathematics, do mathematics problems, etc.) that is of interest to this study. Bandura's other theorized task specific efficacy expectations, math efficacy and math teaching efficacy, will be part of this study.

Beyond the Rand studies, Gibson and Dembo (1984) developed a 30-item measure of teacher efficacy. The instrument measured personal teaching efficacy and general teaching efficacy. Multiple studies have been carried out in an attempt to investigate teacher efficacy and its relationship or impact on student achievement (Moore & Esselman, 1992; Watson, 1991), teacher resiliency (Allinder, 1994), improved student engagement and attitude (Woolfolk, Rosoff, & Hoy, 1990), and instructional strategies

(Allinder, 1994). The Gibson and Dembo instrument provided a valuable tool to measure teacher efficacy in different settings.

Teachers' Mathematics Self-Efficacy

Mathematics self-efficacy has been defined as an individual's beliefs in his/her ability to do mathematics (Betz & Hacket, 1983) or a person's perceived ability in the context of mathematics (Pajares, 1996). Due to the construct of efficacy being specific to particular tasks, mathematics efficacy is often measured as one's own judgment of ability to solve specific mathematics problems, mathematics related tasks, and success in specific mathematics related courses (Betz & Hacket, 1983). Teachers possess varied levels of mathematics self-efficacy. There are multiple factors that affect teachers' mathematics self-efficacy beliefs including mathematics content knowledge, teacher preparation, student achievement results, the individual's level of personal efficacy and their own level of mastery (Bandura, 1986). In addition, mathematics anxiety has also been connected to teacher mathematics' efficacy beliefs (Gresham, 2008). Mathematics efficacy is an important factor in math education and the level of mathematics efficacy a teacher brings to the classroom will determine the quality of math instruction students receive. This section reviews the existing research on the level of math efficacy of teachers and prospective teachers coming into the profession.

Studies have been conducted to determine the level of mathematics content knowledge and efficacy beliefs of prospective teachers (Ball, 1990a; Cornell, 1999; L. Ma, 1999). Ball (1990) conducted a mixed methods study with 250 teacher candidates. The study aimed to investigate the subject's mathematical content knowledge, their ways

of representing mathematics problems, and their general feelings towards mathematics. Subjects participated in interviews and responded to questionnaires as part of the study. The study concluded that teacher candidates bring a limited understanding of mathematics as they begin their university education. Teacher candidates demonstrated a limited ability in representing a division problem in the appropriate mathematics context.

In a different study, Ma (1999) found similar results when it comes to the limited understanding of mathematics of teachers in the United States. Despite having a small sample of teachers in her study, 23 U.S. teachers and 72 Chinese teachers, Ma's study brought to the forefront the weak understanding of mathematics of U.S. teachers in the areas of modeling division of fractions, error detection in multi-digit subtraction, explanation of subtraction with regrouping, and responding to student connections of mathematics concepts. In contrast, Chinese teachers demonstrated what Ma labeled as a profound understanding of fundamental mathematics. Teachers possessing such understanding of mathematics displayed positive attitudes towards mathematics, were open to multiple perspectives and approaches to solving math problems, and connected procedural and conceptual understanding of mathematics.

Mathematics Teaching Self-Efficacy

Mathematics teaching self-efficacy refers to an individual's self-perceived ability to teach mathematics effectively (Enochs, Smith, & Huiker, 2000). It is a judgment on the part of teachers as to whether they can effectively teach mathematics concepts given their own competence in those mathematics concepts (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). Teachers with a high sense of mathematics teaching self-efficacy are more

likely to try different strategies when teaching, reflect on their teaching when students don't learn, and are more confident in their ability to teach mathematics (Bates, Kim, & Latham, 2011).

Mathematics ability on its own does not guarantee that an individual will be an effective teacher. However, pre-existing beliefs about mathematics ability, learning, and teaching play an important role in the planning and implementation of math lessons for pre-service teachers and those new to the teaching profession (Benbow, 1995). In addition, existing research indicates that teachers' pre-existing beliefs about mathematics are rooted in previous experiences, positive or negative, as mathematics students (Smith, 1996). This is consistent with Bandura's (1977, 1986) efficacy theory which indicates that mastery experiences will provide an individual with an increased level of confidence in being able to accomplish future tasks. A mastery experience for teachers includes teaching a lesson successfully. Teacher preparation programs and the student teaching component of teacher preparation programs generally provide opportunities for mastery experiences.

Teacher preparation programs. In the context of mathematics teaching, it is important to understand the role of teacher preparation programs in the formation of mathematics teaching efficacy beliefs. Teachers' qualifications, competency, and mathematics performance can have an effect on student achievement (Kukla-Acevedo, 2009). Existing research suggests that teacher efficacy can be developed and enhanced during the pre-service teaching preparation stage (Charalambous, Philippou, & Kyriakides, 2008). In addition, research indicates that experiences provided by teacher preparation programs, such as mathematics methods courses and student teaching, can

have an effect on the efficacy beliefs of elementary level teaching candidates (Vacc and Bright, 1999; Ebby, 2000; Kim & Sharp, 2000).

The first teaching experience of pre-service teachers occurs during the student teaching assignment portion of teacher preparation programs. Research on the effect of teacher preparation programs across different countries was conducted by using data from the Teacher Education and Development Study in Mathematics (Schmidt, Cogan, & Houang, 2011). Data across multiple countries was analyzed and the effects of student teaching and university coursework were examined. Findings indicate that differences in mathematics content knowledge and mathematics knowledge for teaching were associated with differences in student teaching experiences as well as mathematics methods coursework taken during preservice teaching programs. In general, preservice teaching candidates with the highest mathematics content knowledge also had taken a significantly larger number of mathematics courses and mathematics methods courses (Schmidt et al., 2011).

Youngs and Qian (2013) conducted a study to find the association between Chinese preservice teachers' levels of mathematics knowledge for teaching and their experiences with mathematics methods courses and student teaching. They found that exposure to student teaching experiences, mathematics methods courses, and general pedagogy courses were directly associated with higher levels of mathematics knowledge for teaching. Following Bandura's (1977, 1986) efficacy theory, a strong connection between high mathematics knowledge for teaching and mathematics teaching efficacy beliefs exists.

The studies discussed above associated teaching methods courses and student teaching experiences with high math knowledge for teaching. Teacher preparation programs are a critical component in the development of teachers. In the United States teacher preparation programs provide preservice teachers with mathematics teaching methods courses and student teaching experiences. This study investigated the specific experiences at teacher preparation programs of participants and the effect these experiences had on their formation of mathematics teaching efficacy beliefs.

Sources of Efficacy

Bandura's social cognitive theory (1977) hypothesized that individuals form conclusions about their abilities to accomplish a task or perform certain actions based on previous experiences or interactions. As a result, Bandura (1977, 1986) proposed four different sources of information from which individuals determine their level of efficacy for a specific task. They are performance accomplishments (mastery experiences), vicarious experiences, social persuasions, and physiological states/emotional arousal. Each of these four sources of information contributes to an individual's level of efficacy in different ways and at varying degrees. Existing research also indicates that these different sources of efficacy impact males and females differently (Zeldin, Britner, & Pajares, 2007).

Performance Accomplishments

According to Bandura (1977, 1986) performance accomplishments (mastery experiences) are by far the most influential source of efficacy information because it is based on experience related to mastery. When an individual succeeds at a task, the mastery

expectation is elevated. When an individual fails, mastery expectation is lowered, particularly if there are repeated failures at the task. When an individual has experienced repeated success, occasional failures have a lesser impact on a person's sense of efficacy, and failure may even serve to enhance persistence. Once self-efficacy is established, it impacts other situations where success is attributed to ability and effort (Bandura 1977, 1993). Perceived performance accomplishments, or perception of one's level of mastery, are a good predictor of self-efficacy and it may be an even better predictor than actual results on a task (Lopez, Lent, Brown, & Gore, 1997).

Vicarious experiences

Bandura (1977, 1986) theorizes that when the skill in question (i.e. two-digit multiplication) is modeled by someone else that the observer identifies with, the level of efficacy of the observer is enhanced. Observing someone else have success at a task makes the observer feel that he/she can accomplish the task as well. However, if the model performs poorly, the observer's efficacy expectations may decrease. In current research, vicarious experiences are measured by using items on survey instruments that deal with exposure to role models, parents, peers, or friends that demonstrate a high level of competence in the subject, class, or topic of interest (Klassen, 2004; Lent, Lopez, Brown, & Gore, 1996).

Verbal persuasions

Verbal persuasion involves feedback received about performance on a specific task from a supervisor, colleague, or external source. According to Bandura (1986), verbal

persuasion can contribute to successful performances by giving a person a boost in their sense of efficacy enough to start a particular task, put more effort on the task, try different strategies, and spend enough effort to succeed. The level of impact of verbal persuasions depends on the credibility, expertise, and level of trust between the parties involved (Bandura, 1986).

Physiological States/Emotional Arousal

Feelings of relaxation and positive emotions, while performing a task, add to the sense of competence of a person and therefore increase self-efficacy and expectations of success (Bandura, 1996). Increased heart and respiratory rate, along with trembling and perspiration can be considered positive emotional arousal but can also be interpreted as negative arousal in the form of stress and anxiety (Bandura, 1997). Emotional arousal can improve performance by allowing the performer to focus on the task at hand, but it can also interfere with a person's judgment and functioning if the level of arousal is high. Negative feelings, anxiety, and emotions impact the sense of competence of a person in a negative way.

Teachers' dislike of mathematics, negative feelings towards mathematics, and anxiety when faced with mathematics tasks is another factor that affects teachers' mathematics efficacy. In fact, Swars, Daane, and Giesen (2006) found a significant negative relationship between anxiety towards mathematics and mathematics teaching efficacy. It seems logical that the level of mathematics self-efficacy in an individual teacher will determine the level of comfort and beliefs held about teaching mathematics. The higher the level of math efficacy an individual has, the higher the comfort and beliefs

about effectively teaching mathematics will be (Gresham, 2008). The level of math efficacy of teachers in the profession and prospective teachers determines the quality of instruction students receive in the classroom across the United States.

Summary

As previously stated, efficacy beliefs can affect an individual's performance in a given task. Existing research points to a percentage of pre-service teachers coming into the profession with a dislike for mathematics, a lack of competence in mathematics, and an elevated level of anxiety towards mathematics (Ball, 1990a; Cornell, 1999; X. Ma, 1999). There is very limited research on the impact of these factors on current practicing elementary school teachers. However, there is evidence of low mathematics achievement of students in the elementary grades (K-5). While there is research that suggests a number of factors affecting student achievement, there is a wealth of information that indicates teacher efficacy is a contributing factor to high student achievement, teachers' choices of instructional practices, and beliefs about students' ability to learn (Ashton, Webb, & Doda, 1983; Ashton & Webb, 1986; Bandura, 1997, Haney, Lumpe, Czerniak, & Egan, 2002). Given the existing state of mathematics achievement in grades K-8 in California (CDE, 2013), this study aims to shed light on the current level of math self-efficacy and math teaching self-efficacy of teachers and investigate the sources of a high sense of efficacy in math and math teaching of current practicing elementary school teachers. The results of this study will inform current teacher preparation programs, school district math professional development, and current teachers' level of math efficacy and achievement results.

CHAPTER THREE: METHODOLOGY

This study utilized a validated Mathematics and Mathematics Teaching Efficacy Beliefs Survey and semi structured interviews to explore the sources and factors contributing to high mathematics efficacy and high mathematics teaching efficacy beliefs of elementary school teachers in grades two through five in a small rural public school district in Southern California, Bella Unified School District (BUSD). The following overall research question and sub-questions guided this study:

What are factors that contribute to the formation of a high level of mathematics self-efficacy and mathematics teaching self-efficacy for teachers in grades K-5th?

- a. What role has site and district leadership had in providing experiences and opportunities for teachers to improve their level of mathematics teaching efficacy?
- b. What role do teacher preparation programs have in fostering high levels of mathematics and mathematics teaching efficacy?

The primary goal of this study was to investigate the mathematics and mathematics teaching experiences of teachers identified as having a high level of mathematics and mathematics teaching self-efficacy as measured by the Mathematics and Mathematics Teaching Self-Efficacy Survey (MMTSES). The rest of this chapter outlines the research questions, study design, process of selecting participants, data collection, and data analysis performed from the data obtained.

Study Methodology and Design

I conducted a study on the factors that contributed to high mathematics and mathematics teaching self-efficacy beliefs of teachers in one school district. The study was conducted in two phases. The first phase involved the administration of the Mathematics and Mathematics Teaching Self-Efficacy Survey (MMTSES). The purpose for the first phase of the study was to identify teachers who scored on the high spectrum of mathematics and mathematics teaching efficacy. The second phase was qualitative and involved in depth semi structured interviews with teachers that rated as having a high sense of mathematics and mathematics teaching self-efficacy as measured by the MMTSES. The explanatory focus for this study sought to describe and document emerging themes of the sources of efficacy of practicing teachers in the Bella Unified School District. The study systematically reflected upon teacher responses to interview questions and identified the sources of high self-efficacy in the areas of mathematics and mathematics teaching.

Sample and Population

Phase I: Survey Component

The first phase of the study included a pool of 64 teachers teaching grades K-5 at three school sites in BUSD. Table 3.1 describes the school population, demographics, and number of teachers at each site. School A has seven kindergarten classes, eight first grade classes, and seven second grade classes. The 22 teachers in School A were invited to

participate in the study. School B has 18 teachers in grades 3-5 and all were invited to participate in the study. School C has 24 teachers teaching K-5 and all teachers were invited to participate in the study. Each of these schools has reading specialists, resource teachers, and special education teachers. These teachers were not invited to participate in the study because this study is aimed at investigating efficacy in general education K-5 teachers who provide mathematics instruction.

Table 1. District Elementary Schools, Demographics, and Potential Participants

<u>School Site</u>	<u>Student Population</u>	<u>Demographics</u>	<u>Number of Teachers</u>
School A	484 Students	48% White 40.2% Hispanic 10.8% Native American 1% Other	22
School B	523 Students	43% White 41.3% Hispanic 10.7 Native American 5% Other	18
School C	548 Students	40.1% White 45.3% Hispanic 10.4% Native American 4.6% Other	24

The three schools chosen to participate in this study are three of the four schools in the district with elementary students enrolled.

