PRESERVICE TEACHERS: INVESTIGATIONS IN EARLY FIELDWORK AND MATHEMATICS EFFICACY BELIEFS

A Dissertation

Presented to

The Faculty of the School of Education

Liberty University

In Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

By

Heidi Hunt-Ruiz

2011

Preservice Teachers: Investigations in Early Fieldwork

and Mathematics Efficacy Beliefs

by Heidi Hunt-Ruiz

APPROVED:

COMMITTEE CHAIR	Scott B. Watson, Ph.D.
COMMITTEE MEMBER	Kristina DeWitt, Ph.D.
COMMITTEE MEMBER	Dennis Gittinger, Ph.D.
ASSOCIATE DEAN, AVANCED PROGRAMS	Scott B. Watson, Ph.D.

ABSTRACT

Heidi Lynn Hunt-Ruiz. PRESERVICE TEACHERS: INVESTIGATIONS IN EARLY FIELDWORK AND MATHEMATICS EFFICACY BELIEFS. (Under the direction of Scott B. Watson, Ph.D.) School of Education, August, 2011.

In this quasi-experimental study, 127 preservice teachers from two community colleges enrolled in a mathematics for teachers two-course sequence. Control and experimental groups were used to investigate the effect that fieldwork had on efficacy beliefs. The Mathematics for Teaching Efficacy Beliefs Instrument (MATHEMATICS TEACHING EFFICACY BELIEFS INSTRUMENT) was used to gather data. Fieldwork was determined not to be a significant factor of personal mathematics efficacy or outcome expectancy. Personal mathematics teaching efficacy did significantly increase for both experimental and control groups; however, mathematics teaching outcome expectancy significantly increased only for the experimental group. Results also showed that length of term was a significant factor of teaching efficacy. Suggestions for further research are also included.

Acknowledgements

I am blessed to be surrounded by family and friends who have consistently been a support to me, each in a unique way. Thank you, Lord, for providing all I have needed. Mom and dad, thank you for always modeling excellence in everything, and for laying a strong foundation for me to build on. Johnny, my husband, thank you for your delightful companionship. I look forward to the rest of our lives together. My son, Ethan, your laughter reminds me of what life is really about. I am deeply honored that God saw fit to give you to me. I am so proud of you. Anthony Coppin and Helen Kirk, thank you for making time for this project, and for your dedication to improve mathematics education. My coworkers, Eddie Bishop and Anna Harwin, thank you for your friendship, and for sharing your expertise in statistics. Sebastian Guerra, you are a lifesaver. Thank you for many last-minute edits. My students, I am honored to have been a part of your education. Your inquisitive minds are an inspiration. Mr. Smith, my high school mathematics teacher, thank you for expecting more of me than I wanted you to. Dennis Gittinger, thank you for your friendship, encouragement, and unsurpassed grammar edits. My chair, Dr. Watson, thank you for your patience and clear guidance through this process.

Table of Contents

List of Tables and Figures

CHAPTER ONE: INTRODUCTION

Statement of the Problem

Reform in mathematics education continues to be on the forefront of research (Ball, Lubienski, & Mewborn, 2001) due in part to the call towards higher-level thinking and conceptual understanding promoted by the standards of the National Council of Teachers of Mathematics (NCTM, 2000). Historically, computational skills have been considered a priority (Battista, 1994) and have driven the elementary curriculum. However, reform movements call for classrooms to develop students who can solve complex problems, build arguments, explore, read, write, and discuss mathematics (NCTM).

With a move away from traditional to more constructivist instructional practices comes a psychological shift in viewing mathematics: from observable behaviors and skills to true mathematics thinking (Battista, 1994). This shift creates a knowledge gap in preservice teachers who have been traditionally educated in algorithms, but are now expected to learn and teach constructively.

Contributing to the knowledge gap are teacher preparation programs that have historically focused on content, but are now emphasizing instructional techniques as well. While pedagogy is obviously important, spending less time to develop content expertise produces teachers who enter classrooms with knowledge that is inadequate to effectively teach at deeper, richer conceptual levels (Adler, Ball, Krainer, Lin, & Novetna, 2005; Ball, Lubienski, & Mewborn, 2001). NCTM recognized and addressed this gap in its call for colleges to reconsider their teaching preparation programs to reflect its curricular recommendations (2000).

Preservice teachers bring with them a wealth of experiences as students and learners, which affect the way they approach, think about and learn mathematics (Ball, 1988; Phillip, 2007). Preservice teachers' past experiences with mathematics come from traditional education, mathematics instruction that relies on transmission of knowledge by the teacher and absorption of facts by the student (Battista, 1994). Many preservice teachers enter their science and mathematics methods courses with limited conceptual knowledge (Ball, 1990), which limits their ability to learn mathematics concepts at a deep level. This can "lead to apprehensions about their ability to teach and their effectiveness as teachers in these subject areas" (Huinker & Madison, 1997, n.p.).

Further, preservice teachers are not always open to relearning mathematics content in a deeper, more conceptual way than they learned in elementary school because of the held belief that knowing a procedure without conceptual knowledge is, in fact, understanding (Phillip et al., 2011). For example, many individuals in the general population remember that to divide a fraction by a fraction, they must invert the divisor and multiply. Even though they have no idea why the algorithm works, they believe it is correct because that is how they were taught. Their resistant views about teaching and learning "do not align well with the national standards for teaching practice" (Lee & Krapfl, 2002, p. 247).

Whether intentional or not, teachers pass on their beliefs and attitudes to their students. If a teacher does not like mathematics, then her attitude toward the subject is carried over in her classroom (Ashton & Webb, 1986; Wilson, 1996). This may manifest itself in shortened time allotments for mathematics instruction, a focus on memorizing facts without understanding concepts, a noncreative approach to mathematics lessons, or a general disinterest in the subject. All of these have the potential to perpetuate a negative view of mathematics and an ill-prepared group of students.

If a teacher learns to teach in ways that relay conceptual knowledge in addition to factual knowledge, then her students will be more prepared for future mathematics courses. If a teacher overcomes her own fear of mathematics, then her students will be more likely to have a positive outlook on mathematics (Wilson, 1996). That is why “one goal of a teacher education program should be to increase preservice teachers’ self-efficacy” (Huinker & Madison, 1997, n.p.).

Improving teacher education is a creditable matter worth investigating. Extensive research has been done on improving the education preservice teachers receive, with an emphasis on attempting to draw focus on what it is that makes a teacher effective. Because “preservice teachers approach their teaching preparation programs with formed values, attitudes, and beliefs” (Huinker & Madison, 1997, n.p.), one area that has received attention in research is teacher beliefs, more specifically teacher efficacy.

This dissertation investigated the impact of early fieldwork on preservice teachers’ mathematics teaching efficacy beliefs. The study used the Mathematics Teaching Efficacy Beliefs Instrument to gauge the perceptions of preservice teachers enrolled in a mathematics course for elementary and middle school teachers. This study not only expands on the current literature on mathematics efficacy, but also fills a gap by offering data from the community college, a sample of preservice teachers in the early stages of their education.

This research project investigated the evolution of preservice teachers’ mathematics efficacy beliefs during a sequence of two courses targeting prospective elementary and middle school mathematics teachers, with fieldwork being a component of the second course for the experimental group. The term, “early,” was used in this study because this study’s sample comprised community college freshmen and sophomores. Even though community colleges play an important function in teacher education, one that will continue to grow as our communities’ and states’ needs change (Ostos, 2011), the overwhelming majority of research reviewed for this study applied to preservice teachers in their last year of college, mainly during student teaching.

General Background

Many elementary and middle school teachers do not initially feel competent in their mathematics ability. “Elementary education majors were shown to possess more negative attitudes toward mathematics than the general college sample” (Rech, Hartzell, & Stephens, 1993, p. 143). Many have had less than quality experiences in mathematics classes and as a result do not feel adequately prepared to teach others what they themselves do not fully understand.

Countless hours of observations of their own teachers, many of whom were not adequately prepared in mathematics, have influenced preservice teachers’ beliefs about what mathematics is and how it should be taught (Ball, 1990). Even if preservice teachers do not understand what they learned, they will reproduce instruction in the same manner in which they learned it, unless they are challenged to become better (Ball, 1990).

The National Council of Teachers of Mathematics has continually promoted a constructivist conceptual view of mathematics instead of a focus on memorization and facts (NCTM, n.d.). Although this is a sound move toward understanding conceptual knowledge, there is a knowledge gap as preservice teachers are expected to teach conceptually even though they have been taught to focus mainly on skill. Preservice teachers cannot teach in a way they do not fully grasp. Preservice programs must be a place where future teachers can brush up on mathematics facts as well as learn to approach mathematics knowledge in a way different from how they were taught.

When preservice teachers are given opportunities to learn mathematics in a supported constructivist environment, they are able to identify their own assumptions about how mathematics is learned and how mathematics should be taught (Ball, 1988). They may even confront the limits of their own knowledge and realize how these limits will make them less effective as a teacher. A constructivist environment in a mathematics methods course has been shown to be a successful way to increase teacher efficacy of elementary preservice teachers, with certain aspects of the course linked to increasing efficacy: the inquiry approach, group investigations, and relating concepts to real-world experiences (Swars, 2010). “If one goal is for preservice teachers to enter the field with high mathematics efficacy beliefs, then investigating variables contributing to such beliefs is valuable (Bingham, 2004, p.5).

Teacher efficacy has been shown to have predictive qualities. There is a “positive relationship between teachers’ efficacy beliefs about teaching mathematics and their effectiveness with teaching mathematics to their students” (Bingham, 2004, p.3). A positive relationship exists between a teacher’s self-efficacy and student achievement (Siegle & McCoach, 2007). Teachers with high efficacy beliefs engender stronger student success than teachers with lower teacher efficacy beliefs (Tschannen-Moran, Woolfolk & Hoy, 1998). Because of the predictive quality, research has been done to explore how self-efficacy can be identified and developed. One such study noted that teachers who work in highly collaborative environments were found to have elevated levels of self-efficacy (Raudenbush, Rowan, & Cheong, 1992).

Pajares cautions that self-efficacy is too general of a construct to adequately measure broad content tasks (1997). Since then, efficacy research began to move in content-specific directions, and discipline-specific terms such as mathematics or science teaching efficacy emerged.

Professional Significance of the Study

Monitoring preservice teachers' field experiences must be a priority because teacher efficacy is a factor that consistently relates to student achievement (Ashton & Webb, 1986; Esterly, 2003), classroom environment (Raudenbush, Rowan, & Cheong, 1992), and student success (Tschannen-Moran, Woolfolk & Hoy, 1998). Advances in the area of teaching efficacy will result in better prepared teachers which in turn will result in higher student achievement (Hill, Rowan, & Ball, 2005).

Although studies have already examined preservice teachers in the area of mathematics teaching efficacy, few of them have been done at the community college level. The researcher is aware of no research that investigates the impact of fieldwork on mathematics efficacy beliefs at the community college level.

Given the broad scope of a community college's mission, critics of research at the community college level may question the ability of a community college to offer preservice teachers an education comparable to that of the university. However, "The National Association of Community College Teacher Education Programs promotes the community college role in the recruitment, preparation, retention, and renewal of diverse

K-12 teachers, and advances quality teacher education programs in the community college" (Ostos, 2011, p.7). All research on preservice teachers, including that at the community college level, can inform best practices.

Since preservice teachers' beliefs are not yet solidified in the freshman and sophomore years, studying a sample of this population during the first or second year of college is ideal, but is an area that is lacking in research, as most studies focus on preservice teachers during student teaching, which typically occurs at the end of the senior year. Preservice teachers' beliefs are malleable only during formal schooling and through the first few years of teaching (Swars, Hart, Smith, Smith, & Tolar, 2007). If that is true, then the earlier preservice teachers' negative beliefs are challenged, the more time there is to modify them in a way that will adequately prepare them for successful experiences in their future classrooms.