Ethical Conduct of Research. The study was approved by UCSD Institutional Board of Research prior to beginning data collection. Subsequently, I informed teachers at each school of the study at a staff meeting and invited them to participate in the study. I explained the study and presented staff with a consent form (Appendix C). After explaining the study, distributing consent forms and the survey instrument, I made myself

available for questions. Teachers received a copy of the survey instrument, a consent form, and a description of the study at the staff meeting. Teachers had the option to abstain from participation completely, participate by completing the survey instrument and mark the consent form to decline an interview, or complete the survey and agree to participate in a follow up interview. No survey instruments were completed or collected at the staff meeting. Teachers had the option of sending the survey to on an envelope provided, submit it in person at a future time, or make a different arrangement to have the survey collected. As surveys and consent forms were received, I stored them in a locked cabinet in my office where I was the only person to have access to them.

Participant Selection

Participants for phase I of the research study were those that returned a signed consent form and a completed survey. The researcher distributed 64 surveys to potential participants and fifteen surveys were collected and processed. The purpose for the first part of the study was to select only those participants that had a completed survey, a consent form, and scored high on the MMTSES. Two of the surveys did not have a signed consent form and one survey was not fully completed. This resulted in 12 surveys to score. Out of these 12 completed surveys, two participants were interviewed but disqualified as one had a mixed teaching assignment that went beyond the fifth grade level and the other scored low on the efficacy scale. The data for both of these participants was not considered for phase two of the study. The demographic data was recorded for the 10 surveys that met the criteria.

Demographics of Participants. The participants were elementary school teachers in grades kindergarten through five from the three different school sites. The teachers were a mixed group of educators with various degrees of teaching experience and education (See Table 2). All participants were female with eight being white, one Hispanic, and one Asian.

Table 2. Demographic Data of Participants

Gender		Race	
M	0	White	8
F	10	Hispanic	1
		Asian	1
Highest Ed.			
BA	5		
MA	5		
Teaching Experience		Grade Taught	
0 to 2	1	K	2
6 to 10	1	2	1
11 to 15	4	3	2
16 to 20	1	4	3
21 to 30	2	5	2
30+	1		

Instruments

The instrument used to measure teacher mathematics self-efficacy and mathematics teaching self-efficacy was the Mathematics and Mathematics Teaching Self-Efficacy Survey (MMTSES). The MMTSES (See Appendix A) consists of 57 items. The purpose of the survey was to (a) identify teachers' levels of mathematics self-efficacy and mathematics teaching self-efficacy, and (b) select teachers with a high level of

mathematics self-efficacy and high mathematics teaching self-efficacy to conduct individual interviews. The MMTSES is a combination of the Mathematics Self Efficacy Scale-Revised (MSES-R), a revised version of the Mathematics Self Efficacy Scale, by Kranzler and Pajares (1997) and the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) developed by Enochs, Smith, and Huinker (2000).

Mathematics Teaching Efficacy Beliefs Instrument. The Mathematics Teaching Efficacy Beliefs Instrument was developed by Enochs et al. (2000) by making modifications to the Science Teaching Efficacy Belief Instrument (Riggs & Enochs, 1990). Items were changed so that future mathematics teaching beliefs were reflected in the responses to the MTEBI. The instrument is made up of 21 items and uses a Likert Scale with five categories: *strongly agree, agree, uncertain, disagree, and strongly disagree*. Each of the items has a score of 1 to 5, strongly agree (5) to strongly disagree (1) and it is reversed for negatively worded items. There are two subscales embedded in the MTEBI; mathematics teaching outcome expectancy (MTOE) and personal mathematics teaching efficacy (PMTE). There are 13 items related to the PMTE, where raw scores can range from 13 to 65, and five items are worded in a positive structure while eight are written negatively. There are eight items related to MTOE and scores can range from 8 to 40, with all items worded positively. The overall raw score can range from 21 to 105. Reliability analysis produced an alpha coefficient of .88 for the PMTE, and the MTOE produced an alpha coefficient of .75. Further confirmatory factor analysis yielded results indicating that the two subscales (PMTE and MTOE) are independent. The MTEBI was

further validated by conducting research with a sample of pre-service elementary teachers (Brown, 2012; Enochs et al., 2000; Swars, 2005).

Permission was requested to utilize the MTEBI as part of this study, and it was granted by Dr. Larry Enochs (See Appendix D).

Mathematics Self-Efficacy Scale-Revised. The Mathematics Self-Efficacy Scale-Revised was developed by Kranzler and Pajares (1997) by revising the Mathematics Self-Efficacy Scale (MSES) created by Betz and Hackett (1983). The MSES was developed to assess the mathematics self-efficacy of college students by having them assess their perception of their capabilities at performing mathematics related tasks (Betz & Hackett, 1983). It consisted of 52 items and three subscales. The subscales represented three domains of math-related behavior described as solution of math problems (18 items), completion of math tasks (18 items) used in everyday life, and satisfactory performance in college courses that require knowledge of mathematics (16 items). The MSES contained a 10 point Likert scale. The resulting MSES-R developed by Kranzler and Pajares (1997) was modified by using a 6 point Likert scale and adopting a previously used problems subscale items that had been validated (Dowling, 1978).

In order to validate the MSES-R, it was administered to 522 undergraduate students enrolled in various college courses at three public universities in the South and Southwest United States. Reliability analysis of the MSES-R produced alpha coefficients of .91 for solution of problems, .94 for completion of math tasks, .91 for satisfactory performance in college courses, and .95 for the entire instrument (Kranzler & Pajares, 1997). Despite the fact that the MSES-R was first utilized and validated with college

students, it has been used in different contexts with high school students (Nielsen & Moore, 2003) and very limited with practicing teachers (Borton-Kahle, 2008). For this study, the performance in college courses portion of the MSES-R was not used due to it not applying to practicing teachers who have already graduated from college. This made the MSES-R portion of the MMTSES 36 questions and the raw score of this portion ranged from 36 to 216.

Survey Data Collection

The Mathematics and Mathematics Teaching Self-Efficacy Survey (MMTSES) was distributed to a pool of 64 teachers at three different elementary school sites, School A, School B, and School C at Bella Unified School District. Any participant who chose to be a part of the study returned the survey and consent forms via district mail in sealed envelopes. Surveys were scored and demographic information for each participant was recorded.

Survey Data Analysis

Once the data was collected, it was reviewed to ensure that only fully completed Mathematics and Mathematics Teaching Self-Efficacy Scales were utilized during the data analysis. The Mathematics Self-Efficacy Scale-Revised and the Mathematics Self-Efficacy Beliefs Instrument was scored by using the existing rubrics for each instrument. After scoring each survey, only the participants scoring high in mathematics efficacy and mathematics teaching efficacy were invited for phase two of the study.

I created raw score intervals to rate participants as low and high in Mathematics Self Efficacy (MSE) and Mathematics Teaching Self Efficacy (MTSE). The interval for low MSE and MTSE was from 18-45. The reasoning for this score range is that it would require a participant to score a one or a two on the majority of the items, with a small number of items scored as a three or higher. This means that the participant would disagree or strongly disagree with the majority of efficacy statements in the MSE and MTSE. Raw scores for the medium interval were from 45-72, and the high interval was from 73-108. A participant classified in the medium interval range score would have scored most responses as a three or a four. In order for a participant to be rated high, the participant answered most of the items with a four or higher.

The reasoning behind the scoring rubric for Mathematics Tasks (MT) was similar to MSE and MTSE. Low efficacy raw scores for MT were in the range of 21-42, Medium was 43-66, and High was from 67-105. The scores for all participants are discussed in more detail in Chapter Four.

Phase Two: Qualitative Component

During phase two of the study individual interviews were conducted with teachers who gave permission to be contacted once the survey MMTSES was administered. These were individuals who scored high on the survey. Ten participants met all the requirements to participate in phase two of the study. Once participants were identified, interviews were held at the place of employment of the participants or an agreed upon location. The goal was to make the participants as comfortable as possible during the interviews and questions were asked in a manner made the participant feel comfortable. The interview

normally began with a statement to let participants know they were selected for phase two of the study due to their high level of mathematics and mathematics teaching efficacy beliefs. Typically the first question was regarding participants' early mathematics experiences, and the interview concluded with the gathering of demographic information. At times, the order of the questions changed depending on the participant and the nature of the initial conversation.

Instruments and Data Collection

Bandura (1977, 1986) states that there are four main sources of influence on self-efficacy which include performance accomplishments (mastery experiences), vicarious experiences, social persuasion, and physiological states (emotional arousal or stress reduction). Interview inquiry was used to investigate the factors that impacted efficacy beliefs in participants. The limiting factors of existing survey instruments currently used to measure sources of efficacy do not lend themselves to investigate this phenomena as well as interviews. Merriam (1988) states that interviewing allows one to "enter into the other person's perspective" (p. 72) and provides the opportunity to focus on the topic at hand as told by the personal story of the interviewee. Different interpretations of what each of the sources of efficacy mean to different participants and the way they respond to survey items causes a limited level of response by the participants. Asking participants to state the role models through which vicarious experiences enhanced their efficacy rather than to choose from a limited list (i.e. teachers, parents, peers, etc.) provided a better description of their personal experience.

The interview protocol (Appendix B) was developed by analyzing Bandura's theorized four sources of efficacy. The interview protocol was semi-structured to allow the participant the flexibility to tell her story. I asked appreciative inquiry based questions to bring out the most positive experiences that contributed to each participant's efficacy beliefs. However, in order to ensure that the interviews provided a complete picture of the heuristics used by the participants to form their efficacy beliefs, some follow up questions were asked of each participant if the participant did not mention the effect of each source of efficacy on her experience.

Questions were asked in different order depending on the participant's engagement in conversation. The first efficacy beliefs question was to analyze the sources of mathematics self-efficacy of the interviewee through an appreciative inquiry style written question. The question asked to the interviewee was the following:

Think about your earliest experience or experiences that made you feel good about your mathematics ability (PA). Can you tell me what you recall about it?

I listened to the response and made note on a table that contained the four hypothesized sources of efficacy to see which of them appeared to have contributed to the positive experience as told by the interviewee (See Table 3). Depending on the response as told by the interviewee, I asked a set of follow-up questions to ensure that if any of the hypothesized sources were not mentioned by the interviewee, they may be brought out by the follow-up questions. The follow up questions were asked in a manner that did not lead the interviewee in any particular direction other than to investigate if the interviewee credits any particular hypothesized source of efficacy with enhancing his/her mathematics

ability. The question was written in a way that allowed the interviewee to share more than one positive experience in regards to his/her mathematics abilities. Despite struggling at first to recall their earliest positive experience with mathematics, all participants were able to provide a detailed description of at least one event, experience, or situation at some point in their lives that contributed to feelings of competency and high level of efficacy in mathematics.

Table 3. Sample Table Used for Interview Question One

Performance Accomplishments (PA) or
Mastery Experiences

Vicarious Experiences (VE)

Verbal Persuasions (VP) of Social
Persuasions

Physiological States (PS)

Possible follow up questions:

Who was involved in the experience (VE)? Did you receive verbal encouragement (VP)? Did you have role models in the area of mathematics (VE)? How did mathematics and specific mathematics topics make you feel (PS)? What/Who do you think made the experience possible? How do you think it can be replicated?)

The purpose of the next question was to investigate the sources of mathematics teaching self-efficacy of the participants.

Can you think back to a positive experience(s) or lesson(s) teaching mathematics?
Can you point out why or what part of the experience made you feel good about your mathematics' teaching ability?

I listened to the response and made note on a table similar to Table 4. It contained the four hypothesized sources of efficacy to see which of them appear to have contributed to the positive experience as told by the interviewee (See Table 4). If the interviewee did not mention some of the sources of efficacy, I asked some of the follow up questions to determine if any of the other sources of efficacy contributed to the mathematics teaching self-efficacy of the interviewee.

Table 4. Sample Table Used for Interviews Question Two

Mathematics Teaching Self-Efficacy	Sources of Efficacy
Performance Accomplishments (PA)	
Vicarious Experiences (VE)	
Verbal Persuasions (VP)	
Physiological States (PS)	
Possible follow up questions:	<p>At what point in your career did it happen (i.e. college, student teaching)? How did you know it was a good teaching experience (PS, PA,)? Had you seen the lesson/experience modeled by a different person (VE)? Did you get the idea from someone else for the lesson (VE, VP)? Did you receive any feedback that confirmed to you it was a good lesson/experience (VP)? What/Who do you think made the experience possible? How do you think it can be replicated?</p>

In addition, it was important to investigate the effect of professional development, workshops, or conferences on teachers' efficacy beliefs and the manner in which efficacy

beliefs are formed. In other words, through which hypothesized sources of efficacy do current elementary teachers form their efficacy beliefs? The questions included in this protocol were intended to bring out important experiences of the participants from different points in time in the development of self-efficacy beliefs in mathematics and mathematics teaching so as to cover the phenomenon thoroughly.

In particular, the two remaining questions were aimed at finding out when in the educational experience the participants found or felt a high sense of efficacy towards math teaching and if there were particular experiences in college or professional development that contributed to the high sense of efficacy identified through the MMTSES. The questions led the participants to focus on their college courses, their teacher preparation programs, and their early experiences with teaching in the classroom or as student teachers. Efficacy beliefs are affected the most at the beginning stages of learning (Bandura, 1977). Therefore, the first few years of teacher development are crucial to the development of teacher efficacy (Hoy, 2000). Multiple studies indicate that mathematics methods courses and student teaching have an impact on the mathematics teaching efficacy beliefs of preservice elementary teachers (Cakiroglu, 2000; Huinker & Madison, 1997; Swars, Hart, Smith, Smith, & Tolar, 2007; Utley, Moseley, & Bryant, 2005). The two remaining questions aimed to discover the effect of these two experiences on mathematics self-efficacy and mathematics teaching self-efficacy.

A set of questions on the interview protocol were used to gather demographic information as well as teaching experience and college academic experience in the area of mathematics. The number of college courses a participant has taken in college can be of

importance as efficacy beliefs and sources of efficacy are analyzed. This information was critical to establish a point of comparison for each participant. These questions were sometimes asked first to some participants, while for others, these questions were asked at the end.

Data Analysis

Interviews were recorded and transcribed to ensure all the stories of each participant were accurately recalled. Each interview participant was provided with a copy of the transcript and was given the opportunity to edit any of the content to ensure the accuracy of the statements given at each interview. The transcripts were utilized to code the participants' responses and identify salient themes.

As noted earlier, according to Bandura (1977, 1986), an individual forms efficacy beliefs based on four modes of information: Performance accomplishments (mastery experiences), vicarious experiences, social persuasion, and physiological states. Structural Coding was utilized to categorize participant's responses in these four categories. Structural coding is an appropriate method of coding for this study because it "...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" (Macqueen, McLellan-Lemal, Bartholow, & Milstein, 2008, p. 124, as quoted on Saldana, 2009). This method of coding is useful because it allows the researcher to use it at a basic level as a categorization technique or for quantitative analysis of the participants' responses. I used a table similar to the tables described above to tally each source of efficacy as it came up in the interviews.

The four sources of efficacy were used as categories to do a first cycle of coding. For example, "social persuasions" was one of the categories for the initial coding of the interview transcripts. A person receives social persuasion, encouragement or discouragement about his/her performance on a task, and that feedback strengthens the person's efficacy beliefs or decreases them. Social persuasion was mentioned by interviewees as a source of math self-efficacy beliefs frequently during the interview. Performance accomplishments, experiencing success at a task, is another source of efficacy beliefs. The existing research indicates that performance accomplishments or mastery experiences are the strongest source of self-efficacy beliefs. Vicarious experiences and physiological states are the other two theorized sources of efficacy, which may be mentioned by the participants as sources of efficacy beliefs. Participants' responses were coded, and their responses categorized into the four sources of efficacy.

Structural coding was used to do basic qualitative analysis and its use was expanded to quantitative analysis of the results. In the present study, the participant responses were analyzed for frequency of responses, and the data was used to determine which of the four sources interviewees recognized as the strongest contributor to their efficacy beliefs. I used a table similar to the tables described above to tally each source of efficacy as it came up in the interviews.

In addition, each category was coded further to determine, in a more specific manner, the source of efficacy beliefs. For example, a participant who received positive feedback in regards to her mathematics' ability, would be categorized as verbal

persuasion. For this study, it was important to know who the interviewees received positive feedback from (i.e. teachers, siblings, parents, peers, etc.).

It was important to determine, specifically, the “who” and “what” in regards to the sources of mathematics self-efficacy and mathematics teaching self-efficacy. The analysis of the qualitative data to determine the most influential source of efficacy as well as the experiences, college classes, professional development, and classroom teacher behaviors that contribute to the increase of self-efficacy beliefs is discussed in Chapter Four.

Positionality

I am an educator who brings into this study the experience of being a math teacher, a school administrator (vice-principal and principal), and have supervised and evaluated math teachers. I have no bias towards teachers who will be participants in this study and have no authority position within the schools where the study took place.

Limitations

This study has several limiting factors that need to be taken into consideration when attempting to make generalizations from the results. This study is limited to one rural school district in Southern California. This study only explored a limited number of teachers (N=10) who took the survey and participated in follow up interviews. The two sub questions investigated in this study involve professional development opportunities provided by district and site leadership, and the role of teacher preparation programs.

It is important to note that this study involved 10 highly efficacious individuals in mathematics and mathematics teaching. The study took place in a rural school district and

teachers may not have taken advantage of professional development opportunities offered through the county office of education, which are available to all educators at minimal expense. In addition this study took place prior to the implementation of Common Core State Standards. Highly efficacious individuals are also not as likely to attend professional development opportunities as those individuals who feel the need to improve or change their instruction. As the Common Core State Standards are being implemented, instructional shifts are necessary. Currently, school districts are investing large amount of resources in mathematics professional development to facilitate the implementation of the Common Core State Standards. It is also worth noting that eight of the 10 participants in this study attended teacher preparation programs anywhere from 11 to 30 years prior to this study taking place. Thus, the experiences of participants in this study are likely to be dramatically different from what current teacher preparation programs have to offer based on the existing research.

CHAPTER FOUR: ANALYSIS

The purpose of this study was to investigate the factors contributing to elementary school teachers' high levels of efficacy beliefs towards mathematics and mathematics teaching. In addition, this study sought to clarify the role of teacher preparation programs as well as district and site leadership in fostering high levels of mathematics and mathematics teaching efficacy beliefs. Bandura's (1977, 1986) social cognitive theory indicates that individuals who have strong efficacy beliefs in their abilities to perform particular tasks will be generally more successful in accomplishing the given task and persevere through obstacles when attempting the task. Mathematics instruction is a critical component in the educational experience of students, and having teachers with high mathematics teaching efficacy beliefs can only support the teaching and learning process.

In this chapter, I report the levels of mathematics and mathematics teaching efficacy beliefs of the ten participants who took the Mathematics and Mathematics Teaching Self Efficacy Survey and participated in the follow up interviews. The data is broken down into Mathematics Self Efficacy (MSE), Mathematics Tasks Self Efficacy (MTSE), and Mathematics Teaching Efficacy Beliefs (MTEB). Next, I report on the different factors that participants identified as contributing to their high level of mathematics efficacy beliefs, beginning with early successful mathematics learning experiences. I also report on factors contributing to participants' successful mathematics teaching experiences. The role of site and district leadership on mathematics teaching efficacy beliefs is also explained as it is viewed through the lens of the ten participants who shared their experiences through semi-structured interviews.

Participants' Efficacy Beliefs

Before delving into the factors that affected the efficacy beliefs of participants in this study, it is important to understand the level of mathematics and mathematics teaching efficacy of participants. It is also important to understand the meaning of having a high level of mathematics and mathematics teaching efficacy beliefs. Participants were identified as having a high level of efficacy beliefs in mathematics and mathematics teaching by having a high raw score in each of the components of the Mathematics and Mathematics Teaching Self Efficacy Survey. Each participant's survey was broken down into the three components of the survey: Mathematics Self Efficacy (MSE), Mathematics Tasks Self Efficacy (MTSE), and Mathematics Teaching Efficacy Beliefs (MTEB). Each component of the survey was scored using a Likert scale from strongly agree to strongly disagree. The Mathematics Teaching Efficacy Beliefs component of the survey used a 5-point Likert scale and the Mathematics and Mathematics Tasks Self Efficacy components were scored using a 6-point Likert Scale.

Table 5 provides raw scores for participants for each component of the MMTSES. Generally, items were scored with "Strongly Disagree" being a one and "Strongly Agree" being a five for positively worded items. For example, item two states, "I am continually finding better ways to teach mathematics." The scores for negatively worded items were reversed in order to reflect the appropriate scoring. For example, item three states, "Even when I try very hard, I don't teach mathematics as well as I can teach other subjects." For this item, the scoring is reversed so that "Strongly Disagree" was scored as a five and "Strongly Agree" was scored as a one. Raw scores in both MSE and MTSE scales could

range from a low of 18 to a maximum of 108, with 18 items in each scale and using a 6-point Likert scale (1= Not confident At All, 6= Completely Confident). Raw scores in the Mathematics Teaching Efficacy Beliefs Instrument could range from a low of 21 to a high of 105, with 21 items and using a 5-point Likert scale (1= Strongly Disagree, 5= Strongly Agree). It is important to note that all ten participants in this study were chosen to participate in the follow up interviews due to their high efficacy beliefs in mathematics and mathematics teaching. Twelve of the fifteen participants who returned a survey (out of 64 surveys distributed) had a high level of efficacy beliefs. This is consistent with efficacy beliefs theory. The MMTSES asked participants to assess their abilities in solving mathematics problems, do certain mathematics tasks, and teach particular mathematics concepts. Bandura (1986) indicates that individuals with low efficacy beliefs towards particular tasks will display avoidance behaviors towards those tasks. It makes sense that the majority of individuals with low mathematics and mathematics teaching efficacy beliefs would not complete a survey that asks them to assess their mathematics abilities. The lone participant who did not have a high level of efficacy beliefs left some of the items unanswered and was disqualified from further consideration for the next phase of the study. The two other participants that had high mathematics and mathematics teaching efficacy scores were disqualified due to part of their teaching assignments being at grade levels above fifth grade.

Table 5. Participants' Raw Scores on the MMTSES

Participant	1	2	3	4	5	6	7	8	9	10
MSE Score	79	90	96	105	89	103	101	96	101	102
MTSE Score	89	96	98	103	86	97	100	90	84	96
MTEB Score	82	94	79	95	87	88	80	78	91	84

Note. The maximum score on the MSE and MTSE was 108 and the MTEB was 105

Mathematics Self Efficacy and Mathematics Tasks Self Efficacy

Self-efficacy beliefs are very specific and task oriented. The general statement, “I’m good at math!” is not specific enough to rate someone as having high mathematics self-efficacy. Mathematics self-efficacy was measured by using two mathematics efficacy scales that included specific mathematics problems on numerical computations, algebra, geometry, and word problems as well as mathematics tasks. Both of these efficacy scales served to triangulate the data from the MTEB and discover any anomalies in the data. For example, a participant with a high mathematics self-efficacy score would be expected to have a high mathematics tasks raw score and vice versa. Mathematics content knowledge and high efficacy beliefs in a particular subject have an impact on an individual’s teaching efficacy beliefs (Ball, 1990b; Bush, 1989; Guskey, 1988). Therefore, the three scores served as a checks and balance for each other.

I created score intervals to rate participants as high in MSE and MTSE. The interval for low MSE and MTSE was from 18-45, the medium interval was from 45-72, and the high interval was from 73-108. The reasoning for these intervals of the raw scores was discussed in chapter 3. The Mathematics Self Efficacy raw scores for participants in this study ranged from 79 to 105. All participants scored in the high interval of mathematics self-efficacy. The Mathematics Tasks Self Efficacy raw scores ranged from 84-103, with all participants being in the high interval of mathematics tasks self-efficacy.

Mathematics Teaching Efficacy Beliefs

For this study, I created intervals of raw scores to classify low, medium, and high MTEB teachers. Raw scores ranging from 21-42 are considered low efficacy, 43-75 medium efficacy, and 76-105 high efficacy. The reasoning for these intervals in scores is discussed in chapter 3. The scores of participants in this study ranged from a low of 78 to a high of 95. All of the participants in this study are considered to be on the high end of the mathematics teaching efficacy spectrum given their overall raw scores in their mathematics teaching efficacy beliefs survey.

Beliefs are determining factors in behaviors or courses of action an individual takes. The difference in mathematics teaching efficacy beliefs of teachers may account for difference in teacher effectiveness in the mathematics classroom. This study is not about teacher effectiveness, but existing research points to a significant positive difference in teaching effectiveness for teachers with high mathematics teaching efficacy beliefs versus those with low mathematics teaching efficacy beliefs (Gibson & Dembo, 1984). The Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) portion of the survey measured teachers' efficacy beliefs in their mathematics teaching efficacy (MTE) and outcome expectancy (OE). Bandura (1977) makes a clear differentiation between efficacy beliefs and outcome expectancy. The difference between MTEB and OE can be described with the following items in the MTEBI:

“I can teach mathematics effectively” (MTEB).

“The inadequacy of a student’s mathematics background can be overcome by good teaching (OE).

The first statement speaks directly to an individual beliefs in mathematics teaching effectiveness. The response to the second statement is an assessment to the outcome of good teaching. The raw scores of the MTEB portion of the survey were impacted by participants' OE beliefs. Seven of the ten participants responded with "disagree" or "strongly disagree" to the OE item above. Three of the participants actually made notes on the margin of the survey to point out other factors that could not be overcome by good teaching such as socio-economic background, family life, and learning disabilities. It is important to note that participants received no instructions on justifying any of their survey responses. There were two other similar survey items that two participants rated as "Disagree" or "Strongly Disagree" and wrote notes on the margins.

Factors Affecting Efficacy Beliefs

The qualitative data was organized by following the primary research question and sub questions and using Bandura's (1977) efficacy theory as the framework. The four theorized sources of efficacy (mastery experiences, vicarious experiences, social persuasions, and physiological states) were utilized to categorize participants' own experiences within each theme. Theme one and two address the primary research question regarding the factors that contribute to teachers' high math efficacy beliefs. Theme three addresses the two sub questions, namely how teacher training and district leadership contribute to teachers' math teaching efficacy. The rest of this chapter provides the qualitative findings of this study as it is presented in Table 6.

Table 6. Organization of Themes and Subthemes

Factors Contributing to high mathematics efficacy beliefs.	Factors contributing to high mathematics teaching efficacy beliefs.	Role of professional development and district leadership on mathematics teaching efficacy beliefs.
Mastery Experiences <ul style="list-style-type: none"> • Competency and success Vicarious Experiences <ul style="list-style-type: none"> • Adult role models • Peers and siblings as role models Social Persuasions <ul style="list-style-type: none"> • Group association • Verbal feedback • Public recognition Physiological States <ul style="list-style-type: none"> • Fear of disappointment as motivation • Sense of belonging as motivation 	Mastery Experiences <ul style="list-style-type: none"> • Student success as an indicator of mastery Vicarious Experiences <ul style="list-style-type: none"> • Other professionals as role models • Teaching credential programs Social Persuasions <ul style="list-style-type: none"> • Peer Feedback • Student Feedback Physiological States <ul style="list-style-type: none"> • Student success as a source of positive PS 	Vicarious Experiences: <ul style="list-style-type: none"> • Modeling of teaching practices as a source of efficacy beliefs • Workshops and conferences as sources of efficacy

Factors Contributing to High Mathematics Efficacy Beliefs

This study's primary research question aimed to investigate the factors that contribute to a high level of mathematics self-efficacy and mathematics teaching self-efficacy of teaching in grades K-5th grade that participated in this study. Using the primary research question to create themes and Bandura's (1977, 1986) efficacy theory to structure the factors into the theorized sources of efficacy, data was coded and aligned with themes and areas within themes. Each of the areas within themes were identified based on participants' responses to each question. Table 7 presents the areas within each

theme and the number of times data was coded for each area. It was possible for data to be categorized in multiple areas of themes.