Likewise, the earlier that preservice teachers' conceptions about mathematics content knowledge can be transformed from a rule-based belief to more of a constructivist approach with dialogue, logical discussions, and investigations, then the more opportunities preservice teachers will have to reevaluate paradigms before beginning their teaching careers.

Teachers with negative attitudes toward mathematics often fail to teach the subject effectively, which negatively influences their students' attitudes towards mathematics (Phillip et al., 2007). Similarly, teachers with insufficient understanding of conceptual knowledge will teach incorrectly. For example, Ball found that preservice teachers applied whole number rules, instead of weakly understood fraction and decimal concepts, to draw false conclusions about rational number representations (1990).

Preservice teachers will serve their future students better if they are able to conceptualize mathematics not as frustrating facts to memorize, but as a creative way of thinking and reasoning. The earlier the change in perspective can occur, the more time a preservice teacher has to discover the logical yet creative nature of mathematics before being inducted into the first year of teaching.

If preservice teachers' beliefs about their mathematics ability significantly improve during this study, then perhaps it offers a rationale both for more methods courses being offered at the community colleges level, and for an introductory education course designed to change students' beliefs about their mathematics ability. Taking mathematics methods courses at the community college level could positively impact future teachers' views of mathematics when they are sophomores rather than late in their senior year, when their negative beliefs are more solidly entrenched.

Questions and Hypotheses

If specific practices, such as fieldwork, are identified as having a significant impact on mathematics teaching efficacy, then preservice programs can be fine-tuned to better equip teachers. This study sought to investigate the effect of fieldwork on preservice teachers' efficacy beliefs, and also explore what happened to different types of students during fieldwork. It was expected that there would be a significant difference in mathematics teaching efficacy between those students who participate in fieldwork while going through mathematics for teachers courses, and those students who go through the courses only.

Of further interest was to investigate the impact that an early fieldwork experience had on different classifications of students. This study used preservice teachers' mathematics content knowledge and initial mathematics teaching efficacy scores to categorize students into four possible groups of high/low mathematics efficacy/content knowledge. These groups of students were followed during the two-course sequence to investigate the impact that fieldwork had on each type of student. The following research questions were generated:

1. Is there a difference in personal efficacy scores between preservice teachers who participate in fieldwork, and preservice teachers who do not participate in fieldwork?
2. Is there a difference in outcome expectancy scores between preservice teachers who participate in fieldwork, and preservice teachers who do not participate in fieldwork?
3. Will there be a difference in personal efficacy pretest and posttest scores of preservice teachers who participate in fieldwork?
4. Will there be a difference in outcome expectancy pretest and posttest scores of preservice teachers who participate in fieldwork?

Null Hypotheses 1: There will be no significant difference in the means of PMTE scores for the experimental group, which participated in fieldwork, and the control group, which did not participate in fieldwork.

Null Hypotheses 2: There will be no significant difference in the means of mathematics teaching outcome expectancy scores for the experimental group, which participated in fieldwork, and the control group, which did not participate in fieldwork.

Null Hypotheses 3: There will be no significant difference in the mean scores of the experimental group, which participated in fieldwork, as measured by the Mathematics Teaching Efficacy Beliefs Instrument pretest and posttest for personal mathematics teaching efficacy.

Null Hypotheses 4: There will be no significant difference in the mean scores of the experimental group, which participated in fieldwork, as measured by the Mathematics Teaching Efficacy Beliefs Instrument pretest and posttest for mathematics teaching outcome expectancy.

Overview of the Methodology

The subjects in this study were an accessible population of freshmen and sophomores enrolled in a Mathematics for Teachers two-course sequence at the community college level. Subjects for this study came from two Midwestern community colleges located in the same city.

Students entered this course sequence with varying mathematical ability, but all students had, at minimum, completed college algebra. Females accounted for approximately seventy percent of the enrollment in the courses. The students ranged in age from early twenties to late forties. Many of the participants were nontraditional students, and many were first generation college students. Many students had experiences working with children in various settings, such as after-school programs or daycare settings which would have given them opportunities to do fieldwork. But because this study captured preservice teachers' mathematics teaching efficacy beliefs at such an early stage in their preservice education, most participants had little to no experience formally teaching mathematics to young children. Likewise, most participants had taken few education courses, which would have given them opportunity to do fieldwork. This study captured a sample of students at the beginning of their teaching education.

Both the experimental and the control groups had the same experience in the first course. However, only the experimental group was required to do fieldwork in the second course. The Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) was given to all students twice to measure change over time. In addition, the Texas Assessment of Knowledge and Skills (TAKS) test, a mathematics content test, was given to students at the onset of the study. After the initial measurements, students were categorized into four groups based on the results of the Mathematics Teaching Efficacy Beliefs Instrument and the Texas Assessment of Knowledge and Skills. The categories were set up only for statistical reporting; students were not physically separated in groups based on ability or efficacy.

The objective of the research was to determine the effect of fieldwork on preservice teachers' mathematics teaching efficacy beliefs and outcome expectancy beliefs, and to discover whether or not the effect varied on students with different characteristics.

This study was a Quasi-Experimental, nonequivalent control group design that explored the differences between the experimental group and control group. The independent variable was fieldwork and the dependent variable was mathematics teaching efficacy. The details of the study's methodology are included in Chapter Three.

Definitions of Key Terms

Self-efficacy: Bandura first introduced this construct in 1977 and further defined it in 1994 as "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" (Bandura, p.71). Teaching self-efficacy: Teaching efficacy is a teacher's estimate of her capabilities to effect desired outcomes of student engagement and learning. Teacher efficacy is not the same as teacher effectiveness. While teacher efficacy is a self-assessed measure of one's abilities, teacher effectiveness is an assessment of success in a specific teaching situation (Esterly, 2003). Teacher efficacy beliefs depend on the specific teaching situation (Esterly, 2003). When no task is identified, efficacy measurements result in ambiguous findings (Pajares, 1997). A more focused perspective of teaching efficacy is a teacher's beliefs about his or her ability to teach mathematics, or mathematics teaching efficacy.

- **Teaching outcome expectancy:** Teaching outcome expectancy is the belief in the ability of an effective teacher to have a significant, positive effect on student learning (Enoch, 2000).
- **Preservice Teacher:** In this study, the term refers to community college students enrolled in a Mathematics for Elementary and Middle School Teachers two-course sequence.
- **MTEBI:** Mathematics Teaching Efficacy Beliefs Instrument
- **NCTM:** National Council of Teachers of Mathematics
- **TAKS**: Texas Assessment of Knowledge and Skills

CHAPTER TWO: REVIEW OF LITERATURE

This literature review provides a theoretical background of the construct of efficacy, and a summary of the historical research on teaching efficacy, followed by research on teachers' content knowledge, beliefs, and efficacy.

Three categories related to teaching efficacy consistently emerged from the articles reviewed for this study: content knowledge, content-specific methods coursework, and fieldwork. Because the overlapping of these categories made it problematic to present them separately, the research was organized under the somewhat broader themes of teacher content knowledge, teacher beliefs, and teacher efficacy. Fieldwork and content-specific methods coursework are presented as they relate to impacting teacher beliefs.

There is no lack of research on teacher content knowledge or teacher beliefs; however, a focused search for articles relating content knowledge or teacher beliefs to teaching efficacy yielded few studies. Even fewer studies investigated the impact that fieldwork has on efficacy beliefs in the teaching of mathematics. Among the studies that examined mathematics teaching efficacy, fewer than five took place at the community college level. The purpose of this literature review, then, is to provide a theoretical framework for viewing self-efficacy, to examine current literature in the areas of content knowledge and teacher beliefs as they relate to teaching efficacy, and to demonstrate the need for this study.

Theoretical Background

Rotter: Social Learning Theory.

Social learning theory says that one's choice of action is determined both by the expected outcome of a potential behavior and by the behavior one places on that outcome. This theory led to other theories that focused on an internal and external perspective, namely Rotter's Theory of Locus of Control and Bandura's Self-efficacy Theory (Mearns, 2009).

Julian B. Rotter first introduced his social learning theory in a publication entitled "Social Learning and Clinical Psychology" (1954). Rotter deviated from the theories of his time, which suggested that instinctive motives determine behavior. He chose to found his theory on the empirical law of effect, which states that people are motivated by positive reinforcement. The main difference in his theory was that one's personality interacts with the environment, and since personality can be malleable, one's behavior and experiences can be changed as well.

Rotter is more commonly known for a branch of his social cognitive theory known as Locus of Control, which refers to people's beliefs about what determines what happens in their lives. An individual's locus of control can be classified along a continuum of possibilities, ranging from internal to external control. In general, a person with more of an internal locus of control believes that he has control over events, whereas, a person with more of an external locus of control believes that the environment controls events, leaving the individual with little influence in outcomes. In a classroom setting, a teacher's locus of control will impact such things as how she manages her class and interacts with students, how she handles conflict, and what classroom management style she uses.

Bandura: Self-efficacy Theory.

Self-efficacy is situated within a social cognitive theory of human behavior. The construct was first introduced in 1977 by Bandura in his work "Self-efficacy: Toward a Unifying Theory of Behavioral Change". Self-efficacy is defined as "people's beliefs about their capability to produce designated levels of performance that exercise influence over events that affect their lives" (Bandura, p. 71).

Bandura distinguished between self-efficacy beliefs and expectancy beliefs, much like Rotter distinguished between an external and internal locus of control. Self-efficacy beliefs are beliefs about one's capability, the internal perspective, whereas, outcome expectancy beliefs are beliefs about one's ability to affect a situation, the external perspective. Guskey and Passaro also report the two factors of Bandura's self-efficacy being oriented to Rotter's internal/external measures of attribution (1994).

It is not that self-efficacy assigns the control of events to internal or external factors, as with Rotter's Locus of Control theory; rather, Bandura recognized that a distinction between self and other must be made in the construct of self-efficacy. The Theory of Locus of Control seems to deal with causation, whereas Self-Efficacy Theory deals more with perceived capability.

Self-efficacy is a measure of one's beliefs, and is therefore a construct that can be influenced. Bandura reports four main sources of influence: enactive experiences (one's competence is strengthened by success), vicarious experiences (observing someone successfully perform a task influences one's own belief about performing that task), social persuasion (feedback from others increases or decreases efficacy beliefs), and physiological and emotional arousal (positive feelings signal assurance and impact beliefs) (1994). In later work (2005), Pajares along with Usher reported a fifth source of efficacy, invitations (in Ross & Bruce, 2007). Invitations are messages we send to ourselves that indicate how capable and valuable we feel we are.

The effects of self-efficacy can be observed in cognitive, motivational, affective and selection processes (Bandura, 1994). Cognitively, people with high self-efficacy believe they are capable of achieving, which will result in high goal setting, firm commitment to those goals, mentally rehearsed successes, and analytical thinking in stressful situations.

Human motivation is generated by beliefs, making it a self-regulated phenomenon. A person with high self-efficacy will associate failure with lack of effort rather than low ability, and will set challenges for herself and be more likely to persist until she succeeds (Plourde, 2002). Life presents options, and people with high efficacy who believe they are capable will try options until they find a way to be successful. Because success breeds success, their efficacy and motivation increases and the cycle will continue.

The amount of stress and depression people experience is related to their belief in their own coping ability (Bandura, 1994) along with their own perceived ability to control their thoughts. People with a low self-efficacy view themselves as unable to control thoughts, which can result in psychological and other health problems. The cycle continues for both high and low self-efficacious individuals.