Table 7. Factors Contributing to High Mathematics Efficacy Beliefs Codes

Areas	Number of Codes
Mastery Experiences	
<ul style="list-style-type: none"> • Competency and Success 	14
Vicarious Experiences	
<ul style="list-style-type: none"> • Adult role models 	22
<ul style="list-style-type: none"> • Peers and siblings as role models 	15
Social Persuasions	
<ul style="list-style-type: none"> • Group association verbal feedback 	15
<ul style="list-style-type: none"> • Individual verbal feedback 	43
Physiological States	
<ul style="list-style-type: none"> • Fear of disappointment as motivation 	12
<ul style="list-style-type: none"> • Sense of belonging as motivation 	35

Mastery and Success

Bandura (1986) considered self-reflection to be the means by which people evaluate their behavior, thinking, and performance. Perceptions of self-efficacy are among the critical self-evaluations that occur through self-reflection. Using Appreciative Inquiry (AI) style questions, participants were asked to think about the earliest positive math experiences that made them feel good about their mathematics ability and to identify what made the experience possible. Participants reflected on very specific aspects of their experiences that made the experience memorable. The experiences shared ranged from

third grade in elementary school to high school. High competency and success in mathematics was identified as one of the factors influencing self-efficacy beliefs. Participants made particular statements as they described their early mathematics experiences. These codes were grouped as a theme because they were uniquely connected to mathematics performance and feelings of success as exemplified by the following quotes:

I still remember in 3rd grade being in Mrs. Shepherd's class and learning about division...and because I remember still going home and writing in my diary about "Look at what I can solve." (Participant #5)

I was like "Yeah, I can do that because I do that right all the time!" (participant #1)

I really can't think of a particular experience because I always did fairly well in mathematics. (Participant #2)

The experience described in the first quote above represents a participant's competency and success (Mastery Experiences) on a task specific task (division). Mastery experiences have a positive effect on efficacy beliefs (Bandura, 1977, 1986). Six out of the 10 participants involved in this study recalled a positive experience that involved mastery of a mathematics task. The six participants pointed out 22 different situations or experiences of success or mastery in mathematics. Each of the experiences mentioned by each participant was coded as a mastery experience or competence. The four remaining participants did not attribute their early positive experience in mathematics to mastery experiences in mathematics. The six participants who recalled mastery experiences in mathematics did not necessarily attribute all of their early positive experience in mathematics to mastery. All of the participants recalled factors that fit into one of the other theorized sources of efficacy beliefs.

One of the advantages of using semi-structured interviews is the ability to ask interviewees to expand on any of their responses and to share how experiences felt. The language used to describe positive experiences reflects the feelings created by the experience. It is important to note that mastery experiences had the most direct and vocal statements of confidence and beliefs in participants' own mathematics abilities. After being able to complete a mathematics task or solve a mathematics problem, participants reported making statements such as "I learned division" or "I do that all the time.", when referring to their math performance. Even when participants did not vocalize their feelings of success, they reported thinking positive thoughts about their experience such as "Look at what I can solve."

Vicarious Experiences

Adults, peers, and siblings as role models. Different individuals derive self-efficacy beliefs from different sources and experiences. Vicarious experiences can generate feelings of confidence in their own abilities to perform a particular and specific task (Bandura, 1977). Vicarious experiences involve seeing others perform a targeted task successfully or unsuccessfully or perceiving a positive influence towards one's own performance via the performance or experience of another individual. In this study, participants pointed out instances of positive results from their peers or positive beliefs from their peers. In academic settings, mathematics in particular, vicarious experiences means seeing others perform mathematics tasks successfully or seeing others being successful in mathematics. As participants in this study described a positive mathematics

learning experience, I recorded, coded and grouped their responses to identify what aspects of their experience involved vicarious experiences.

Participants described different vicarious experiences that connected directly to the theoretical framework of self-efficacy. Two of the participants stated the following about their early mathematics experience:

I was with the smart kids...they were kind of role models. They scored really well so I wanted to be where they were. (Participant #7)

I just remember that we were part of that group and I remember [another student] being part of that group and he was the kid who was going out of the classroom to a different math group during regular math time and now I was part of that group. So it made you feel...your self-esteem was built up. (Participant #5)

It was evident from participants' responses that seeing their peers being successful or perceiving their peers being successful in mathematics provided a level of confidence in their own mathematics ability. The desire to be around students, perceived to be successful in mathematical tasks, motivated some of the participants to work harder so that they too could be in that group. Some of the experiences shared by participants fit multiple factors in Bandura's framework. I identified codes that fit into vicarious experiences as well as social persuasions as is reported later in this chapter.

Vicarious experiences are not limited to peers or individuals within the same age group. Four participants in this study connected their desire to be good at math or pursue high achievement in math to role models outside their age group. One of the participants mentioned older college-age siblings having success in mathematics and being role models they wished to emulate. Another participant stated feeling capable of high

mathematic achievement due to having a grandfather who was an accountant. Two other participants related to good teachers who provided an example to follow and made mathematics look easy as exemplified by the following statement:

I remember I had good teachers in elementary school. They made mathematics look like easy tasks that I could accomplish. They would work on math on the board and would show me that it was easy to do. Then I would go up to the board and do it just like they did. (Participant #10)

The teachers themselves provided vicarious experiences for participants who in turn acquired beliefs in their own abilities to perform the mathematics tasks being modeled.

Social Persuasions

Efficacy beliefs towards specific tasks can be impacted by the feedback received on an individual's performance and by the level of encouragement received when attempting a specific task. According to Bandura (1977, 1986), social persuasions have the potential of increasing an individual's efficacy beliefs if they are positive in nature and promote performing the task at hand. Bandura (1977) also stated that efficacy beliefs and expectations produced by verbal persuasions are "likely to be weaker" than the efficacy beliefs that arise from one's accomplishments. Social persuasions range from words of encouragement as an individual attempts a task, to words of praise as the individual completes or attempts to complete the task.

Participants in this study were asked to recall their earliest positive experience with mathematics. Asking follow up questions as part of the interview protocol allowed the participants the opportunity to reflect on the experience and identify all factors that

contributed to the positive experience in mathematics. All participants identified different factors that were attributed to social persuasions. In the course of data analysis, I identified more codes associated with social persuasions than the codes associated with any of the other individual factors influencing efficacy beliefs. In order to better understand and dig deeper, I identified three areas within social persuasions that embodied the social persuasions experienced by participants: group recognition, individual verbal feedback, and public recognition.

Group Recognition. Some of the participants identified being praised for being with a particular group of high achievers as a reason for having positive mathematics experiences in their early years as students. The responses were coded to differentiate between the effect social persuasions had on the interviewee's efficacy beliefs and the physiological/emotional effects of being in a group. The interview format provided the opportunity to ask clarifying questions that differentiated the efficacy beliefs generated by the two factors. Two participants described their experience with being part of a group that worked on higher-level mathematics than the rest of their peers as follows:

I was part of a group that would go out of the classroom to a different math group during math time, and I remember other kids saying that we were the math nerds which at the time, it was back in third grade, it wasn't a bad thing to be considered a math nerd (laughs). (Participant #8)

I remember being in a higher math group and so we were working with her instructional aide but we were going high and above what everybody else was doing...the instructional aide would tell us what a smart group we were and how good we were in math. As a young girl I did not want to leave this group because most were boys...I really liked that we were praised for being good in math and I didn't want to disappoint my teacher or my peers. (Participant #5)

By asking clarifying questions, participants were able to point out that the comments about their high mathematics ability coming from peers and adults created positive feelings about their mathematics ability. Other participants made statements of affirmation and confidence towards their mathematics abilities such as “It made me feel like, ‘I can do this!’”, and “I got this!” as a result of their perceived new found ability and the social persuasion expressed or implied by the adults.

Group association is not discussed in Bandura’s (1977) efficacy theory. However, participants in this study identified being part of a group as having a positive effect on their educational experience and learning environment. The feelings expressed by participants regarding the positive feedback received for being part of a particular group appeared to have a significant positive effect on the participants’ efficacy beliefs towards mathematics. Statements such as, “I was with the smart kids... They scored really well so I wanted to be where they were” were indicative of the effect group association had for some of the participants. The feelings associated with being part of a group are also discussed later in the physiological states section of this chapter.

Individual Feedback. Participants’ responses were analyzed to look for words or phrases that related to social persuasions or verbal feedback. The use of Appreciative Inquiry (AI) style questions allowed the participants to focus primarily on positive experiences or feedback. I was then able to focus on identifying themes and codes that produced individual feedback as a common theme. Positive feedback received by the participants about their mathematics abilities improved their beliefs about what they

thought they could accomplish. One participant in the study recalled an exchange with her teacher about her mathematics ability:

He told me one day, ‘You should be a mathematician. You are good at math.’ I never thought I was good in math. He really did turn me around and made me think about how much fun math was. (Participant #7)

The feedback provided by the teacher made the participant change her perception about mathematics and about her own abilities in solving mathematics problems and tasks. All participants in this study received some form of individual feedback regarding their mathematics abilities or potential that added to their efficacy beliefs.

For the participants in this study, it did not matter who provided the positive feedback to participants. The common trend was receiving affirmation about their mathematics potential. The 10 participants interviewed for this study identified 48 different individuals including teachers, siblings, parents, grandparents, friends, peers, classroom instructional assistants, and even neighbors as sources of positive verbal feedback towards participants’ mathematical abilities. The confidence level of participants seemed to grow, and/or be reinforced, as a result of positive feedback.

Physiological States

Physiological states refers to the emotional arousal elicited by a situation (Bandura, 1977, 1986). Individuals can have a positive response, a negative response, or a limited response to a given situation. If a person has a fear of heights, the response to a request to cross a high hanging bridge will elicit a degree of emotional arousal that will have a negative effect in accomplishing the task of crossing the bridge. An individual’s

physiological state is another source of information that will affect a person's efforts and actions in accomplishing a task. Mathematics has been and still is the subject of fear and anxiety for some. The math anxiety experienced by some will inevitably generate avoidance behaviors towards any mathematics' tasks. On the other hand, participants in this study have high self-efficacy beliefs in their mathematics abilities. I found that participants in this study received praise, had positive role models in mathematics, and experienced success in mathematics at some point that led to a life-long positive belief in their abilities to perform mathematics tasks. Participants also experienced positive emotional arousal instead of negative arousal. This section explores the interplay of all factors impacting efficacy beliefs for the ten participants in this study as experienced in their earliest positive experience with mathematics.

The code, "physiological states" was the second most frequently used code in the analysis of the interview data from the ten participants in this study. There were 47 different words or phrases that were coded which were further divided into two separate themes: Fear of disappointment as motivation and sense of belonging as motivation. The vast majority of data (35 instances of coded data) was coded under "sense of belonging as motivation" due to the specific experiences shared by participants. All participants provided at least one piece of data that could be classified under the two themes. Some of the experiences expressed by participants could be classified as negative arousal, but further inquiry revealed that participants saw these experiences as positive sources of information.

Fear of disappointment as motivation. Bandura (1977) describes techniques to diminish emotional arousal as follows:

...Desensitization and massive exposure treatments aimed at extinguishing anxiety arousal produce some reductions in avoidance behavior. Anxiety arousal to threats is likewise diminished by modeling, and is even more thoroughly eliminated by experienced mastery achieved through participant modeling. (p. 199)

From the description above, exposing an individual to the source of their anxiety, and providing opportunities for mastery experiences has a positive effect in reducing the negative arousal that results from engaging in particular behaviors (i.e. working on mathematics). Fear and disappointment can be viewed as negative arousal towards a particular task. Three participants in this study saw fear of disappointment as a reason to put more effort and resilience towards mathematics in order to not disappoint someone in their lives. Participant # 6 points out her experience during the interview as follows:

Participant #6: I knew I wanted to please my teacher, my parents, and my brother and I would be proud of myself if I got a good grade.

Interviewer: Is there a particular reason you wanted to please your teacher, parents and brother?

Participant #6: I guess because they expected me to do well. Maybe pleasing them is not the right word. I just didn't want them to be disappointed in me.

Interviewer: In what ways would you classify or describe the feelings you had from not wanting to disappoint them?

Participant #6: Well, I was afraid of disappointing them. So it made me try harder and harder and not give up.

Participant #9 describes a similar feeling of not wanting to disappoint others whom she held in high esteem.

Participant #9: I really liked that we were praised for being good in math and I didn't want to disappoint my teacher or my peers.

Interviewer: In what ways would you classify or describe the feelings you had from not wanting to disappoint them?

Participant #9: I really can't put my finger on it, but I think it was being afraid of not being able to go with the same group to work on math.

Interviewer: In what ways did this impact your math performance, if it had any impact at all?

Participant #9: Oh it made me work harder and even practice at home with my dad or my brother.

Participant #8 shared a similar experience of not wanting to fail in math because she wanted to challenge the belief that girls are not strong in mathematics. For these three participants, the fear of failing or disappointing others due to their math performance created an increase in effort and work output in order to be successful.

Bandura's (1977, 1986) efficacy theory proposes that negative emotional arousal, which includes fear and anxiety, tends to lead to avoidance behaviors. Participants in this study were asked to remember their earliest positive experience with mathematics. Inevitably, thinking about a positive experience meant that if participants had a negative physiological state at some point in their lives when mathematics tasks were presented, that was no longer the case. These interviews do point to the power of efficacy beliefs in

overcoming negative emotional arousal. In fact, three participants used any negative emotional arousal as motivation to improve their mathematics performance.

Sense of belonging as motivation. The emotional response an individual experiences when presented with a situation is a determining factor in the effort, if any, an individual will exert to accomplish the task. Seven of the 10 participants in this study expressed physiological states that had a significant impact in their efforts towards mathematics tasks. This in turn had a significant effect in their mathematics performance. Participants were asked to think about their earliest positive experience with mathematics. All participants described mathematics experiences occurring in the elementary grades. For some, it was finally getting a problem right or attaining a higher level of math competency. I analyzed the data to look for common themes and categorized them according to the four theorized sources of efficacy (mastery experiences, vicarious experiences, social persuasions, and physiological states). Seven of the ten participants had a common theme in their experiences: Sense of belonging to a group.

Following Bandura's (1977, 1986) efficacy theory, the best fit for the sense of belonging pieces of data was physiological states. Sense of belonging in this study refers to participants' emotional states towards being in a specific group. The group associated with the sense of belonging refers to students who were successful in mathematics or were considered to be high achievers in mathematics. Once participants were part of such a group, the desire to continue to be a part of the group motivated participants to exert more effort towards mathematics tasks in order to continue to be a part of the group. This is not

to say that there is a cause and effect relationship, but the level of motivation to do well in mathematics and the effort exerted was increased. This is consistent with efficacy theory.

Physiological states influenced by verbal persuasions. Participant #7 shared a powerful experience that shows the relationship between these factors and how one influences the other.

He told me one day, “You should be a mathematician. You are good at math.” I never thought I was good in math. He really did turn me around and made me think about how much fun math was. (Participant #7)

In essence, the social persuasion received by participant #7 generated feelings of efficacy towards mathematics. This statement also communicates a complete shift in thinking about mathematical ability and emotional response to mathematics. The existing literature points to individuals that express math fears and anxiety (Burns, 1998; Paulos, 1988).

Participant #7 directly expresses a shift in any negative feelings from “I never thought I was good in math” to “He really did turn me around and made me think about how much fun math was.” In an effort to find the true source of this participant’s newfound efficacy beliefs in mathematics, I further questioned this participant regarding math performance. She did not mention mastery experiences as the reason for her shift in mathematics efficacy beliefs. The manner in which the teacher approached mathematics instruction made mathematics seem fun. The way the teacher made the student feel about her mathematics ability had a positive effect. When positive verbal persuasions were part of the interactions, this participant felt a level of confidence in her abilities that overcame any negative beliefs or feelings towards mathematics. This clearly supports efficacy theory

and supports the theory that physiological states are a major source of information when it comes to an individual's efficacy beliefs (Bandura, 1986).

Summary of Factors Affecting Efficacy Beliefs

Participants in this study were able to recall vivid stories of early success in mathematics. Some of these individuals' positive mathematics learning experiences occurred close to 50 years prior to the time the interview took place. The experiences were powerful enough for participants to still remember the situation, the people involved, the context, and the outcome of their experiences. In fact, all participants were able to describe how they felt at the time they lived the experience and could make statements such as, "It (math) didn't scare me," "I didn't want to lose my spot in the group," and "I got to go out with the smart kids." Even when participants pointed out to experiences that were threatening, the outcome was that of perseverance. The role of the adults in the experiences and the power of the relationships built between the participants their teachers, siblings, extended family members, and classmates played an important, if not vital, role in the development of efficacy beliefs of participants. The implications of replicating the conditions for some of the experiences lived by participants in this study is discussed in chapter five.

Factors Contributing to High Mathematics Teaching Efficacy Beliefs

This study also aimed to investigate the factors that led to participants' high levels of mathematics teaching efficacy beliefs. Mathematics teaching efficacy beliefs can make a difference in the manner in which teachers approach their practice, in particular their

teaching methods and strategies used (Allinder, 1994; Bates, Kim, & Latham, 2011), and even the effort invested in planning instruction (Ashton & Webb, 1986). As with all other efficacy beliefs, the level of mathematics teaching efficacy beliefs are measured by the individual's beliefs in teaching a particular subject and particular skills within a subject. In addition, teaching efficacy includes the beliefs that teaching has an impact in the learning outcomes of students. All participants in this study received a high raw score in mathematics teaching efficacy beliefs. In this section, I describe the factors that contributed to the high levels of mathematics teaching efficacy of the ten participants in this study.

Content knowledge and competency is important in the exchange of information that occurs through the teaching and learning process. All participants in this study made statements about their comfort with the mathematics content taught at the elementary grades. Eight of the 10 participants made very specific statements such as "I've always been good at math", "Math was always my favorite subject in school", and "It (math) came easy to me in the lower grades." This impacted their mathematics teaching efficacy beliefs, but there were other factors that also had an effect on mathematics teaching efficacy beliefs. These factors included students' success, peer role models, peer persuasions, and student persuasions. These factors are explored further in this section.

Mastery Experiences

Student success. Using Bandura's (1977) efficacy framework, participant's experiences were coded and assigned to particular areas that fit with efficacy theory. Mastery experiences have the biggest impact on efficacy beliefs. Measuring teaching

efficacy and designating a teaching experience as a mastery experience is difficult because it is subject to interpretation as to what effective is in the classroom. Participants in this study equated a mastery experience of teaching mathematics to the level of student success experienced by their students. Student success can be interpreted as a level of performance or mastery of a subject. It can also be interpreted as an experience of success on a specific task, on any given situation. The degree of success, or what was deemed as student success, by participants varied. However, a common measure used by eight of the 10 participants was student success as experienced and stated by their students.

Participants in this study were asked to think back to a positive experience or lesson teaching mathematics. They were asked follow up questions to dig deeper as to what made the experience possible, what part of the experience made the participant feel good about their teaching ability, and at what point in their teaching career this particular experience occurred. All participants were able to think back to a positive teaching experience at some point in their careers. Some of the experiences shared went back to teachers' student teaching, while others had very recent experiences. Participant #4 described an early experience teaching mathematics as follows:

When I was student teaching and I was deciding if I was going to be a teacher or not, I was teaching a little group in South East County. My master teacher gave me a group of kids to take to the gym with a white board to teach them multi digit multiplication. They were fourth graders. So I was teaching them the steps she had taught them. They had a little chant to do it. And we were going through the directions and carrying and borrowing and where to puts the digits and everything. And this one little boy he says "I get it. It's like fireworks. We are shooting fireworks. I understand now." The look on his face and how excited he was that he actually understood the concept, and then we came to the classroom and he yelled to all the kids that he understood. But I just remember being so

excited that he got it. That I had gotten through to somebody. He had been considered an intervention kid, someone who was below grade level.
(Participant #4)

The fact that a single student showed a high degree of success made a lasting impact on this participant. After this experience, this participant's efficacy beliefs towards mathematics teaching were enhanced and her beliefs that she could teach students were reinforced. Her decision to go into the teaching profession was heavily influenced by the experience described above. Her perception that her teaching had helped a student, who was previously considered a low achiever, was certainly a determining factor that affected her mathematics teaching efficacy beliefs.

Other participants cited slightly different experiences that made them feel a strong sense of ability to teach mathematics. One participant cited her ability to work with kids and allow them to experiment with mathematics. Another participant cited her ability to back up her instruction to the point where students were struggling, and helping him or her move forward from that point. Upon asking directly what part of the experience made them feel that they possessed the skills to teach mathematics, both of these participants referred back to their students' success. When students grasped a concept, understood the steps, or were able to successfully complete the math problem, teachers felt a sense of accomplishment. When asked further what they would equate this sense of accomplishment with, participants indicated that this provided them with confidence in their abilities to teach other students. This, in itself, is what mathematics teaching efficacy beliefs are defined as in the existing research.

Vicarious Experiences

Peer role models. Vicarious experiences, which in this case refers to seeing other teachers successfully teach mathematics, was a major factor in the efficacy beliefs of participants in this study. This piece of data did not come from the original interview question asking teachers to point out any teaching experiences with mathematics, but it came from the part of the interview asking teachers to identify any supports provided by the district office or district leadership. Six of the ten participants pointed out to a former high school mathematics teacher who was served as a teacher-coach for elementary teachers in the district. The following quote from one of the participants represents the vicarious experiences of all six participants who mentioned this individual teacher.

I still remember when I was new, they had this teacher. I think he was a high school teacher. He would come in and present lessons. He came in with different examples and different ways to look at the problem. I still remember he taught this lesson about area. He brought the little tiles, he gave the example of the pool. (Participant #2)

We could tell him, we are having trouble with this concept and he would put together a lesson. The kids loved it. He would put all the notes together and it was very valuable to us. (Participant #10)

A teacher, he would come around to our classrooms and like teach us new math, and he would have all these things that we would do in class and really intrigued us all teachers to get really excited to about math. That was the best experience I've ever had. It was really inspiring! You can ask anyone! (Participant #1)

But when I first started teaching, our district had a district math specialist. He would come in and do a model a math lesson. He used to be my algebra teacher in high school. I just enjoyed watching him and build algebraic thinking with my students and I took a lot away from that experience and have embedded that in my own teaching. It provided me an example to follow. (Participant #5)

These vicarious experiences for teachers impacted their own efficacy beliefs. The experience of seeing someone else create success with their own students helped develop their beliefs of being able to teach mathematics themselves.

The quotes above are from four participants in this study, but they could have been from all six participants who mentioned the same individual, who had a very similar effect on their development as teachers. It is important to point out that the six participants also emphasized the experiences the students had while participating in the lessons with the teacher-coach. Statements such as “The kids loved the activities” and “The kids really seemed to get it” are consistent with the connection between student success and teaching mastery experiences that participants made when assessing their own mastery experiences in teaching mathematics.

Three participants pointed out peer role models that influenced their efficacy beliefs in mathematics teaching. The role model experiences were not necessarily of observing others teaching mathematics effectively, but there were other aspects of the role models that affected the efficacy beliefs of participants. One of the participants pointed out to her mother being a teacher for 40 years and having memories of her mother being energetic with her students. This provided her with a model to follow as a teacher. Another participant attributed vicarious experiences to her community college professor who she held as a great educator and an example to follow. The third participant in this group identified teachers she worked with that utilized multiple strategies to reach students, planned lessons together, and observed each other. The enthusiasm of her

colleagues produced in this participant the feeling that she could be just as effective about her teaching.

Social Persuasions

Peer Persuasions. Positive feedback about one's performance has an effect on efficacy beliefs. Two participants in this study reported an increase in motivation and feelings of competency as a result of feedback received from their peers (other teachers) regarding their mathematics teaching of a particular concept. A participant in this study reported during the interview that her colleagues were not comfortable with teaching a specific mathematics concept: Slope. She reported her colleagues making statements such as, "You will teach slope." According to this participant, the reason for colleagues asking her to teach "slope" was due to the perception that she was comfortable and competent with teaching slope. This is consistent with Bandura's (1977, 1986) efficacy theory which indicates that social persuasions have an impact on the efficacy beliefs of individuals being able to perform specific tasks. In this case, it was this individual's ability to teach "slope" that was enhanced by her colleagues' persuasions.

Another participant proudly pointed out that other teachers would come to her and ask for advice on teaching statistics.

Sometimes people ask me when it comes to statistics, people will come up to me and ask how I teach these topics. New teachers coming on would come and have never done stem-and-leaf plots, they come and ask me how I teach these. (Participant #1)

The fact that other teachers sought this participant for advice increased her beliefs in her ability to teach statistics effectively. This participant did not mention any student outcomes to indicate that she was effective in teaching statistics. The feedback received from her colleagues was enough to have an effect on her beliefs.

Student persuasions. Another factor that affected teachers' mathematics teaching efficacy beliefs was students' verbal persuasions. Students making positive comments about the effectiveness of their teachers had a significant impact on participants' efficacy beliefs towards mathematics teaching. Student persuasions either generated positive beliefs in participants or served as an affirmation of their already perceived mathematics teaching efficacy beliefs. Three participants expressed the feedback received from students as a measure of their mathematics teaching abilities. Participants cited students' statements such as, "The kids sometimes tell me I'm a good math teacher" or "Students tell me they hope I can be their teacher next year." One participant noted one of her previous students coming back and saying how much he missed her because she made math fun and not so difficult.

All three of these participants followed the statements above with one of more comments of reflection about the effect of students' statements. One of the participants stated the following:

When students tell me I'm a good math teacher, it tells me that I am doing things right in the classroom. It means that math is making sense to them because of how I teach them. It makes me prepare my lessons keeping in mind the kids that will learn more or think that they can do math because of how I teach. (Participant #9)

This participant's statement exemplifies Bandura's (1977, 1986) efficacy theory on the effect of verbal persuasions. If students do not make comments on this teacher's mathematics teaching performance, efficacy beliefs are not strengthened. In fact, if no positive persuasion occurs and this particular teacher has a negative teaching experience, it is likely that this individual's efficacy beliefs towards mathematics teaching will decrease. According to Bandura (1977), the opposite effect can occur with positive verbal persuasions. A negative experience will not necessarily decrease a person's efficacy beliefs in their teaching ability if they have received feedback that their teaching is effective. For participants in this study, feedback received from their students was particularly powerful.

Physiological States

Perceived student success as a source of positive physiological states. The emotional state of a teacher towards teaching a particular subject is critical in the elementary classroom. Research conducted with pre-service elementary school teachers indicates that in some instances, half of elementary teaching candidates are either afraid of mathematics or dislike mathematics (Ball, 1990a; Cornell, 1990). Teaching mathematics when there is a negative physiological state towards mathematics is bound to be ineffective. This study aimed to find any factors that created a positive physiological state towards mathematics. Participants' in this study described different positive experiences in mathematics and mathematics teaching. One factor, which all participants pointed to as significant in their teaching experiences, was physiological states produced as a result of students' positive experiences. The positive emotions expressed by students, and student

success as perceived by participants, served as an emotional catalyst for participants to teach mathematics in ways that could continue to produce the same result in their students.