Bandura's Theory of Self-Efficacy also poses four processes of change: acquisition, generality, durability, and resilience. Acquisition deals with the initial development of self-beliefs, generality involves how wide-spread the beliefs can be used in other situations, durability refers to how well the beliefs are maintained over time, and resilience refers to how well an individual can recover from a negative experience (1997).

Although efficacy is a self-perception which cannot be measured objectively, it is nevertheless worth investigating, even subjectively, because research shows that teacher efficacy is linked to the health of the classroom environment (Raudenbush, Rowan, & Cheong, 1992), student success (Tschannen-Moran, Woolfolk & Hoy, 1998), and student achievement (Ashton & Webb, 1986; Esterly, 2003).

Although this dissertation will primarily use Bandura's theory of self-efficacy as its lens, the research acknowledges that Bandura's and Rotter's theory have significant commonalities. Bandura defined self-efficacy in terms of personal self-efficacy (internal) and outcome expectancy (external). A significant difference exists, however, in the two theories. Locus of control deals with causation, beliefs about the relationship between actions and outcomes, whereas self-efficacy deals with one's ability to succeed at achieving a task.

Historical Background.

Over the last two decades, emerging research indicates that teachers' self-efficacy is a "powerful variable in studies of instructional effectiveness" (Guskey & Passaro, 1994, p. 628). In early studies of teacher efficacy, measures were simplistic. The seminal study cited in efficacy research was done by the RAND corporation, and used Rotter's theory of Locus of Control as its theoretical foundation. In the RAND study, teacher efficacy was strongly related to positive change in student performance, as well as the "continued use of project methods and materials after the project ended" (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998, p. 204).

Interestingly, the RAND study contained only two questions: "When it comes right down to it, a teacher can't do much because most of a student's motivation and performance depends on his or her home environment" and "If I try really hard, I can get through to even the most difficult or unmotivated students" (Armor et al., 1976).

Using the RAND items, teacher efficacy has been correlated with teachers' willingness to implement innovation, teachers' stress level, and teachers' willingness to stay in the field (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). Since then, teacher efficacy has been shown to have many predictive qualities, which offers a strong rationale for research in this area.

The two questions from the RAND survey were later associated with Bandura's Theory of Self-Efficacy by Ashton and Webb (1984, 1986), who further developed the theoretical model for measuring teacher efficacy. Shortly after Ashton and Webb's work, Gibson and Dembo (1984) developed the Teacher Efficacy Scale, which was later revised by Woolfolk and Hoy (1990). Soon after the Teacher Efficacy Scale was developed, Riggs and Enochs developed content-specific instruments, namely the Science Teaching Efficacy Beliefs Instrument, and Mathematics Teaching Efficacy Beliefs Instrument (1990). The development of content-specific instruments was warranted as teaching efficacy is a construct both context and subject-matter specific (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). Teachers may feel comfortable teaching English, and as a result have high efficacy scores in English teaching efficacy, yet have reservations about teaching mathematics, and as a result have low efficacy scores in mathematics teaching efficacy.

Issues relating to how to best measure the construct began to surface as a result of calls for specificity and clarity of the construct. In 1997, Bandura developed his own

Teacher Self-Efficacy Scale in an effort to offer aid in measuring the construct. In the field of education, three main research areas developed related to self- efficacy: student efficacy as it relates to career choices, the relationship between teacher efficacy beliefs and instructional practices, and the correlation between student self-efficacy beliefs and motivation (Pajares, 1997). During the 1980's and 1990's, self-efficacy was the subject of many studies and is now supported by an ever-increasing body of research (Pajares, 1997).

Researchers in the field of education recognize that a teacher's beliefs affect what happens in the classroom (Staub & Stern, 2002; Raudenbush, Rowan, & Cheong, 1992; Tschannen-Moran, Woolfolk & Hoy, 1998; Guskey, 1982, 1987; Ashton & Webb, 1986). Early studies in preservice teacher efficacy revealed the construct is associated with attitude towards their students, and beliefs about control in the classroom (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). Teachers' beliefs of personal efficacy affect the instructional activities chosen, and their orientation toward the educational process (Pajares, 1997).

Gibson and Dembo found that teachers with higher efficacy are less likely to criticize a student for offering an incorrect answer, are more likely to persist with a student in a failure situation, and are more likely to set up small groups for constructivist learning instead of relying on traditional lectures (Gibson & Dembo, 1984).

Tschannen-Moran, Woolfolk Hoy, and Hoy report that teacher efficacy is linked to willingness to try new instructional strategies, the desire to find better ways to teach, the level of fairness a teacher displays, teacher behavior in the classroom, the goals a teacher sets, and the level of enthusiasm a teacher brings to the classroom (1998).

Teacher efficacy has also been associated with student outcomes and achievement (Armor, et al., 1976; Ashton & Webb, 1986).

In 1997, Pajares noted several directions for future research in self-efficacy, one of which was refining the study of teacher efficacy. Researchers continue to discover more about efficacy, allowing the construct to be further refined and allowing specific groups to be researched. Preservice teachers are an ideal sample to research as they are upcoming teachers who will affect our future classrooms, and because their beliefs are malleable only for a limited amount of time (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998; Swars, Hart, Smith, Smith, & Tolar, 2007).

This dissertation builds off of work of those who refined the meaning of the construct to a discipline-specific level, along with those who began investigating the connection between teacher efficacy and all that is encompassed in an elementary classroom. This study further investigates the impact of one variable, fieldwork, on teaching efficacy in the mathematics classroom. By discovering what impacts preservice teachers' efficacy, we can learn how to better shape preservice teachers' beliefs, a move towards the goal of creating a positive mathematics environment in elementary classrooms.

We are not there yet. Sadly, preservice programs are inadequately preparing future teachers, which contributes to the United States falling behind many other countries in mathematics achievement (Vail, 2005). A meta-analysis of mathematics research showed the trend in movement toward the "massification" of mathematics as countries want mathematics available to everyone, and as our cultures become more reliant on technology (Adler, Ball, Krainer, Lin, & Novotna, 2005). With the desire for mathematics to be made available comes the need for more qualified mathematics teachers (2005), which raises the question, "Who is qualified to teach mathematics?"

It used to be thought that anyone who knew how to do mathematics could explain it to someone else. We now know that teaching mathematics goes well beyond computational ability. Over the last twenty years, more and more focus has been placed on understanding a topic conceptually rather than simply being able to complete blind calculations in order to get the answer in the back of the book. This change in focus requires that teachers understand mathematics at a deeper level.

Standards issued by the National Council of Teachers of Mathematics, a national organization that has a vision to bring reform to the traditional way that mathematics is taught, envision students not only able to acquire basic skills but to look for patterns, to explore and investigate, and to think logically (NCTM). For students to be able to learn at a deeper level, the teacher must possess both deep and wide knowledge to bring about such higher levels of thinking in students. According to Shulman's model, what teachers must know to be successful comprises five components: the content itself, knowledge of pedagogy, knowledge of student cognition, context specific knowledge, and teacher's beliefs (1987). These are all areas that should be developed in teacher preparation programs.

Improving teacher preparation programs has been cited as an area in need of further research. Adler, Ball, Krainer, Lin, and Novotna reviewed 300 studies in mathematics education, noting authors, settings, theoretical bases, and designs. They reviewed articles from around the world in an attempt to assess what is known and what is being studied in relation to mathematics education. After reviewing hundreds of articles, they reached several conclusions, one of which was that we know "astonishingly little about the range of ways teachers acquire—or don't—the mathematics knowledge needed for teaching" (2005, p. 370). Their study also addressed areas that are notably missing in current research, one of which is research on teachers learning from experience. "We understand far too little about what helps some teachers to develop from their own teaching while others do not" (p. 376). More work is needed to discover how and why teachers, and preservice teachers, learn from their own learning.

The fact that we know little about how preservice and inservice teachers learn is cause for concern, especially considering the increasing scrutiny of teacher preparation programs from political influences such as No Child Left Behind (O'Brian, Stoner, Appel, & House, 2007). One possible explanation for the lack of identified knowledge in how preservice teachers learn may be due to the lack of consistency in terminology. Fieldwork, field experience, practicum, internship and student teaching are terms used in literature to describe the same aspects of student teaching or work done prior to student teaching (O'Brian, Stoner, Appel, & House, 2007). These experiences can range from simple observations to the culmination of a preservice teacher's education—student teaching. This is a range too great in task to make comparisons of the experience without better identifying the activity in which preservice teachers are engaged.

Another area of preservice teaching that has received—and continues to receive—attention in current research is teachers' beliefs and how they impact different aspects of the classroom, with student achievement being of greatest concern (Hill, Rowan, & Ball, 2005; Ashton & Webb, 1986). Researchers have failed to reach consensus as to how beliefs change during a preservice program. "The lack of consensus (about how beliefs and knowledge are formed) renders the period of preservice teacher education fruitful for examining the development of teacher efficacy beliefs" (Charalambos, Philippou, & Kyriakides, 2008, p. 128).

Before teachers can begin to prepare to teach mathematics, they must unlearn the way they were taught (Ball, 1988), or change their beliefs about mathematics. Preservice teachers' beliefs about mathematics affect the way they learn mathematics, and their beliefs must challenged in order for them to see mathematics in a new way (Ball, 1988). Future teachers have spent countless hours observing their own teachers and have made their own conclusions about what mathematics is, what a teacher's role is, and how the subject should be taught.

Research demonstrates that teacher beliefs impact the cycle of learning in crucial ways. Teacher beliefs affect that affective domain in a classroom by impacting such elements as that teacher's attitude (Ashton & Webb, 1986; Wilson, 1996), and level of trust (Woolfolk & Hoy, 1990). The cognitive domain is also affected by a teacher's beliefs and shows up in the classroom in modes of instruction. A teacher with low efficacy beliefs will rely on computation and memorization (Battista, 1994), and procedural over conceptual learning (Phillip, et al., 2007). Further, students of teachers with high efficacy beliefs have been shown to have greater success than students of teachers with low efficacy (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). This lifespan of experiences affects how these students, who become preservice teachers, think about mathematics (Ball, 1988; Phillip et al., 2007). As a consequence, preservice teachers bring with them inadequate knowledge to fully grasp how to teach mathematics

(Ball, 1988) as well as apprehensions about teaching the subject (Huinker & Madison, 1997).

But, only when preservice teaching programs challenge prevalent paradigms can new strategies for effective teaching be explored. Challenging held beliefs is an area of interest, especially efficacy beliefs, as they have significant predictive qualities.

Researchers have investigated teacher efficacy beliefs for nearly 30 years, and have made progress in understanding its nature, how it relates to other variables, and how it can be measured (Utley, Moseley, & Bryant, 2005). The earliest study, conducted by the RAND corporation measured items such as a teacher's beliefs about environmental factors that influence students' performance, as well as a teacher's belief that her efforts could reach a student. These items match closely with what has since been termed general teaching efficacy—or outcome expectancy—and personal teaching efficacy.

During the 1980's and 1990's the construct of teacher efficacy became more closely associated with Bandura's social cognitive theory, and was further refined (Utley, Moseley, & Bryant, 2005). The Teacher Efficacy Scale, developed by Gibson and Dembo (1984), was created to comprise two subscales, outcome expectancy and personal efficacy. Gibson and Dembo's scale led to the development of content-specific scales, such as the Mathematics Teaching Efficacy Beliefs Instrument, which has been used in many studies to further investigate teachers' efficacy beliefs. Specific studies and their finding are discussed in remaining sections of the literature review.