Having a positive physiological state towards a task provides individuals with an increased level of resilience towards performing the task. Participants were asked to describe a positive teaching experience they had, and what part of the experience made them feel good about their mathematics teaching ability. For the last part question, teachers made statements such as “It’s really exciting to see the light bulbs go off.”, “I think when the kids get it, they get excited.”, and “I just remember being so excited that he got it. That I had gotten through to somebody.” Some of these experiences were classified as mastery experiences for participants, but it is clear that the interview question, “What part of the experience made you feel good about your mathematics teaching ability?” brought out the physiological states as a factor in mathematics teaching efficacy beliefs. In fact, three participants made the following statements when asked the question above:

I knew that it was good because I could go back to the classroom and get kids excited about learning. (Participant #1)

When I can figure out that specific way in which they finally get it. When you can back it up, lower the level, do something that can bring them forward and they finally get it. (Participant #10)

I use manipulatives to build more positive experiences where students feel successful. It gives you a sense of satisfaction to see students being successful. (Participant #5)

Students’ positive experiences are a focus for these participants and creating more of these experiences is a driving force behind their efforts and lesson planning.

Role of Professional Development and District Leadership on Mathematics Teaching Efficacy Beliefs

Participants in this study had varying degrees of experience, but of the ten participants, only one had been in the district two years or less. All other participants had a minimum of six years of experience with the district. This fact provided more validity to the experiences these educators had in this district, as it related to the role of professional development and district leadership on mathematics teaching efficacy beliefs of these educators. The experiences of nine out of the ten participants seemed to indicate that the focus of any professional development was directed at literacy and school wide reading targets. Since this district had a component of bilingual education, part of the focus was on instruction supporting bilingual education. Mathematics instruction appeared to take second place to reading in the hierarchy of needs of the schools in the district. This was reflected by the professional development provided at the district and site level.

Participants recalled examples of recent professional development opportunities they were provided that could be tied to mathematics, but they were not necessarily addressing instructional strategies, opportunities for vicarious experiences, nor opportunities for mastery experiences. In fact, one participant indicated she couldn't remember any, another responded with "Pass!" and three more couldn't recall any mathematics teaching related opportunities. Five of the participants did mention being involved in math competitions and being provided some guidance on how to implement the program and train their students. Of the eight participants who had been in the district for 11 years or more, six recalled attending mathematics related workshops and

conferences that provided experiences, which affected their efficacy beliefs. Eight of the ten participants provided feedback on modeling of teaching practices as a major factor affecting their mathematics teaching efficacy beliefs.

Professional development opportunities were of value to those individuals who recalled having the opportunity to attend in previous years. Participants in this study were specifically asked about any professional development opportunities provided by their site or district leadership. The county office of education associated with this school district has a department dedicated to providing professional development in mathematics. It is not known if participants in this study participated in professional development opportunities provided by the county because they were not asked specifically about county professional development participation. Participants in this study were 10 highly efficacious individuals. As noted earlier, it is reasonable to assume that highly efficacious individuals would not attend professional development opportunities that can be perceived as “training” for new teachers. The rural location of the school district where this study took place may also add to the lack of access, if any, to county level professional development opportunities.

Workshops and Conferences Affecting Efficacy Beliefs

Despite not having attended workshops or conferences in the previous six to eight years, participants pointed out multiple beneficial outcomes from attending workshops. For three participants, it was watching presentations by presenters who were teachers. The ideas shared by fellow colleagues during workshops made them applicable to their classrooms and their students. One participant explained her experience as follows:

The ones that were useful when I attended, it involved having the presenter demonstrate the lesson, hands on stuff, explain the good ideas. I would go and ask questions, and I would have a copy of it to take home and I knew it could be done by the time I came back to the classroom. The presenter provided the examples of how to use the materials and how it worked in the classroom. (Participant #3)

Using Bandura's (1977, 1986) efficacy theory, I classified this experience as a vicarious experience and verbal persuasion. A successful implementation by a peer provides an individual with beliefs that he or she can accomplish the same task. Participants repeatedly expressed similar feelings when describing workshops or conferences.

Being able to attend workshops and conferences did appear to have an effect on participants. The factors affecting efficacy beliefs experienced by teachers were aligned with vicarious experiences and verbal persuasions. Vicarious experiences seemed to be the more powerful of the two factors when it came to professional development opportunities or workshops attended. As it turns out, participants did not have to go to conferences or a workshop to live vicariously through another individual's teaching experiences.

District and Site Leadership

Participants were asked to describe any professional development opportunities offered by the school site leadership or district leadership. All participants provided at least one vicarious experience that affected their teaching practices and efficacy beliefs. Some of the experiences occurred at workshops or conferences. Out of the eight participants that had been employed by the district for 10 or more years, six pointed out to vicarious experiences provided by the district's math specialist. He was a former mathematics high school teacher, previously discussed in this chapter, who was assigned

to be the district's mathematics specialist. In the estimation of participants, he provided the most helpful experiences that made teaching mathematics concepts an accomplishable task.

The semi-structured interviews allowed me the opportunity to ask follow up questions as participants recalled some of their experiences. The following is a recollection of participant #10 and her experience with the mathematics specialist.

- Interviewer:** What experiences have you been provided with by site and district leadership to develop your mathematics teaching skills?
- Participant #10:** We use to have a lot more workshops or be able to go to workshops and conferences, but I haven't been to one in a long time, 5-6 years.
- Interviewer:** What about professional development within the district or your own school site?
- Participant #10:** Oh I remember a high school math teacher that I think the district put him on special assignment, kind of like a [Teacher on Assignment] TOA. He became the district's math specialist. He would come in and do some math workshops that I still remember because they kind of got you excited about teaching math.
- Interviewer:** Were these workshops for teachers, professional development at your site or working individually with teachers?
- Participant #10:** Well, I remember we would have workshops for teachers in the district, sometimes at our own school site. But we could also contact him and ask him for help on any lessons we were working on and he would work one on one with you.
- Interviewer:** From what I am hearing you say, this was a very valuable support for you. What part of the experience was the most valuable to you?

- Participant #10:** I would have to say that the lessons he prepared for my class and actually came and taught the lesson. We would give him a concept that our students were having trouble with. He would prepare the lesson, bring materials, tiles, etc. and teach the lesson for my class.
- Interviewer:** Why was this valuable for you?
- Participant #10:** This was so valuable because it showed me that the lessons worked, and they worked on my students, and I could put together lessons like that. I guess it showed me that my students could learn if I could put some pieces in place and make it, meaningful. That's it! He made the lesson meaningful to the kids because I remember he had the students build things that were connected to the math. It made it make sense to the kids.
- Interviewer:** In what ways did this affect your mathematics teaching?
- Participant #10:** It gave me tools, but I think it gave me the feeling that I too could teach the math lessons and that my students could learn from me.

The support and modeling of lessons that participants experienced, considered vicarious experiences by Bandura's (1977, 1986) efficacy theory, was by far the most powerful experience any of the participants cited. Mathematics teaching efficacy beliefs generated by this experience cannot be quantified, but efficacy theory and the reported influence of the experience by participants is very indicative of the effect it had.

The example above was one of six experiences expressed by participants about the same individual and similar outcomes. Not all participants had as strong of an experience as participant #10, but all six participants who recalled the math specialist were affected by the experiences in a positive manner. The math specialist in the district provided this

level of support for three to four years. Participants had to request the support from the math specialist in order for them to receive the individual support. All participants received some level of support from the math specialist either in the classroom or as a small group. The need for more opportunities for teachers to work with experts in the field is further discussed in Chapter 5.

Professional development in mathematics at Bella Unified School District was not as prevalent at the time this study took place. This study took place over two years ago. The implementation of Common Core State Standards was in its infancy. Since then, Bella Unified School District has invested heavily in mathematics professional development towards the implementation of the Standards for Mathematical Practice.

Role of Teacher Preparation Programs

Participants were asked to describe their experiences as it pertained to the teacher credential program they completed as pre-service teachers. It is important to note that the majority of participants in this study are experienced teachers who completed a teacher credential program between eleven and 30 years prior to participating in this study. Teacher preparation programs have changed considerably since that time and continue change even more with the implementation of the Common Core State Standards. The experiences of participants in this study do not necessarily represent what is currently experienced in teacher preparation programs. The intent of this part of the interview was to gather information on any factors that influenced participants' efficacy beliefs as a result of the teacher preparation program. As participants responded, I asked follow up questions to clarify if their experiences involved any of the theorized sources of efficacy.

Two primary themes aroused from this portion of the interview connected to vicarious experiences and mastery experiences.

Vicarious experiences. Participants reported that vicarious experiences, provided as part of the credential program, had an effect on their mathematics teaching efficacy beliefs. Two participants credited professors in their credential program with being role models and showing them strategies and techniques that were very valuable in their development as mathematics teachers. One participant described her experience as follows:

One of my professors, she would go, “If they’re lost on this here’s how you can approach it. If they get it already, here is how you can extend it.”
(Participant #4)

Modeling instruction for this participant provided her with the belief that she could be effective in helping students. Another participant credited her credential professor with providing her strategies that worked and made mathematics “not so complicated for kids.” It is clear that role models at the credential program level can have a lasting impact on pre-service teachers’ mathematics teaching efficacy beliefs.

Additional participants had more vicarious experiences as part of their credential program. One participant credited her master teacher with modeling for her the use of Cornell notes. She also learned from her how to get students to use them as a study tool. Two participants credit their credential program with providing them the skills to build their hands-on mathematics binders that they still use for instruction.

Mastery experience. One participant indicated that her student teaching provided her with strong beliefs about her abilities to teach mathematics. The fact that her credential program required her to do her lesson plans and put them to use in the classroom forced her to put the time and effort into making the best lessons possible. The experience was classified as a mastery experience due to the following statement made by this participant.

We had to do our lessons and then put them to use in the classroom. I know it would work in the classroom because we had to do it in our student teaching. I knew it already worked with real life kids. (Participant #4)

There were additional findings regarding the emphasis of credential programs completed by participants as well as the lack of mathematics methods courses. Six participants reported having only one mathematics methods courses, one had four methods courses, and one had none. One participant did not recall having methods courses, but her credential program had been long ago that it is possible she just could not remember. Eight of the ten participants reported that the emphasis of the credential program they completed was around reading and writing. Mathematics was limited in the number of methods courses and the overall emphasis of the program. Only two of the participants reported having a binder with materials related to mathematics instruction.

As previously mentioned, the majority of participants in this study are experienced teachers who completed teaching credential programs that do not necessarily reflect the programs currently experienced by preservice teachers. With the implementation of the new Common Core State Standards, mathematics instruction will experience changes and teaching candidates will be the first to experience this change through teacher preparation programs. It is important to note that teacher preparation programs, experienced by

participants in this study, provided them with vicarious experiences, mastery experiences, and social persuasions that factored in the formation of their mathematics teaching efficacy beliefs.

Summary and Conclusion

In this chapter, I reported the findings from this study that employed the use of a survey and semi structured interviews. I gave a brief summary of the results of the survey and the purpose for administering the survey. All ten participants in this study scored high in mathematics efficacy and mathematics teaching efficacy on the administered survey. I provided a detailed analysis of participants' responses during semi structured interviews and how participants' experiences relate to existing efficacy theory. Factors influencing mathematics and mathematics teaching efficacy beliefs were identified.

By examining participants' early experiences in mathematics, common factors affecting participants' mathematics efficacy beliefs emerged. Efficacy theory points to mastery experiences as the strongest of all sources of efficacy. For participants in this study, social persuasions and physiological states were some of the primary and most important factors influencing their efforts and beliefs towards mathematics. Social persuasions, which includes verbal feedback from peers and adults was the most significant factor driving individuals in their early mathematics experiences. Emotional states, which included fear of disappointing others and sense of belonging as motivation to work harder and excel in mathematics, provided participants with the drive to succeed in mathematics. Participants used fear and pressure to perform well in mathematics as a motivation instead. Efficacy theory indicates that fear is a driving force in preventing

individuals from attempting a task. Fear had the opposite effect on participants in this study.

Role models were also critical factors in the development of efficacy beliefs of participants. These role models included siblings, peers, parents, teachers, and grandparents. Teachers had the biggest impact on the development of efficacy beliefs because they served multiple roles. Teachers provided students with vicarious experiences, an example of how to solve math problems, how easy mathematics could be, and in most instances a person to emulate. They also provided students with verbal feedback on their mathematics performance (overwhelmingly positive), encouragement, and a safe environment where students' emotional states were conducive to learning.

Factors affecting mathematics teaching efficacy beliefs were associated with student success, peer role models, peer persuasions, and student verbal persuasions. The strongest factors cited by participants were student success, and peer role models. Student success provided participants with a desire to find ways to make mathematics meaningful to students and make it fun. As students made statements of affirmation about their learning, participants felt competent and inclined to spend more time and energy on improving their teaching practices. A math specialist who was available to teachers in the district provided the most powerful peer role model experience. Modeling a lesson for teachers with their own students proved to be impactful and increased participants' feelings of efficacy towards their own teaching abilities, skills, and state of mind towards mathematics instruction. Teacher preparation programs had a significant effect on six of the participants. Vicarious experiences provided by different individuals associated with a

teacher credential program allowed participants to make positive conclusions about their own mathematics teaching performance.

CHAPTER FIVE: CONCLUSION

Summary of Findings

In my experience as a middle and high school mathematics teacher, students came into the classroom with different set of beliefs about their mathematics abilities. Some came in with a distaste or “hate” for mathematics and with a predetermined and self-fulfilling belief that they were not good in math and would likely fail my math class. On the other hand, there are individuals that grow up and acquire a set of positive beliefs in their abilities to accomplish mathematics tasks. Bandura (1977, 1986) describes these sets of beliefs as efficacy beliefs. This study investigated the factors that influence a high level of mathematics and mathematics teaching efficacy beliefs in 10 elementary school teachers as measured by the Mathematics and Mathematics Teaching Efficacy Beliefs Survey (MMTEBS).

I distributed the MMTEBS to a group of 64 elementary (K-5th grade) teachers in the Bella Unified School District in Southern California. Ten participants were identified as having a high level of efficacy beliefs in mathematics and mathematics teaching. They were selected to participate in the second phase of the study. Semi structured interviews were conducted with the ten participants by using an Appreciative Inquiry style questionnaire. The questions aimed to discover the factors that led to participant’s high efficacy beliefs in mathematics and mathematics teaching. Participants responses were structurally coded to align with Bandura’s (1977, 1986) four theorized sources of efficacy beliefs: Mastery Experiences, Vicarious Experiences, Social Persuasions, and Physiological States.

Bandura's (1977, 1986) social cognitive theory suggests that mastery experiences are the most influential experiences in the formation of an individual's efficacy beliefs. This means that if you successfully complete a task (have a mastery experience), you are more likely to attempt the task again, spend more effort at the task, and persevere at completing the task (increase in efficacy beliefs). Using structural coding and categorizing experiences from participants' responses, salient themes were identified. All four theorized sources of efficacy beliefs were identified by participants as having some effect on their efficacy beliefs. However, vicarious experiences, social persuasions, and physiological states were the most significant factors identified by participants in the formation of their efficacy beliefs. Mastery experiences were important, but some participants acknowledged not focusing on getting the right answer when solving a math problem or working on a math task. The most critical part was working hard and meeting the expectations of those they considered role models.

Vicarious Experiences

Vicarious experiences refer to seeing someone else performing a task and formulating the belief that one can also accomplish the task. It also refers to having a role model, someone who sets the example and, for this study, performs the mathematics tasks. Participants identified 22 adult role models and 15 peers or siblings that served as role models. For adult role models, sometimes it meant seeing someone who was good at using mathematics in their employment or performed tasks requiring mathematics. One participant referred to her grandfather who was an accountant, another referred to her mother who was a teacher. Most participants also recalled a teacher they had in their early

years. Teachers were acknowledged for making math seem easy, fun, and non-threatening. Teachers had a double and at times triple effect on participants' early mathematics experiences. Not only did they serve as role models, but teachers also provided students with social persuasions and affected participants' physiological states in the process.

Peer role models were also critical factors in the formation of participants' efficacy beliefs. At times, same age peers provided participants with the belief that they too could be successful if they observed their peers accomplish particular math tasks. Peer role models also provided participants with motivation to be around them. This meant that participants would exert additional effort to ensure they had the opportunity to go with the particular group of kids who were successful in mathematics. Being in the same group meant being recognized as part of the "smart group" or the "advanced group" for math instruction time. Two participants mentioned specific students in their classroom that served as role models. The vicarious experiences provided by their peers were incredibly valuable to participants as they recalled their best mathematics learning experiences. All participants recalled a learning experience during their elementary school years.

Social Persuasions

Encouraging words or actions from others about one's abilities to perform a task has a positive effect in the formation of efficacy beliefs. When the person delivering the social persuasion is someone of trust, the effect of social persuasion was very effective for all participants in this study. Participants reported feeling empowered and encouraged when given positive feedback about their effort and performance. The result was an improved mathematics performance and a better disposition towards mathematics tasks.

Teachers were credited with delivering the majority of social persuasions to participants. Most of the social persuasions were verbal, but they did not have to be. Participants recalled the groupings teachers made as a persuasion that they could go to a higher level of math. At times being chosen as a group leader or a tutor persuaded participants to increase the amount of effort and work put into learning mathematics.

Physiological States

Participants were very vivid in their descriptions of their earliest positive mathematics experiences. All participants' shared how their experiences made them feel about themselves and their mathematics ability. Physiological states, when negative, can prevent a person from accomplishing or even attempting a task. When the emotional state of a participant is positive, the amount of effort increases, the disposition to attempt the task improves, and the task is more likely to be accomplished. Participants reported that the positive feelings, created by adults, were a major factor in their beliefs towards mathematics. In fact, as discussed in chapter 4, a participant credited her teacher with changing her thinking about her mathematics ability completely. When her teacher told her she should be a mathematician, this participant had a paradigm shift. She never thought she was good at math. Due to the social persuasion of her teacher, her physiological state shifted completely. Suddenly, she reported feeling efficacious towards mathematics. Her effort, work, and beliefs towards mathematics were changed from that point on.

Contributions to Theory and Prior Research

Bandura (1986) theorized that performance accomplishments provide the strongest predictors of efficacy beliefs. Additional existing research suggests that perceived performance accomplishments, or perception of one's level of mastery, are good predictors of self-efficacy beliefs (Lopez, Lent, Brown, & Gore, 1997). This study similarly found mathematics teaching efficacy beliefs to be strongly influenced by participants' perceived mastery experiences in teaching mathematics. An interesting point in this study is that participants equated mathematics teaching mastery experiences with students' perception of mastery. This means that if students found success in learning the concepts, participants equated that success with their own mathematics teaching success. This resulted in increased mathematics teaching efficacy beliefs.

In the existing research, vicarious experiences are investigated by using items on survey instruments that deal with exposure to role models, parents, peers, or friends that demonstrate a high level of competence in the subject, class, or topic of interest (Klassen, 2004; Lent, Lopez, Brown, & Gore, 1996). This research study employed different methodology that allowed participants to describe their experiences by using Appreciative Inquiry style questions during semi-structured interviews. Participants were able to describe the experiences using their own words. By using these methods, I was able to explore at a deeper level how they felt and the effect vicarious experiences had on their mathematics and mathematics teaching efficacy beliefs. Participants in this study credited vicarious experiences as the most influential factor in the formation of their mathematics teaching efficacy beliefs.

This study provided new insights on factors increasing mathematics efficacy beliefs. Mastery was not necessarily the most influential factor on mathematics efficacy beliefs for participants. Mathematics efficacy beliefs in this study focused on early mathematics experiences and all participants recalled elementary school experiences. Contrary to Bandura's (1977, 1986) efficacy theory, participants reported vicarious experiences, social persuasions, and physiological states as having a bigger effect on their efficacy beliefs than mastery experiences. In fact, when three participants were asked how important getting the correct answer on math problems was, they indicated that getting the right answer was not the most important. For participants in this study, getting positive feedback about their work from the teacher, receiving affirmation, being part of a group, and receiving encouragement created far more feelings of efficacy than getting correct answers on math problems or assignments.

Results from this study confirmed findings from a previous study that credited vicarious experiences with raising students' efficacy beliefs and increasing persistence and accuracy in their work with division problems (Schunk, 1981). Participants' statements on their early mathematics experiences also confirmed existing research on verbal persuasions. Studies by Schunk (1982, 1983) and Schunk and Gunn (1986) concluded that effort attributed feedback such as "You're working really hard, keep going" and ability feedback such as "You're good at this" had an effect on student performance. These particular studies employed "treatment methods", which meant that students were given statements of affirmation towards their efforts and abilities. Their performance and accuracy on mathematics tasks were examined to determine the effect of the treatment on

their performance and mathematics efficacy beliefs. I used the reverse approach by asking adults with high math efficacy beliefs to recall what factors made positive mathematics experiences possible in their early years of school. Participants attributed positive verbal feedback about their ability and effort as being impactful to their beliefs that they could be good at math.

The performance of teachers is impacted by their efficacy beliefs. Existing research points to a negative relationship between mathematics anxiety and mathematics teaching efficacy (Swars, Daane, & Giesen 2006). Teachers with high mathematics teaching efficacy beliefs are more resourceful when students don't learn and are more confident in their abilities to teach mathematics (Bates, Latham, & Kim, 2011). Participants in this study consistently expressed their desire to find new ways to teach students who were not being successful. Their beliefs about their ability to teach mathematics overshadowed any degree of anxiety or hesitation towards teaching in general.

This study confirmed findings of previous research and provided new insights as to the development of efficacy beliefs from the perspective of 10 highly efficacious elementary school teachers. Existing research with current practicing elementary school teachers is very limited. The vast majority of current research on mathematics efficacy beliefs and mathematics teaching efficacy beliefs has been done with pre-service teachers, college students, and even K-12 students. This study explored the factors that contributed to the formation of efficacy beliefs of 10 teachers through their experiences as students in the K-12 education system, their college education, teacher preparation programs, and

professional development opportunities. To my knowledge, a study of this nature has not been done before.

In addition, this study has provided differing views, from the existing theory, on factors affecting mathematics efficacy beliefs as expressed by participants. Efficacy theory points to mastery experiences as the strongest source of efficacy beliefs. In their earliest mathematics learning experiences at the elementary school level, participants in this study point to verbal feedback and role models (Vicarious Experiences) as the major factors in the formation of their efficacy beliefs. This is not to say that mastery experiences are not important. Eight participants did recognize that being able to solve particular mathematics problems was influential in the formation of their mathematics efficacy beliefs. However, the number of times verbal persuasions and role models are cited by participants as improving their efficacy beliefs outnumbers mastery experiences. In fact, three participants indicated directly that getting the correct answer to a math problem was not as significant as putting forth hard work and effort that their teachers and peers could recognize through verbal feedback and praise.

Implications for future research

This study has resulted in a better understanding of factors affecting efficacy beliefs towards mathematics and mathematics teaching. Participants' experiences in this study indicate that mastery experiences are not necessarily the most impactful factors in the early years of mathematics education. Future research involving a larger sample size of current practicing elementary school teachers may provide an opportunity to generalize the results of this study to a larger population. In addition, extending this study to

participants with low levels of mathematics or mathematics teaching efficacy may provide the opportunity to compare the different experiences of individuals at different ends of the levels of efficacy beliefs. This can provide current teachers, administrators, and students' families with recommendations on best practices, in the classroom and at home, to improve students' mathematics experiences and increase self-efficacy beliefs.

Further research with a larger sample size could also explore the role of mathematics teaching efficacy beliefs on teachers' instructional practices, and their perseverance when instructing students that are not being successful. As previously stated, the majority of existing research has not been done with experienced teachers. The results of this study indicate that teachers' instructional practices make a difference in student efficacy beliefs. Teachers in this study expressed a willingness to change instructional strategies and utilize multiple strategies to ensure that students were able to understand a concept or complete a mathematics task. A larger sample size could provide generalization to a larger population of teachers and give more validity to recommendations.

A larger sample size can also provide the opportunity to research the difference in teaching practices of teachers with low mathematics teaching self-efficacy and teachers with high mathematics teaching self-efficacy. This study focused on teachers with high mathematics teaching efficacy beliefs but did not focus directly on teaching practices. A larger sample size can provide the opportunity to explore in depth teaching practices and teachers' dispositions towards improving student efficacy beliefs.

Lastly, future research could focus on investigating any relationship between the level of efficacy beliefs of teachers and students' achievement and learning outcomes. It

can be hypothesized that teachers with high mathematics and mathematics teaching efficacy are more effective and have higher student achievement than low efficacy teachers. Future research could help prove or disprove this hypothesis. A quantitative study could investigate this phenomenon and help quantify differences in achievement level, if any exist.

Implications for policy and practice

Professional Development

This study has shown that mathematics and mathematics teaching self-efficacy beliefs are affected by a multitude of factors that can be replicated. Participants' earliest successful mathematics experiences involved a high level of affirmation, encouragement, praise, support, and modeling. Professional development at the elementary level needs to focus on improving teacher awareness of these factors so that they can be part of daily mathematics instruction. Participants in this study were able to recognize these practices as having an effect on their mathematics efficacy beliefs when they were students at the elementary grades. Therefore, it is critical that teachers receive professional development in this area so that students can benefit from an environment that fosters factors that will increase efficacy beliefs.

Professional development needs to focus on instructional pedagogy that strengthens teachers' skills to work with students that may not be successful during first instruction of mathematics concepts. Participants in this study had high mathematics teaching efficacy beliefs. They credited their ability to take a math problem and make it

simpler, model it, act it out, break it down to the more basic math concepts, and guide students through the multiple steps as the reason for feeling a high level of efficacy beliefs. A teacher that reaffirms students, provides students with an example to follow, and models mathematics as an attainable skill provides students with a great deal of support and improves efficacy beliefs in students.

In the new era of Common Core State Standards (CCSS) and the new Standards for Mathematical Practice, it is critical that our teachers are equipped with the skills and beliefs that they can model mathematics, teach students to have discussions about mathematics, and to persevere through problems until they are solved. Modeling of mathematics is going to prove critical as students move through our school system with these new expectations. School districts and site leadership need to make it a priority to provide new and experienced teachers with models of math lessons that match the expectations of the new CCSS and Standards for Mathematical Practices. Professional development efforts will need to maintain this focus if we expect our new teachers and experienced teachers to implement these changes in pedagogy in the classrooms.

Teacher Preparation Programs

As new pre-service candidates make the decision to go into teaching, it is critical that they are equipped with beliefs that they can help students learn. It is also critical that all their actions and practices are consistent and targeted to increasing students' efficacy beliefs. Teacher preparation programs can support pre-service teachers by providing them with teacher role models that have high mathematics teaching efficacy, teaching pedagogy that matches the expectations of the new Standards for Mathematical Practices, and a

specific awareness of the effects teachers can have on the efficacy beliefs of their students. New teachers can be better trained on instructional practices and classroom management techniques that focus on providing students with the appropriate feedback that foster efficacy beliefs. If teacher preparation programs provide new teachers with experienced role models, who have a high level of efficacy beliefs in mathematics teaching, this can provide an excellent start and focus to new teachers in the profession.

Classroom Instructional Practices

The results of this study and the existing research support the practice of providing students with positive feedback on performance, encourage effort, and provide opportunities for success (mastery experiences). Unfortunately, there are instructional practices in place at elementary schools around the country that should be modified if we reflect on what factors affect the formation of efficacy beliefs. For example, many of us remember having to reach the addition, subtraction, division, and multiplication goals for our grade levels as part of our math education at the elementary level. This is still going on in today's classrooms. Having the goal itself is not a negative effect on efficacy beliefs. Unfortunately, the majority of these benchmarks involve time tests that are designed for students to fail initially and reach the goal at some point later in the school year. Instead of providing students with mastery experiences that build mathematics efficacy in our elementary students, we provide multiple opportunities to fail.

The classroom practice discussed above is only one example of a practice that does not support or foster the formation of efficacy beliefs. It would benefit our schools in general to spend time and resources analyzing the classroom practices we currently have

in place and adjust them to ensure students' experiences are filled with opportunities to build efficacy. Instead of carrying out classroom practices that are designed for students to fail, adjust those practices to provide students with opportunities to be successful. Instead of giving students a large assessment that the majority of students will fail, give smaller assessments so that students can experience success and build up to the larger assessments.