Teacher Content Knowledge

Content knowledge is a term used to describe both procedural knowledge—skills needed to work a problem—and conceptual knowledge—themes that connect mathematics ideas. Both are necessary knowledge domains needed to be an effective teacher. Unfortunately, teacher education programs are inadequately preparing future teachers in both procedural and conceptual content knowledge (Burton, 2006; Ball and Wilson, 1990).

Experienced and preservice teachers alike rely on procedural knowledge, and believe that a good teacher is one who shows students exactly how to work a problem (Capraro, Capraro, Parker, Kulm, & Raulerson, 2005), while ignoring rich conceptual teaching and learning. For example, a teacher who solely relies on procedural knowledge would teach the steps needed to solve a problem, but without referencing context. Most adults could easily compute the division problem twelve divided by three yet fail to recognize that this could be modeled as three groups of four or four groups of three depending on the question being asked (Swars, 2007). Without analyzing connections between mathematical operations, for example, mathematics, to the student, then becomes a large number of rules and steps to follow instead of a brilliant connection of ideas and ways of thinking.

"The belief, held by many PSTs, that mathematics is a fixed set of rules and procedures together with their belief that children and adults learn mathematics by being shown how to solve problems in a prescribed, step-by-step fashion can clash with the more conceptual, meaning-making goals that many mathematics-course designers hold for PSTs" (Phillip et al., 2007, p. 439). Preservice teachers do not enter their programs with the understanding that there is a difference between the mathematics knowledge one needs to be an effective teacher and the knowledge one needs to be a mathematician (Mohr, 2006). Often, students think that the more classes an individual successfully completes, the better teacher that individual would be. Preservice teachers that were good in mathematics were often good at memorizing facts and procedures, rather than being good at constructing rich knowledge. Research shows that it is likely to be a frustrating challenge for these good mathematics students to change from a traditional view of mathematics to a more constructivist view (Huinker & Madison, 1995).

Findings in studies that looked at mathematics content knowledge and teacher or student performance suggest that content knowledge by itself is not a predictor of success. Strawhecker found that teachers' content knowledge does not correlate with teacher performance (2005), indicating that there is more to teaching than merely acquiring content knowledge. Additionally, preservice teachers' grades earned as a student in previous mathematics courses do not predict effectiveness as a teacher (Capraro, Capraro, Parker, Kulm, & Raulerson, 2005). Likewise, there is little correlation (Swars, Hart, Smith, Smith, & Tolar, 2007) and even negative correlation (Ma, 1999) between the number of higher mathematics content courses teachers take and their students' learning, indicating that successful completion of college coursework does not guarantee comprehension of elementary mathematics. "Mathematics course-taking does not guarantee that preservice teachers apply their knowledge correctly in the classroom" (Capraro, Capraro, parker, Kulm, & Raulerson, 2005, p. 113). Knowing mathematics is a necessary, but not sufficient, requirement for teaching it.

However, studies from Ball (1990) and Ma (1999) suggest that students' learning is dependent on their teachers' content knowledge, but only when the interaction between content knowledge and the students' thinking about the mathematics content is also considered. In other words, an increase in the number of mathematics courses taken by the teacher is not in itself correlated with student achievement; but, when a teacher's mathematics coursework is considered along with how the teacher has taught her students to think about mathematics, then there is a correlation.

This suggests that the teacher's content knowledge must be accompanied by a certain kind of thinking about mathematics from both the teacher and the student, which reminds us of the importance of viewing mathematics not as procedures alone, but viewing mathematics in rich conceptual ways. Shulman referred to this knowledge as pedagogical content knowledge, or knowing how to represent specific subject content in an appropriate way to diverse learners (1986).

Although not a new construct, pedagogical knowledge has received attention in recent research (Ball, Lubienski, & Mewborn, 2001; Staub & Stern, 2002; Frykholm & Glasson, 2005: Strawhecker, 2005), and has also been found to have predictive qualities on student achievement (Hill, Rowan, & Ball, 2005). One example of pedagogical knowledge is questioning strategies, the ability to ask guiding questions or facilitate a conversation about a mathematical topic that leads students to the correct conclusion. This is a skill that is difficult to teach because it does not involve a series of steps that preservice teachers can follow. It requires that preservice teachers know the content, are comfortable speaking the language of mathematics, and have insight into what the student is struggling with—all of which take time and experience to develop.

To produce teachers who effectively teach mathematics, preservice programs must develop more than the content. Courses designed to increase future teachers' knowledge of mathematics must allow for rethinking not only the content, but also how to teach it (Wilson, 1996). The way preservice teachers think about mathematics is highly significant because it determines how they learn and subsequently teach (Ball, 2001). It should be a goal then, for preservice programs to develop correct thinking about the nature of mathematics.

Capraro, Capraro, Parker, Kulm, & Raulerson note that preservice programs are often measured by the success of the teacher certification examinations, which may not be aligned well with the richer more conceptual type of learning (2005). It becomes a balancing act for preservice programs to choose what to focus on, presenting mathematics content with little attention to deeper inquiry, or focusing on pedagogical issues with little focus on mathematical content. In their study dealing with preservice teachers' pedagogical knowledge, Capraro, Capraro, Parker, Kulm, & Raulerson confirmed previous research and found that students' performance in previous mathematics courses was not an important factor of pedagogical knowledge. However, previous mathematics coursework was the best predictor of mandated state exit tests (2005).

Preservice teachers who have more specialized content knowledge are more likely to believe that children can construct their own knowledge (Swars, Hart, Smith, Smith, & Tolar, 2007). A teacher's constructivist view is associated with larger student achievement gains in solving mathematics word problems (Staub and Stern, 2002). Conversely, it is the "lack of mathematics content knowledge that leads to ineffective mathematics instruction" (Capraro, Capraro, Parker, Kulm, & Raulerson, 2005, p. 113).

Constructivist teaching methods can require more time both in planning activities and in implementation. There is also concern from traditionalists that computational rigor may be lost. However, even though some teachers reject constructivist methods because of the fear that rigor will be lost, research shows that teachers with a more traditional view of teaching were no more successful than constructivist teachers in developing computational proficiency in their students (Staub and Stern, 2002). Clearly then, what teachers believe about mathematics affects how they teach and how effective they are with their students.

Teacher Beliefs

Research revealed that to impact beliefs, preservice programs should: teach by example, create opportunities for reflection, include field experiences, encourage problem-solving, and confront and challenge preservice teachers' beliefs about mathematics (Beck, King, & Marshall, 2001; Emenaker, 1995; Fleener, 1995; Johnston, 2001; Lee & Krapfl, 2002; Phillip et al., 2007; Steele, 1994; Wilcox, 1991). Two of the recommendations, challenging beliefs and fieldwork, were researched further.

Challenging beliefs.

Currently, there is a misalignment between what preservice teachers believe and learn in their coursework, and the expectations that national standards set forth (Phillip et. al, 2007; Lee & Krapfl, 2002). The National Council of Teachers of Mathematics has historically called for constructivist collaborative teaching methods, which have far-reaching implications for mathematics classrooms (NCTM, 2000). Working with preservice teachers becomes an important task, as these are the individuals who will help continue to usher in reform efforts. Therefore, teacher preservice programs must "model reform efforts both in content and methods", and that over a period of time changes will come (Lee & Krapfl, 2002, p. 247).

At what point should a preservice program begin modeling reform? By the time a student enters college, his or her beliefs are well established (Swars, Hart, Smith, Smith, & Tolar, 2007) which implies that teacher preparation programs have a limited amount of time to change a preservice teacher's pedagogical beliefs. If beliefs are well established when a student enters college, then it seems clear that the earlier those beliefs are challenged, the more likely they could be changed. Although it is typical for preservice teachers to have intensive field experiences at the end of their education—namely student teaching—an earlier field experience would be appropriate if preparation programs have a vested interest in challenging preservice teachers' beliefs.

It is the responsibility of teacher preparation programs to address preservice teachers' beliefs. "Teacher educators must be aware of their students' beliefs and plan for experiences which will have positive impact on teacher self-efficacy and outcome expectancy" (Enochs and Riggs, 1990, p. 701). Phillip et al., also calls for an earlier introduction of experiences—experimentation, invention and discovery—that challenge preservice teachers' beliefs, noting that "these changes will help the PSTs to approach their future mathematics experiences from a meaning-making perspective so that they might take full advantage of future mathematics content and methods courses" (2007, p. 472).

There is evidence that preservice teachers' beliefs can be changed (Emenaker, 1995). Since a teacher's beliefs affect methodology (Wilcox, 1991), student achievement (Ashton & Webb, 1986), the level of responsibility taken for student achievement (Guskey, 1982), and positive attitudes about teaching (Guskey, 1984), preservice programs should be concerned with addressing preservice teachers' beliefs. Beliefs of preservice teachers must be confronted and tested, opportunities for conversation and reflection must be made available to preservice and new teachers, and there must be veteran teachers or other mentors available to guide both preservice and new teachers.

> "If understanding the teaching/learning process from a constructivist view is itself constructed, and if teachers tend to teach as they were taught, rather than as they were taught to teach, then teacher education needs to begin with these traditional beliefs and subsequently challenge them through activity, reflection, and discourse both in coursework and fieldwork throughout the duration of the program" (Fosnot, 1996, p. 206).

Fieldwork.

Ambrose indicates that fieldwork does have an impact on preservice teachers' beliefs, noting that during coursework preservice teachers "treat their coursework as an exercise in memorization rather than a meaning-making experience…because their beliefs about mathematics limit their engagement with the course material" (2001, p. 3). Ambrose showed that fieldwork can be used to impact preservice teachers' beliefs about how mathematics is learned (2001).

Preservice teachers with field experiences show an increase in content knowledge and in constructivist beliefs when compared with those preservice teachers without field experiences (Phillip et al., 2007). Preservice teachers' beliefs can be changed; however, it is doubtful that beliefs can be changed without a simultaneous fieldwork experience. "Trying to examine a preservice teachers' 'beliefs' in a classroom absent a concurrent field placement implies to some extent that stated beliefs or other cognitive measures can be decontextualized in language" (Spielman, n.d., p. 127). Preservice teachers do not yet have the experiences and the language necessary to address their underlying beliefs about teaching. Concurrent fieldwork allows them a context in which to examine their beliefs. Allowing preservice teachers to learn in a context in which they can examine beliefs aligns with Bandura's Theory of Self-Efficacy, which suggests there are four sources that contribute to the development of self-efficacy: enactive experiences, vicarious experiences, social persuasion, and physiological and emotional arousal.

Enactive experiences are thought to be strongest sources of efficacy. A sense of accomplishment will increase self-efficacy, whereas a sense of defeat will lower self-efficacy. Because of the numerous uncontrollable factors in any elementary classroom, fieldwork can be a positive or negative experience for preservice teachers. If a preservice teacher works one-on-one with a struggling child, that preservice teacher may leave with a decreased sense of her ability to teach. In contrast, if that preservice teacher works with a student who catches on quickly, the preservice teacher may leave with an increased sense of her ability to teach. Vicarious experiences relate to observing someone else perform the task. The message is sent to the observer that, "If they can do it, I can do it." As the preservice teacher watches a teacher effectively teaching, the preservice teacher's self-efficacy should be affected.

Charalambos, Philippou, & Kyriakides set up interviews at several points during preservice teachers' student teaching experiences. They found that the preservice teachers' initial sense of self-efficacy had been established mainly by previous enactive experiences in elementary school. In a follow-up interview, they discovered that self-efficacy had been shaped again mainly by enactive experiences, namely, how well—or not—the children in their student teaching classrooms reacted to the lessons they taught

(2008). They further suggest that preservice teachers' development of self-efficacy during student teaching is not uniform. Those preservice teachers with very low efficacy should be identified early on and offered the extra support they need to be effective teachers (Charalambos, Philippou, & Kyriakides, 2008).