In the new era of Common Core State Standards, our classrooms need to provide students with opportunities to model mathematics for themselves and their peers. Students seeing their peers being successful at mathematics' tasks create the potential to increase mathematics efficacy beliefs. We need to create instructional shifts from teacher directed instruction to teacher-facilitated classrooms where the teacher provides positive feedback and guidance as students discover mathematics. We need to provide students with the language and structure, including sentence frames, for students to use statements of affirmation towards each other. Validating students' accomplishments and recognizing their efforts has the potential to create a positive emotional response towards mathematics.

District and Site Leadership

Participants in this study mentioned professional development opportunities as valuable, but had not been available to them for the previous five to six years. Participants recalled attending workshops or conferences that provided them with lessons they used in their class immediately. It is critical that teachers continue to be provided with access to workshops, conferences, and experiences that will increase their skills and beliefs in their mathematics teaching abilities. District and site leadership need to allocate resources to

continue to provide meaningful opportunities for teachers to improve their instruction and their beliefs about their instruction. For rural districts such as Bella Unified School District, having teachers attend professional development offered by the county needs to be an expectation, and it is an expectation with the implementation of CCSS. For experienced and highly efficacious teachers, professional development is critical as new standards for instruction will mean a shift in teaching pedagogy.

Participants in this study recalled a teacher on assignment (TOA) as someone who provided the most meaningful experience to improve their mathematics instruction. This individual was able to provide participants with a role model figure and with instructional strategies that participants could put to use immediately. An added source of confidence came from having the TOA teach lessons in participants' classrooms. This gave participants the feeling that they would also be able to replicate the experiences the TOA provided students. For reasons unknown to participants, this practice was suspended and never brought back. It is critical that district leaders and administrators provide teachers with peer role models that can support them and create the beliefs that effective mathematics teaching is attainable.

Final Remarks

The findings in this study suggest that mathematics and mathematics teaching efficacy beliefs are not stagnant or unchanging. People are not born with a "math brain" or one that is not a "math brain." Efficacy beliefs can be developed, acquired, and instilled in people of all ages. Participants described their early mathematics experiences and the impact the experiences had on them. If our educational system focuses on replicating the

experiences participants had in the classroom, and we work with families to provide students with rich mathematical experiences outside of the school setting, we can start the process of developing mathematically inclined students. If our district and site leadership develop a systematic way of providing teachers with continuous professional development experiences aimed at increasing mathematics and mathematics teaching efficacy beliefs, then we will see students being provided with similar experiences. Our educational system needs highly efficacious mathematics educators in order for our students and our nation to be back on top when compared with the rest of the world.

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APPENDIX A

Demographic Information

Name: _____

Gender: _____

Grade Level: _____

Number of years of teaching experience:

- A. 0-2 B. 3-5 C. 6-10 D. 11-15 E. 16-20 F. 21-30 G. 30+

Race/Ethnicity: _____

Highest educational level completed:

- A. Bachelors Degree B. Masters Degree C. Doctorate

Undergraduate Degree Area

- A. Education B. Mathematics C. Human Development C. Other

**MATHEMATICS AND MATHEMATICS TEACHING SELF-EFFICACY SCALE
(MMTSES)**

(MTEBI)

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

SD	D	N	A	SA
Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

1. When a student does better than usual in mathematics, it is often because the teacher exerted a little extra effort.

SD	D	N	A	SA
----	---	---	---	----

2. I am continually finding better ways to teach mathematics.

SD	D	N	A	SA
----	---	---	---	----

3. Even when I try very hard, I don't teach mathematics as well as I can teach other subjects.

SD	D	N	A	SA
----	---	---	---	----

4. When the mathematics grades of students improve, it is often due to their teacher's having found a more effective teaching approach.

SD D N A SA

5. I know the steps to teach mathematics concepts effectively.

SD D N A SA

6. I am not very effective in monitoring mathematics activities.

SD D N A SA

7. If students are underachieving in mathematics, it is most likely due to ineffective mathematics teaching.

SD D N A SA

8. I generally teach mathematics ineffectively.

SD D N A SA

9. The inadequacy of a student's mathematics background can be overcome by good teaching.

SD D N A SA

10. When a low-achieving child progresses in mathematics, it is usually due to extra attention given by the teacher.

SD D N A SA

11. I understand mathematics concepts well enough to be effective in teaching secondary school mathematics.

SD D N A SA

12. The teacher is generally responsible for the achievement of students in mathematics.

SD D N A SA

13. Students' achievement in mathematics is directly related to their teachers' effectiveness in mathematics teaching.

SD D N A SA

14. If parents comment that their child is showing more interest in mathematics at school, it is probably due to the performance of the child's teacher.

SD D N A SA

15. I find it difficult to use manipulatives to explain to students why mathematics works.

SD D N A SA

16. I am typically able to answer students' mathematics questions.

SD D N A SA

17. I wonder if I have the necessary skills to teach mathematics

SD D N A SA

18. Given a choice, I would not invite the principal to evaluate my mathematics teaching.

SD D N A SA

19. When a student has difficulty understanding a mathematics concept, I am usually at a loss as to how to help the student understand it better.

SD D N A SA

20. When teaching mathematics, I usually welcome student questions.

SD D N A SA

21. I do not know what to do to turn students on to mathematics.

SD D N A SA

8. The hands of a clock form an obtuse angle at ----- o'clock.

1 2 3 4 5 6

9. Bridget buys a packet containing 9-cent and 13-cent stamps for \$2.65. If there are 25 stamps in the packet, how many are 13-cent stamps?

1 2 3 4 5 6

10. On a certain map, $\frac{7}{8}$ inch represents 200 miles. How far apart are two towns whose distance apart on the map is $3\frac{1}{2}$ inches?

1 2 3 4 5 6

11. Fred's bill for some household supplies was \$13.64. If he paid for the items with a \$20 bill, how much change should he receive?

1 2 3 4 5 6

12. Some people suggest that the following formula be used to determine the average weight for boys between the ages of 1 and 7: $W = 17 + 5A$ where W is the weight in pounds and A is the boy's age in years. According to this formula, for each year older a boy gets, should his weight become more or less, and by how much?

1 2 3 4 5 6

13. Five spelling tests are to be given to Mary's class. Each test has a value of 25 points. Mary's average for the first four tests is 15. What is the highest possible average she can have on all five tests?

1 2 3 4 5 6

14. $3\frac{4}{5} - \frac{1}{2} = \text{-----}$.

1 2 3 4 5 6

15. In an auditorium, the chairs are usually arranged so that there are x rows and y seats in a row. For a popular speaker, an extra row is added, and an extra seat is added to every row. Thus, there are $x + 1$ rows and $y + 1$ seats in each row, and there will be $(x + 1)$ and $(y + 1)$ seats in the auditorium. Multiply $(x + 1)(y + 1)$.

1 2 3 4 5 6

16. A Ferris wheel measures 80 feet in circumference. The distance on the circle between two of the seats is 10 feet. Find the measure in degrees of the central angle SOT whose rays support the two seats.

1 2 3 4 5 6

17. Set up the problem to be done to find the number asked for in the expression "six less than twice $4\frac{5}{6}$ "?

1 2 3 4 5 6

higher salary but no benefits, the other with a lower salary plus room,
board, and travel expenses.

1 2 3 4 5 6

17. Figure out the tip on your part of a dinner bill split 8 ways.

1 2 3 4 5 6

18. Figure out how much lumber you need to buy in order to build
a set of bookshelves.

1 2 3 4 5 6

APPENDIX B

Interview Protocol

Background information:

What is your age? What schools have you attended? How long have you been a teacher? What grade levels have you taught? Have you taught higher grade levels than K-5? If so, what subject did you teach? How many mathematics courses did you take during your undergraduate and postgraduate work?

Disclaimer:

You have been asked to participate in this interview because you were identified as having a high level of mathematics and mathematics teaching self-efficacy. I'm going to ask you a few questions to help me better understand what made it possible for you to feel the way you feel about mathematics and mathematics teaching.

Think about your earliest experience or experiences that made you feel good about your mathematics ability (PA). Can you tell me what you recall about it?

Possible follow up questions: Who was involved in the experience (VE)? Did you receive verbal encouragement (VP)? Did you have role models in the area of mathematics (VE)? How did mathematics and specific mathematics topics make you feel (PS)? What/Who do you think made the experience possible? How do you think it can be replicated?

Can you think back to a positive experience(s) or lesson(s) teaching mathematics (PS, PA)? Can you point why or what part of the experience made you feel good about your mathematics' teaching ability (PS)?

Possible follow up questions: At what point in your career did it happen (i.e. college, student teaching)? How did you know it was a good teaching experience (PS, PA,)? Had you seen the lesson/experience modeled by a different person (VE)? Did you get the idea from someone else for the lesson (VE, VP)? Did you receive any feedback that confirmed to you it was a good lesson/experience (VP)? What/Who do you think made the experience possible? How do you think it can be replicated?

Can you think of learning experiences as a college student or early in your teaching career that have contributed to you feeling positive about mathematics and mathematics teaching (VE, VP, PA)?

Possible follow up questions: Were there college courses during your undergraduate work or teacher credential program? What role did your master teacher have?

Can you think of a professional development workshop, conference, or program you have attended recently that has helped improve your mathematics teaching (VE, PA)?

Possible follow up questions: What kind of activities did the professional development, workshop, or conference include (PA)? What do you feel it provided you with (PS)?

APPENDIX C

University of California, San Diego Consent to Act as a Research Subject

Sources of Elementary Teachers' Mathematics Efficacy and Mathematics Teaching Efficacy

Ignacio Ramirez, under the supervision of Dr. Amanda Datnow, Professor and Chair, UCSD Education Studies, with approval of Dr. Lou Obermeyer, Superintendent of Valley Center-Pauma Unified School District, is conducting a research study to investigate the sources mathematics self-efficacy and mathematics teaching self-efficacy. As an educator of students in grades K-5, your permission is requested to participate in this study. There will be approximately 60 educators participating in part I of this study, which involves taking a survey that takes approximately 15-20 minutes, and part II that involves a one-on-one interview taking 30-40 minutes. The purposes of this study are to investigate the level of mathematics and mathematics teaching self-efficacy of teachers, the correlation to student achievement, and the sources of high levels of mathematics and mathematics teaching self-efficacy.

If you agree to participate in this study, the following will take place:

Participants will be asked to take the Mathematics and Mathematics Teaching Self Efficacy Scale. The survey consists of three parts, which will measure how the participant feels about his/her abilities to solve certain types of mathematics problems, do certain tasks that involve mathematics, and teaching mathematics concepts. Student achievement data will be collected to investigate if a correlation exists between student achievement and level of efficacy of participants.

Participants will be invited to participate in an interview. The interview will be conducted sometime between February 1, 2012 and April 30, 2012. The interview will take 30-40 minutes, and will be conducted in English. Ignacio Ramirez, the researcher, will conduct the interviews, which will be held at a location and time that is acceptable to the participant. The interviews will be recorded and transcribed. A transcript of the recording will be provided to the participant to review and ensure the accuracy of the content.

Participation in this study may involve some added risks or discomforts. These include:

1. A potential for the loss of confidentiality. This is highly unlikely since no teacher names or identifying information will be used. Research records will be kept confidential to the extent allowed by law. Research records may be reviewed by the UCSD Institutional Review Board.
2. Due to the interview being voluntary, participants may skip a question or discontinue the interview at any time if they become bored or ill.

Appendix C: Sources of Elementary Teachers' Efficacy... Informed Consent (cont.)

3. The administration of this interview and its contents do not, in any way, create a risk for the educator. The results are in no way related to any evaluation or judgment of the staff member.

Because this is a research study, there may also be some unknown risks that are currently unforeseeable. You will be informed of any significant findings.

There may or may not be a direct benefits to educators from participating in this study. The interview may serve educators to reflect on how they feel about mathematics, mathematics instruction, and reflect on experiences that formed their beliefs about mathematics and mathematics instruction. The researcher may learn more about the type of experiences, training, or professional development that create positive feelings of efficacy for educators in the area of mathematics.

Your participation in this study is voluntary. You may refuse to participate in the survey or interview at any time without penalty or loss of benefits to which you are entitled.

You will be told if any important new information is found during the course of this study that may affect your wanting to continue.

There is no compensation or cost for you participating in this study.

Ignacio Ramirez has explained this study to you and answered your questions. If you have any additional research-related questions, you may reach Ignacio Ramirez at (760) 807-1819. You may call the Human Research Protections Program Office at (858) 455-5050 to inquire about your rights as a research subject or to report research-related problems.

You have received a copy of this consent document.

I agree to participate in the study.

Subject's signature

Witness

Date

_____ I am interested in participating in a follow-up interview.

_____ I am **not** interested in participating in a follow-up interview.

Name

Best Contact phone number

APPENDIX D

November 18, 2012

By using portions of the instrument, you might reduce the validity. However, you have our permission to use the MTEBI

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“Students should continue to learn and use their learning in more effective problem solving for the rest of their lives. When one takes life-long learning and thinking as the major goal of education, knowledge becomes a means rather than an end, and other formerly implicit goals become more explicit.” (McKeachie et al, 1986, p1.)

APPENDIX E

Kranzler, John H.

November 17, 2012

You have permission. Frank unfortunately passed away a few years ago.

John

> Dr. Kranzler,

>

> My name is Ignacio Ramirez and I'm a student at the University of California San Diego. I'm in the Ed.D program and am in the process of submitting my proposal investigating the sources of mathematics efficacy of elementary school teachers. Part of my research will include the use of a survey to measure the level of mathematics efficacy of participants. I would like to request permission to use portion of the MSES-R that you along with Dr. Pajares (RIP) validated back in 1997.

>

> I'm rather new to the world of research, and I'm going out on a limb emailing you with my request. If there is a more formal process I need to follow, please let me know. I am working towards completing my dissertation, and I'm also working full time as a high school assistant principal. I am a former mathematics teacher and am very excited about the prospect of completing my study.

>

> Thank you in advance for your time and consideration of my request.

>

> Ignacio Ramirez

> Assistant Principal

> Valley Center High School