Assessing fieldwork is challenging because each preservice teacher may respond differently to the same situation. Likewise, field experiences are not all the same, and cannot be measured by just the amount of time spent in an elementary classroom. In order for preservice teachers' beliefs to be impacted, meaningful experiences must take place during field experiences. The benefit of field experiences depends on (1) the quality of the mentorship, (2) the rigor of the pedagogical expectations, and (3) the willingness of the preservice teacher to engage in content and pedagogy (Capraro, Capraro, Parker, Kulm, & Raulerson, 2005).

Although the effects of fieldwork cannot be measured by just the amount of time in a classroom, the amount of time spent in field experience classrooms did in fact impact the extent to which preservice teachers were able to develop mathematical ideas conceptually for their students (Capraro, Capraro, Parker, Kulm, & Raulerson, 2005). Preservice teachers who participate in extended field experiences become better math teachers, and more experience in the classrooms fosters deeper understanding of the teaching and learning process (Capraro, Capraro, Parker, Kulm, & Raulerson, 2005). Time on task seems to be a factor in improving preservice teachers' development of conceptual understanding. The task itself is a factor of improving preservice teachers' beliefs. Different aspects of fieldwork impact the amount of change in preservice teachers' beliefs. Preservice teachers who analyzed videos of children solving problems, and then worked with children face-to-face showed a greater move toward constructivist beliefs than those who merely observed an elementary classroom (Phillip et al., 2007).

The preservice teachers who analyzed videos were exposed to a child's way of thinking, rather than assuming their own process was the only way, which caused preservice teachers to rethink what was assumed to be known. However, preservice teachers who observed a classroom were outsiders with no opportunity to investigate how the children were processing information. There was little opportunity for the preservice teachers' beliefs to be challenged.

Teacher Efficacy

Teacher efficacy has been the focus of several researchers (Ashton & Webb, 1986; Gibson & Dembo, 1984; Woolfolk & Hoy, 1990; Guskey & Passaro, 1994; Swars, 2007). In early studies, teacher efficacy was measured simplistically. Since the development of more task-specific instruments, teacher efficacy is in most cases now researched in terms of its two components: personal teaching efficacy and teaching outcome expectancy (Enochs, Smith & Huinker, 2000). Personal teaching efficacy is a teacher's beliefs in the skill to be an effective teacher. Teaching outcome expectancy is a teacher's belief that effective teaching can positively impact learning.

Significance and Impacts of Teacher Efficacy.

"No other teacher characteristic has demonstrated such a consistent relationship to student achievement (than teacher efficacy)…A potentially powerful paradigm for teacher education can be developed on the basis of the construct of teacher efficacy" (Ashton, 1984, p. 27). There are strong implications for elementary classrooms: simply increasing teacher efficacy would result in an associated increase in student achievement.

Research on teacher efficacy indicates that a teacher's classroom behavior—including instructional strategies, willingness to embrace reform, commitment to teaching, and dedication to student achievement—is affected by her degree of efficacy (Swars, Daane, & Giesen, 2006). Behaviors such as persistence at a task, risk-taking, and innovations are related to degrees of efficacy (Ashton & Webb, 1986). Ashton and Webb (1986) suggested that teachers' self-efficacy varies depending on what subject is being considered. If a teacher's efficacy is low in mathematics, for example, perhaps less time in preparation and implementation would be devoted to the subject.

Likewise, if a teacher's efficacy is high in mathematics, then more time in preparation and implementation would be devoted to the subject. While there are many exceptions—some teachers with low efficacy in mathematics would actually spend more time in preparing their mathematics lessons—most people simply prefer to spend more time doing what they are good at. Teachers with low efficacy in mathematics might convince themselves that it is acceptable for their students to be low achievers in mathematics as well.

Gibson and Dembo (1984) found that there are differences in classroom behavior when comparing teachers with low and high efficacy. When students of low efficacy teachers asked questions, 4% of the teacher reactions involved criticism; whereas, with high efficacy teachers, there was no criticism. Low efficacy teachers were more likely to respond to wrong answers by giving the answer or asking another student, while high efficacy teachers chose to lead the students to the correct response. Low efficacy teachers appeared flustered by interruptions to their schedule while high efficacy teachers seemed more at ease with change. A teacher's low efficacy may result in reduced quality of teaching the topic, and the negative belief is often transferred to the student, whereas teachers with positive beliefs cultivate similar beliefs among their students (Wilson, 1996).

Teacher efficacy is an area of interest to researchers because of its predictive impact on both students and teachers (Esterly, 2003). According to Bandura's Theory of Self-Efficacy there are four influencers of self-efficacy. From the literature, there are two pronounced factors: content-specific methods coursework and fieldwork.

Methods coursework.

Changes that are mandated by national reformists such as the National Council of Teachers of Mathematics (NCTM) which promote a move from simply acquiring facts to using and applying mathematical ideas to facilitate making relationships and predicting, implies changes in the classroom (TSS, 1997). Since many preservice programs offer mathematics methods courses that are inconsistent with the requirements to teach mathematics (TSS, 1997), often there may exist a misalignment between what preservice teachers are taught and what they are expected to teach. Since poor teaching often begets poor teaching, a systemic cycle is created. The Texas Statewide Systemic Initiative (TSS) recommends that to break the cycle of poor mathematics education, faculty of preservice teachers should make use of a variety of teaching strategies to reach all learners, and should present preservice teachers with challenging tasks in an environment where it is safe to take risks (1997).

A constructivist mathematics methods course relies on a hands-on, minds-on philosophy. Instructors approach content through building concepts, using investigations, student-centered activities, and manipulatives. Students are seated in groups and engage in discussions, dialogue to defend their answers, and work towards the discovery of solutions. These characteristics of a constructivist classroom are aligned well with what research indicates are factors that contribute to positively impacting personal efficacy. Palmer reports that the use of the inquire approach, hands-on activities, group investigations, activities relevant to the primary classroom, relating concepts to the real world, practice teaching exercises, and a classroom environment that promotes fun and success are factors of a methods course that have the potential to contribute to change in efficacy (2006).

A constructivist mathematics methods course is the ideal place to approach preservice teachers' teaching efficacy beliefs because it is here that preservice teachers are being challenged to unlearn the way they were taught, to relearn with a child's perspective, and to put what they learn into practice. Negative past experiences in mathematics classrooms have formed unhealthy attitudes and beliefs in preservice teachers which need to be changed before the teaching years begin.

Swars reports that many studies on preservice teachers and teaching efficacy have examined effects of mathematics methods courses (2006). Constructivist mathematics methods coursework has been shown to have a positive impact on teaching efficacy (Swars, n.d.; Cooper & Robinson, 1991; Vinson 2001; Strawhecker 2005; Quinn 2001; Huinker and Madison 1997; Utley, Moseley, & Bryant, 2005). Quinn researched the effects of mathematics methods courses on attitudes and content knowledge of preservice teachers and found that preservice teachers' attitudes toward mathematics as well as their pedagogical content knowledge of mathematics improved significantly as a result of the methods course (2001). He concluded that the more time that is spent in methods courses observing sound pedagogy, the more positive change can be affected in preservice teachers' pedagogical content knowledge and attitudes. Preservice teachers' time on task, then, is a topic for further investigation.

A teacher's sense of efficacy affects instructional strategies which ultimately affects student achievement (Riggs & Enochs, 1990). Therefore, efficacy beliefs should be considered in a preservice program, more specifically in the methods courses. Preservice teachers in discipline-specific methods courses have been the target of much research as they are an ideal population to work with if change is going to occur within our schools.

In the last decade, research that investigates the impact of methods courses on teaching efficacy beliefs has begun to receive attention. For this portion of the literature review, only articles that strictly dealt with methods courses and teacher efficacy were selected. Utley, Moseley, and Bryant found that preservice teachers in mathematics and science methods courses showed an increase in both personal teaching efficacy rates as well as outcome expectancy beliefs (2005). Likewise, Huinker and Madison (1997) found that significant increases occur in self-efficacy and outcome expectancy when preservice teachers are in a constructivist course, finding that the gains in efficacy were related to whether or not the students were able to shift from a traditional teaching paradigm to a more constructivist one. Research dealing just with methods course and teaching efficacy is limited.

These studies were done with student teachers, an ideal sample. However, because all student teachers are required to student teach, there was no control group. "Comparisons to methods courses without a fieldwork component could help identify the specific elements of influence that arise from experiences in which preservice teachers work with children in elementary classrooms" (Huinker and Madison, 1997, p. 18).

Fieldwork.

Fieldwork gives future teachers opportunities to implement what they have learned. Fieldwork is highly beneficial to preservice teachers' development in attitudes, beliefs, and skills (Bright, 1994; Emenaker, 1995; Johnston, 2001; Steele, 1994). It is the field where future teachers can "make their first steps as teachers and observe experienced teachers, having sometimes the role of teachers and sometimes as learners" (Krainer & Goffree, n.d., p. 233). It is the field that provides opportunity for early teaching experiences to help preservice teachers connect theory to practice (Davis, Petish, & Smithey, 2006).

The findings are not conclusive, possibly because fieldwork can imply a variety of different events and can happen during different years in a preservice teachers' education. But, the majority of research indicates that fieldwork has positive impacts on preservice teachers' teaching efficacy. The aim of this portion of the literature review was to determine what effect fieldwork has on preservice teachers' beliefs. Research chosen for this portion of the literature review deals with fieldwork as it relates to teaching efficacy.

In a meta-analysis, Davis, Petish, and Smithey found that fieldwork within a methods course contributes to the maturation of preservice teachers' understanding of content as well as an increase in teaching efficacy (2006). Similar findings indicate that after six months of fieldwork, preservice teachers showed a large increase in efficacy rates (Wilson, 1996), and preservice teachers made positive gains when involved with one-on-one tutoring sessions while concurrently enrolled in a subject-specific methods course that matched the content being tutored (Hedrick, 2000).

Moyer and Husman (2006) worked with senior preservice teachers and found that those who took part in fieldwork while concurrently enrolled in a mathematics methods course—located at the fieldwork site—showed greater ownership of and more responsibility for their own learning, had a clearer picture of their future as teachers, and had greater understanding of their coursework than those preservice teachers who did not participate in the fieldwork experience.

However, efficacy must be segmented into its two components in order to provide meaningful results (Woolfolk & Hoy,1990). "The results of such a combination can be misleading…sense of teaching efficacy changed in one direction, and sense of personal efficacy changed in the opposite direction" (Woolfolk & Hoy, 1990, p. 296). There are inconclusive findings with respect to fieldwork when efficacy is segmented into its two components: outcome expectancy beliefs and personal teaching efficacy beliefs.

Research reveals inconclusive results regarding fieldwork taken with methods courses. Although each study that follows deals with teaching efficacy and fieldwork, there were differences in each study that should be mentioned. Because of the complex nature of attempting to measure results of fieldwork, each study will be presented with unique characteristics discussed.

Woolfolk and Hoy studied preservice teachers' orientations of control. The study attempted to set up, as close as possible, experimental and control groups by including three samples of students in their study: (1) preservice teachers who were student teaching served as the experimental group, (2) preservice teachers during methods courses, and (3) preservice teachers in the beginning of their educational career. The latter two groups served as the control group. The study used the Teacher Efficacy Scale (1990). They found that during student teaching, student teachers' personal teaching efficacy improved but outcome expectancy—termed general teaching efficacy in their study—decreased during student teaching. A possible explanation suggested that during student teaching, the reality of all that is expected of a teacher sets in.

The nonstudent-teaching samples experienced significant positive changes in their personal teaching efficacy, but did not change in their outcome expectancy—general teaching efficacy. "The picture that emerges from these findings is that student teaching influences the orientation of prospective teachers by making them…less confident in the power of schools to overcome students' background and ability deficits, but more confident in their personal efficacy" (Woolfolk & Hoy, 1990, p. 295).

Fieldwork simultaneously occurring with a constructivist methods course has been found to increase both personal efficacy and outcome expectancy. Huinker and Madison established that personal teaching efficacy as well as outcome expectancy significantly increased in both mathematics and science efficacy beliefs for preservice teachers who were enrolled in a constructivist methods course. The study used the Mathematics for Teaching Efficacy Beliefs Instrument and the Science for Teaching Efficacy beliefs Instrument. In this study, emphasis was placed on shifting preservice teachers' beliefs from traditional to constructivist thinking (1997).

Swars also found that both personal teaching efficacy and outcome expectancy significantly increased (2007). The study used the Mathematics for Teaching Efficacy Beliefs Instrument to compare beliefs of preservice teachers to those of inservice teachers after two semesters of time-intensive work with students.

Utley, Mosely, & Bryant tracked preservice teachers during their methods course and during fieldwork. They measured efficacy beliefs twice, once during the methods course and once during student teaching (2005). The Mathematics Teaching Efficacy Beliefs Instrument and the Science Teaching Efficacy Beliefs Instrument were used. The results of their study revealed that preservice teachers' mathematics and science beliefs moved in similar directions at similar times. During the course itself, both personal teaching efficacy and outcome expectancy for mathematics and science increased. However, during student teaching, there was no change in personal teaching efficacy yet outcome expectancy increased. This may suggest that a methods course is an influential factor of personal teaching efficacy, while fieldwork is an influential factor of outcome expectancy.

Plourde studied preservice teachers' beliefs about teaching science during student teaching experiences (2002). The instrument used was the Science Teaching Efficacy Beliefs Instrument. Results of this study showed no change in personal teaching efficacy but a decrease in outcome expectancy. Again, this may suggest that fieldwork is an influential factor of outcome expectancy—whether positive or negative.

Swars found that preservice teachers who were engaged in fieldwork and professional development prior to student teaching increased in personal teaching efficacy, and had stable outcome expectancy beliefs during their student teaching experience (2010). Fieldwork before student teaching contributes to outcome expectancy beliefs remaining stable (Swars, Hart, Smith, Smith, & Tolar, 2007; Swars, 2010) during student teaching.

There is a “crucial importance of placing preservice teachers in classrooms before their student teaching experiences” (Davis, Petish, & Smithey, 2010, p. 19). This study places preservice teachers in classrooms within their first two years of college.

CHAPTER THREE: METHODOLOGY

Overview of the Study

Research shows that a teacher's beliefs affect what happens in a classroom, which ultimately affects student learning (Ashton & Webb, 1986; Esterly, 2003; Raudenbush, Rowan, & Cheong, 1992; Tschannen-Moran, Woolfolk & Hoy, 1998; Hill, 2005). A competent teacher who believes what she does makes a difference for students will perform differently than an apprehensive teacher who believes there is nothing that can be done for her students. Since a teacher's beliefs are only malleable for a limited amount of time (Swars, Hart, Smith, Smith, & Tolar, 2007), training programs must challenge and change unproductive beliefs in addition to preparing preservice teachers in content before future teachers enter the classroom to teach.

This study investigated what impact fieldwork has on preservice teachers' mathematics self-efficacy and outcome expectancy beliefs. This chapter provides a description of the study's methodology, procedures, and data analysis. Information about the subjects and sampling procedures is also provided.

Students in this study enrolled in a mathematics for teachers two-course sequence. Three sections served as the control group and were not required to participate in fieldwork. Three sections served as the experimental group, and were required to participate in fieldwork. In an attempt to form similar control and experimental groups, each section's length of term and time of day was taken into consideration. Of these six sections, two were daytime eight-week courses, two were evening eight-week courses, and two were daytime sixteen-week courses. The control and experimental groups were each comprised of one daytime eight-week section, one evening eight-week section, and one sixteen-week section. Data collection took place during the Fall, 2010 and Spring, 2011 semesters.

One might expect that every methods course would have a fieldwork requirement; however, this is not the case at these community colleges. The methods courses are taken two years before student teaching experience, and there is no mandated requirement that fieldwork be included in the curriculum. This is a significant aspect of this study, as there is a lack of research with preservice teachers at the community college level, and a lack of experimental research using early fieldwork experiences. Thus, the findings of a study like this could have far-reaching implications.

Data for this study were collected from the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI). The Mathematics Teaching Efficacy Beliefs Instrument measures two constructs: personal mathematics teaching efficacy, and mathematics teaching outcome expectancy. Scores were also collected using the Texas Assessment of Knowledge and Skills (TAKS) for 6^{th} graders. The ages of preservice teachers were also recorded. Data for this study were analyzed using XLStat and SPSS software.

Null Hypotheses 1: There will be no significant difference in the means of PMTE scores for the experimental group, which participated in fieldwork, and the control group, which did not participate in fieldwork.

Null Hypotheses 2: There will be no significant difference in the means of mathematics teaching outcome expectancy scores for the experimental group, which participated in fieldwork, and the control group, which did not participate in fieldwork.

Null Hypotheses 3: There will be no significant difference in the mean scores of the experimental group, which participated in fieldwork, as measured by the Mathematics Teaching Efficacy Beliefs Instrument pretest and posttest for personal mathematics teaching efficacy.

Null Hypotheses 4: There will be no significant difference in the mean scores of the experimental group, which participated in fieldwork, as measured by the Mathematics Teaching Efficacy Beliefs Instrument pretest and posttest for mathematics teaching outcome expectancy.

Design of the Study

Six sections of the mathematics for teachers two-course sequence were selected, coming from two community colleges. Course content, standards and methodology were the same for all sections. Three sections composed the experimental group, in which preservice teachers were required to participate in fieldwork. The other three sections composed the control group, in which students were not required to participate in fieldwork.

A total of three instructors were part of the study, all of whom are full-time faculty and have taught these courses for over five years. One faculty member taught one daytime experimental section, and one evening experimental section. Another faculty member taught one daytime control section and one evening control section. The third faculty member taught one daytime experimental section, and one daytime control section. The assignment of sections to the control or experimental group was based on whether or not the instructor required fieldwork as a component of the course. Before the project began, in order to ensure that the students in each group were treated uniformly, the instructors met regularly to coordinate their plan of action. This strategy strengthened the study's validity.

To quantitatively determine if fieldwork had an effect on preservice teachers' mathematics efficacy beliefs, a Quasi-Experimental design was used. More specifically, this was a control group pretest-posttest design that looked at mean differences in mathematics efficacy between the control group and experimental group during the two course sequence. Gall, Gall, & Borg (2003) note that when using the pretest-posttest control group design, "If properly carried out, the pretest-posttest control group design effectively controls for eight threats to internal validity" (p. 392).

Four sections of the mathematics methods sequence were taught in a short-term format, where each course lasted half of a semester. Two sections were taught in the regular-term format, where each course lasted a full semester. Some students finished the two course sequence in one semester, while others finished in two semesters. This study also investigated the impact that length of term had on preservice teachers' personal mathematics teaching efficacy and mathematics teaching outcome expectancy. (See Appendix A).

The same students were enrolled in the first and second course making it possible to track progress over the two-sequence period. Students attended the same college and had the same instructor for the two-course sequence.

The courses were taught using similar methodology, assignments, grading policies, and course calendars. All students had the same experience in the first course. However, in the second course, the experimental group was involved in fieldwork, whereas the control group was not.

Fieldwork took place in elementary or middle school settings. “Fieldwork” has come to imply a variety of activities. For this study, fieldwork implies that a preservice teacher supplemented an elementary/middle school teacher’s instruction in a one-on-one setting with the possible use of manipulatives. Some preservice teachers also led mathematics related activities in small group settings. The aim of this study was to have preservice teachers take the ideas of constructive teaching/learning from the methods course and apply them in a school setting. Therefore, observation alone was not enough to fulfill requirements for the course, as it would not have provided the interaction necessary to challenge beliefs and construct knowledge (Phillip, 2007).

Preservice teachers were placed in a school that had a partnership with their community college. Each preservice student was to meet the same ten-hour fieldwork requirement. Although the grade levels assigned ranged from pre-K to middle school to reflect topics in the two methods courses, most placements occurred at the elementary school level.

Subjects

The subjects in this study were an accessible population of freshmen and sophomores enrolled in a two-course mathematics methods sequence. Participants came from two community colleges in the Midwest, with populations of approximately 9,000 and 14,000 students respectively.

The sample’s ethnicity is reflective of the surrounding community at large: approximately 40% Hispanic, 40% non-Hispanic Caucasian, 15% African American and 5% other. Nationally, of the preservice teachers attending community college, 15% are Hispanic and 13% are African American (Ostos, 2011). Of the students in the study, 75% were female, compared with the national average of 80% (Ostos, 2011).

The students ranged in age from early twenties to late forties. Age diversity is typical of a community college, where some students enroll directly out of high school, while others are beginning a second career in education. More than half of the participants were nontraditional in that they had families to care for, lived off campus, were first generation college students, and worked at least part-time.

Students entered the courses having varying mathematics abilities, but all students had at least completed college algebra. It was expected that most students would not remember basic arithmetic skills as they have relied on calculators for the majority of their mathematics career. In the mathematics methods courses, basic skills were revisited early on to ensure students had the necessary groundwork to successfully complete the courses. Typically, students are initially frustrated at their lack of ability to perform basic skills without a calculator. However, through class discussions and investigations, students soon come to recognize the danger in solely relying on memorization, and see the importance of learning at deeper levels. This shift in learning frames the type of learning required for the rest of the course.

The method of learning mathematics for most participants has been memorization, which makes this course difficult, as it requires deep understanding of content, fluent use of vocabulary, and recognition of the interconnectedness of basic and abstract mathematics concepts. Through the two-course sequence, students move from passively receiving information to constructing, dialoguing about, and synthesizing information. This is usually a major change in the way they have learned mathematics up to this point.

The past experiences of students varied: some had never been in the classroom or worked with children, while others had worked at daycares or volunteered in elementary classrooms. Some students had taken an education course, which may have required fieldwork or some element of interaction with children. But very few students worked with children specifically in mathematics under formal guidelines as this fieldwork experienced required.

Since most students had not formally worked with children in the discipline of mathematics, their beliefs about teaching mathematics had not yet been solidified. This study investigated how students' beliefs about their own ability to teach mathematics, and the likelihood that their teaching would result in students' learning, changed during the fieldwork experience.

Upon entering the methods courses, preservice teachers had completed their basic course requirements and most had a transfer agreement in place to a four-year university, so motivation was generally a positive factor. There was rarely a problem with absences or lack of commitment to the course. Students naturally formed groups and often studied together, showing support of each other and commitment to learning.

Instrumentation

The Mathematics Teaching Efficacy Beliefs Instrument was used to measure preservice teachers' teaching efficacy beliefs. The Mathematics Teaching Efficacy Beliefs Instrument is a Likert-type survey that yields numerical data in two categories: personal teaching efficacy and outcome expectancy. Personal teaching efficacy is confidence in one's own teaching ability, and outcome expectancy is the degree to which one believes that student learning can be influenced by effective teaching.

This survey offers a broad-spectrum perspective into preservice teachers' beliefs. Although aggregating a class's scores together prevents insight into a specific preservice teacher's growth, this study aimed to answer the general question of what happened to the class as a whole over time, then to investigate what happened to various types of students such as high/low efficacy and high/low content knowledge. Looking at class means allowed for a broad view while, looking at means for types of students allowed for a more in-depth view.

The Mathematics Teaching Efficacy Beliefs Instrument is a modification of the Science Teaching Efficacy Beliefs Instrument. The Mathematics Teaching Efficacy Beliefs Instrument consists of 21 items. Thirteen items measure personal mathematics teaching efficacy (PMTE), with scores ranging from 13 to 65 on this section. Eight items measure mathematics teaching outcome expectancy (MTOE), with possible scores ranging from 8 to 40 on this section.

The validity and reliability of this instrument were established and found to be acceptable in a study by Enochs, Smith, and Huinker (2000). The first version of the Mathematics Teaching Efficacy Beliefs Instrument consisted of 23 items; however, two items were deleted as they were found to be invalid. The current version of the Mathematics Teaching Efficacy Beliefs Instrument now has 21 items. "Reliability analysis produced an alpha coefficient of 0.88 for the PMTE scale and an alpha coefficient of 0.77 for the MTOE scale" (2000).

The instrument's validity was established through confirmatory factor analysis, a process that "relies on a specific hypothetical or expected factor structure and serves to confirm its presence in the data" (2000). Enochs, Smith, and Huinker reported that, because the initial confirmatory factor analysis yielded a figure less than the 0.90 good model fit, an improved model was sought. The modified model provided an acceptable confirmatory factor index of 0.919.

The mathematics content knowledge test is the mathematics portion of the Texas Assessment of Knowledge and Skills (TAKS) state test given to sixth graders. This test was used along with the Mathematics Teaching Efficacy Beliefs Instrument to categorize students into four groups, high/low efficacy and high/low content knowledge. The rationale for using a test given to sixth graders, instead of a teacher preparation type of test, is that preservice teachers in this course are freshman or sophomores and have not had exposure to educational theory. Furthermore, most students enter these courses lacking basic mathematics skills. The 4^{th} grade test was piloted in Fall, 2009 and found to be too easy for most. The 6^{th} grade test was piloted in Spring, 2010 and found to be a measure that could be used to group students by ability.

The Kuder Richardson Formula 20 (KR20) established the reliability of the TAKS test. Reliability is reported to range from 0.87 to 0.90 (TAKS, 2008). Content validity was established by seeking input from current and former teachers nationwide, along with test development specialists. Groups were asked to develop test objectives and create test questions. Content validity and construct validity are reported to be intertwined for the TAKS test. “The construct tested is the academic content required by the statewide curriculum. With curriculum-based achievement tests, both types of validity are intertwined” (TEKS, 2004, p. 121). Criterion-related validity was established by “…correlating performance on exit level TAKS tests with performance on national testing programs” (TEKS, 2004, p. 122).

Sampling Procedure

The population of this study comprised 127 preservice teachers at two community colleges in the Midwest. This study used pre-existing classes of students for its sample, and is therefore a nonrandomized sample.

Institutional Review Boarb (IRB) approval was obtained prior to the data being collected for this study. Participants were enrolled in a two course sequence designed for elementary and middle school preservice teachers from August 2010 to May 2011. Prior to the beginning of the semester, all instructors involved in the study met to be trained on protocol (see Appendix B) for administering the Mathematics Teaching Efficacy Belief Instrument (See Appendix C) and the mathematics content test. Instructors also compared foci of the course, assignments and projects, and methodologies. Similar assignments and approaches were used among all instructors.

During the first week of class, instructors informed students that the course in which they enrolled was being used as part of a research project. Students in both the control and experimental group were given a consent form (see Appendix D) and told they had the option to participate in the study. Those willing to participate signed the consent form and were given the Mathematics Teaching Efficacy Beliefs Instrument in class. Less than 5% of students declined to be in the study. Students enrolled in the researcher's class were asked to use code names on all administrations of the Mathematics Teaching Efficacy Beliefs Instrument survey to reduce possible instructor bias. The mathematics content test was also given to all students during the first week of the first methods course.

No problems arose with the administration of the Mathematics Teaching Efficacy

Beliefs Instrument. There was a concern related to the administration of the content test, however. Students were given approximately 50 minutes to complete the test. However, some students did not finish in the allotted time. Because one instructor chose to allow students more time to finish and two instructors did not, only the first 25 (out of 46) questions were considered in calculating a student's score to give all students as similar a testing experience as possible.

The initial administration of the Mathematics Teaching Efficacy Beliefs Instrument occurred during the first week of the first mathematics methods course. The second administration of the Mathematics Teaching Efficacy Beliefs Instrument occurred during the last week of the second mathematics methods course. An Analysis of Variance (ANOVA) was done to determine if there was a significant difference between the experimental group's personal mathematics teaching efficacy pretest and posttest, and between the experimental group's mathematics teaching outcome expectancy pretest and posttest scores.

The initial scores of the Mathematics Teaching Efficacy Beliefs Instrument and the Texas Assessment of Knowledge and Skills (TAKS) mathematics content test were used to form four categories of students in the experimental group: high efficacy and high content knowledge, high efficacy and low content knowledge, low efficacy and high content knowledge, and low efficacy and low content knowledge. First, the mean of the personal mathematics teaching efficacy portion of the Mathematics Teaching Efficacy Beliefs Instrument was calculated for students in the experimental group. Students whose personal mathematics teaching efficacy score fell below the mean were categorized as having low PMTE, and students whose personal mathematics teaching efficacy score was above the mean were categorized as having high PMTE. Personal mathematics teaching efficacy was chosen to form groups instead of mathematics teaching outcome expectancy. The researcher's initial interest in forming these groups was to investigate the impact that fieldwork has on preservice teachers' beliefs about their perceived ability.

Next, the mean of the mathematics content test was calculated for students in the experimental group. Students whose content score fell below the mean were categorized as having low content knowledge, and students whose score was above the mean were categorized as having high content knowledge.

Four groups were formed: high efficacy and high content knowledge, high efficacy and low content knowledge, low efficacy and high content knowledge, and low efficacy and low content knowledge. Although, the four groups were not treated differently based on their test results, the researcher expected that fieldwork would have differing effects on each groups' mathematics teaching efficacy.

The main focus of this study was to examine what effect fieldwork had on mathematics teaching efficacy beliefs. A minor focus was to investigate what type of student benefitted most from fieldwork. For example, would a student that had low content knowledge and low efficacy show more or less improvement during fieldwork than a student with high efficacy and high content knowledge?

The Mathematics Teaching Efficacy Beliefs Instrument was administered two times in class: the beginning of the first methods course, and the end of the second methods course. The mathematics content test was administered one time in class at the beginning of the first methods course. The content test was used in conjunction with the

Mathematics Teaching Efficacy Beliefs Instrument to group students by mathematics ability and personal mathematics teaching efficacy so the effects of the course and fieldwork could be seen on different types of students (high efficacy/low content knowledge, for example).

Data Analysis Procedures

This study is a nonrandomized pretest-posttest control group design. Descriptive statistics (mean and standard deviation) were calculated for the pretest and posttest for the control group and the experimental group. Gall, Gall & Borg (2003) note that when using the pretest-posttest control group design, "If properly carried out, the pretest-posttest control group design effectively controls for eight threats to internal validity: history, maturation, testing, instrumentation, statistical regression, differential selection, experimental mortality, and selection-maturation interaction." (p. 392).

An Analysis of Covariance (ANCOVA) is suggested when using the pretest-posttest design (Gall, Gall & Borg, 2003). An ANCOVA was used to determine the statistical significance between the personal mathematics teaching efficacy scores of the experimental group and the control group; however, a Mann-Whitney U-test was used to determine the statistical difference between the mathematics teaching outcome expectancy scores of the experimental group, and the control group as assumptions for the ANCOVA test was not met.

An Analysis of Variance (ANOVA) was used to determine the statistical significance between the pretest and the posttest scores of the experimental group. Using this test is supported by Gall, Gall & Borg (2003) and Howell (2008) when determining the statistical difference between pretest and posttest means.

The Mathematics Teaching Efficacy Beliefs Instrument yields two scores per student: personal mathematics teaching efficacy and mathematics teaching outcome efficacy. Means for the control group's personal mathematics teaching efficacy and mathematics teaching outcome expectancy, and means for the experimental group's personal mathematics teaching efficacy and mathematics teaching outcome expectancy were calculated at two different time intervals: pretest and posttest.

To investigate what impact fieldwork had on the four types of students, mean gain scores for personal mathematics teaching efficacy were calculated for each of the four groups. Linear plots were used to show what effect, positive or negative, the early fieldwork experience had on personal mathematics teaching efficacy.

CHAPTER FOUR: RESULTS

With the move from traditional to constructivist instructional practices comes a need to address how preservice teachers think about mathematics. This psychological shift in viewing mathematics requires preservice teachers to transition from observable behaviors and skills to true mathematics thinking (Battista, 1994). Preservice teachers must be challenged to think differently about what mathematics is, and what it means to teach mathematics. Because a preservice teacher's beliefs are impressionable for a limited time, their beliefs must be explored and challenged early during preservice programs. This research project explored changes in preservice teachers' mathematics efficacy beliefs with the following null hypotheses:

Null Hypotheses 1: There will be no significant difference in the means of personal mathematics teaching efficacy scores for the experimental group, which participated in fieldwork, and the control group, which did not participate in fieldwork.

Null Hypotheses 2: There will be no significant difference in the means of mathematics teaching outcome expectancy scores for the experimental group, which participated in fieldwork, and the control group, which did not participate in fieldwork.

Null Hypotheses 3: There will be no significant difference in the mean scores of the experimental group, which participated in fieldwork, as measured by the Mathematics Teaching Efficacy Beliefs Instrument pretest and posttest for personal mathematics teaching efficacy.

Null Hypotheses 4: There will be no significant difference in the mean scores of the experimental group, which participated in fieldwork, as measured by the Mathematics Teaching Efficacy Beliefs Instrument pretest and posttest for mathematics teaching outcome expectancy.

Chapter Four describes the results produced from this project. Data are presented as it relates to each hypothesis. The data collected from preservice teachers were organized by the following categories: personal mathematics teaching efficacy pretest and posttest, mathematics teaching outcome expectancy pretest and posttest, group (control or experimental), TAKS mathematics content test score, format (8- or 16-week course), and age. An alpha of 0.05 was used for all tests.

Analysis of Covariance (ANCOVA) Summary.

Levene's Test for Equality of Variances determined the p-value for the dependent variable to be 0.258 when testing personal mathematics teaching efficacy, which met the equality of variance assumption. When testing mathematics teaching outcome expectancy for the experimental group and control group the Levene statistic did not indicate equality of variances. (see Table 1).

Table 1

Levene's Test

	F	*df1*	*df2*	*Sig*	*alpha*
PMTE	1.215	20	101	.258	0.05
MTOE	1.869	20	101	.023`	0.05

The Analysis of Covariance (ANCOVA) controlled for initial differences between the experimental group and the control group before making comparisons of within-groups variance and between-groups variance (Gall, Gall, & Borg, 2003). An ANCOVA was run for personal mathematics teaching efficacy. Pretest scores were the covariate; the fixed variables were age, group (control/experimental), and format (eight-weeks/sixteen-weeks); the dependent variable was posttest scores.

The ANCOVA results analyzed the mean posttest scores of the control group and the experimental group, and determined the differences in posttest scores were not statistically significant. However, format was a statistically significant factor, but its effect size was only 0.066. Results for personal mathematics teaching efficacy are shown in Table 2. The significance level, alpha, was set at 0.05 for all statistical tests.

Table 2

Dependent Variable: Personal Mathematics Teaching Efficacy Posttest

Source	*Df*	*MS*	*F*	Sig.
Corrected Model	21	0.429	2.374	0.002
Intercept	1	18.839	104.29	-
Pretest	1	5.622	31.343	-
Group	1	0.070	0.389	0.534
Format	1	1.268	7.019	0.009
Age	5	0.394	2.18	0.062
Error	100	0.181	-	-
Total	122	-	-	-

R Squared = .333 (Adjusted R Squared = .193)

ANCOVA results established that the only statistically significant factor in this model was format. This model explained only 19.3% of the variability in the personal mathematics teaching efficacy post test scores.

Mann-Whitney U-test Summary

Neither an ANCOVA nor a t-test were options to measure mathematics teaching outcome expectancy, as the assumption of equality of variances was not met. Rather, a non-parametric Mann-Whitney U-test was used to test if the two independent samples came from populations with the same sampling distribution. Null Hypothesis 2 stated: There will be no significant difference in the means of mathematics teaching outcome expectancy scores for the experimental group, which participated in fieldwork, and the control group, which did not participate in fieldwork. To reflect the non-parametric test being used, the Null Hypothesis was reworded: There will be no significant difference in sampling distribution of the experimental group and the control group.

Table 3

Mann-Whitney U Results

U	1818
Expected	1982.5
Variance	41688.77
P-Value	0.422
α	0.05

ANCOVA results established that the variable "group" was not a statistically significant factor of personal mathematics teaching efficacy. The differences between the control group's personal mathematics teaching efficacy and the experimental group's personal mathematics teaching efficacy posttest scores were not statistically significant, and the sampling distribution of the control group's mathematics teaching outcome expectancy and the experimental group's mathematics teaching outcome expectancy posttest scores were not statistically different. Therefore, Null Hypotheses 1 and 2 were retained.

ANOVA Summary

Mean scores and standard deviations (SD) for personal mathematics teaching efficacy and mathematics teaching outcome expectancy pretests and posttests were sorted by control group and experimental group. Linear graphs were used to plot pretest and posttest scores. See Figures 1 & 2. An ANOVA was used to determine the statistical significance of the pretest and posttest scores (Gall, Gall, & Borg, 2003). See Table 4.

Figure 1

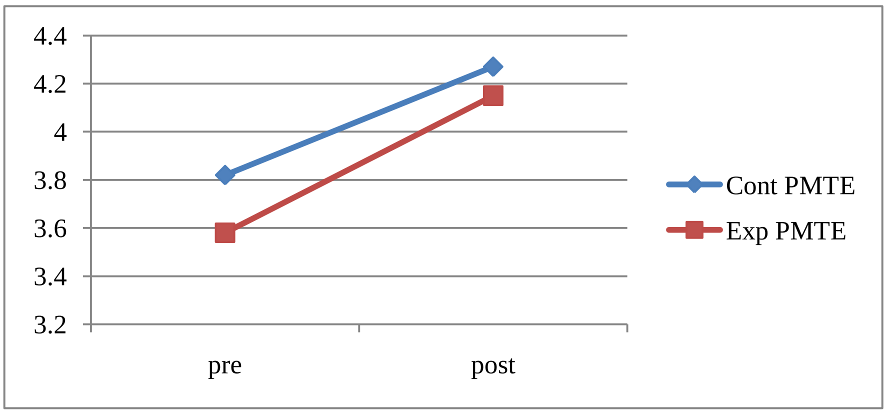


Table 4

Analysis of Variance (ANOVA): Personal Mathematics Teaching Efficacy

Source	*df*	Sum of squares	Mean of squares	*F*	*Pr > F*
		Experimental Group			
Model	1	2.455	2.455	12.73	0.001
Error	63	12.149	0.193	-	-
Corrected	64	14.604	-	-	-
		Control Group			
Model	1	4.754	4.75	16.12	0.00
Error	59	17.30	0.29	-	-
Corrected	60	22.14	-	-	-

Computed against model Y=Mean(Y)

The control group's (n = 61) personal mathematics teaching efficacy mean score increased from 3.82 (SD 0.60) on the pretest to 4.27 (SD 0.47) on the posttest. The experimental group's (n = 65) personal mathematics teaching efficacy mean score increased from 3.58 (SD 0.52) on the pretest to 4.15 (SD = 0.47) on the posttest. The increase in personal mathematics teaching efficacy scores was significant for the experimental group ($p < 0.001$), but not for the control group ($p < 0.00$).

Figure 2

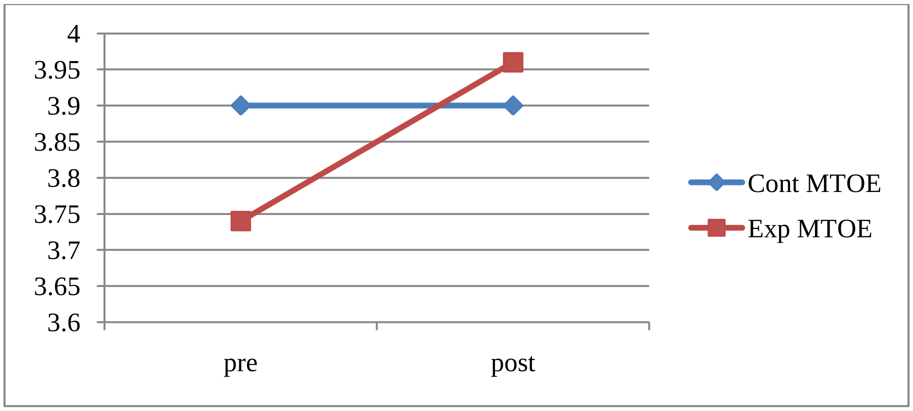


Table 5

Analysis of Variance: Mathematics Teaching Outcome Expectancy

Source	*df*	Sum of squares	Mean of squares	*F*	*Pr > F*
		Experimental Group			
Model	1	7.898	7.898	28.133	< 0.0001
Error	63	17.687	0.281	-	-
Corrected Total	64	25.585	-	-	-
		Control Group			
Model	1	4.778	4.778	32.360	<0.0001
Error	59	8.711	0.148	-	-
Corrected Total	60	13.489	-	-	-

The control group's (n = 61) mathematics teaching outcome expectancy mean score remained at 3.9 (SD 0.47) on the pretest and posttest (SD 0.48). The experimental group's (n = 65) mathematics teaching outcome expectancy mean score increased from 3.74 (SD 0.51) on the pretest to 3.96 (SD = 0.63) on the posttest. The increase in mathematics teaching outcome expectancy scores was significant for the experimental group ($p < 0.0001$). The control group's mean did not change.

Further Investigation

Categorical Groups Summary

The last item for investigation was the effect fieldwork had on different categories of preservice teachers, namely high/low efficacy and high/low content knowledge. Students from the experimental group were placed into four categories based on the results of the Mathematics Teaching Efficacy Beliefs Instrument and the Texas Assessment of Knowledge and Skills. Labels of high and low were determined by the mean of personal mathematics teaching efficacy and the mean of the content knowledge test. Personal mathematics teaching efficacy was measured using the Mathematics Teaching Efficacy Beliefs Instrument. Content knowledge was measured using the Texas Assessment of Knowledge and Skills test for 6th graders.

Mean gain scores for personal mathematics teaching efficacy were calculated for each of the four groups. Linear plots were used to show what effect, positive or negative, the early fieldwork experience had on personal mathematics teaching efficacy. (See Figure 3 and Table 6).

Figure 3

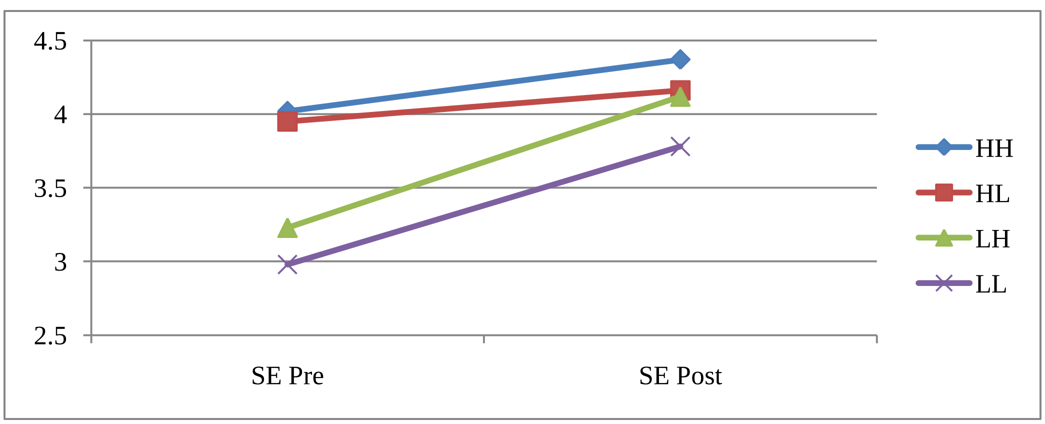


Table 6

Categories of Preservice Teachers based on Personal Efficacy and Content Knowledge

PMTE	Content Knowledge	PMTE Pretest	PMTE Posttest	*N*
High	High	4.02	4.37	20
High	Low	3.95	4.16	14
Low	High	3.23	4.12	22
Low	Low	2.98	3.78	9

Statistical tests were not done for this section, as the sample sizes were small and did not follow a normal distribution. However, the results do indicate that all groups increased in personal mathematics teaching efficacy, with the low efficacy/high content knowledge group showed the most improvement in personal mathematics teaching efficacy, and the high efficacy/low content knowledge group showed the least improvement in personal mathematics teaching efficacy.

CHAPTER FIVE: DISCUSSION

Summary of Findings

Monitoring teaching efficacy must continue to be investigated because teacher efficacy is a factor that consistently relates to student achievement (Ashton & Webb, 1986; Esterly, 2003), classroom environment (Raudenbush, Rowan, & Cheong, 1992), and student success (Tschannen-Moran, Woolfolk & Hoy, 1998). Advances in the area of teaching efficacy will result in better prepared teachers, which in turn will result in higher student achievement (Hill, Rowan, & Ball, 2005).

Comparisons of the experimental and control groups' personal mathematics teaching efficacy posttests were analyzed using an Analysis of Variance (ANCOVA). Comparisons of the experimental and control groups' mathematics teaching outcome expectancy were analyzed using the Mann-Whitney U-test as the assumption of equality of variance was not met. Analysis of Covariance (ANCOVA) results from this study showed that fieldwork—which was the variable "group"—was not a significant factor that impacted personal mathematics teaching efficacy. The only significant factor that impacted personal mathematics teaching efficacy was "format". The Mann-Whitney U-test revealed that the experimental and control groups' mathematics teaching outcome expectancy posttests were not significantly different.

Pretests and posttests of preservice teachers in the experimental group were analyzed using Analysis of Variance (ANOVA). Two Analysis of Variance (ANOVA) were run—one for personal mathematics teaching efficacy and one for mathematics teaching outcome expectancy. Results from this study showed that personal mathematics teaching efficacy scores did significantly increase for both the experimental and control groups. The Analysis of Variance (ANOVA) results also revealed that outcome expectancy scores did significantly increase for the experimental group but did not significantly change for the control group.

These results provide further evidence that a mathematics course for future teachers taken simultaneously with fieldwork can positively impact both the personal efficacy and outcome expectancy constructs of teaching efficacy (Utley, Moseley, & Bryant, 2005; Huinker & Madison, 1997). As a result of going through the methods course and fieldwork, preservice teachers did experience a significant increase in their personal beliefs about their ability to teach mathematics, as well as a significant increase in their beliefs about their ability to impact students' learning.

By having a control group, this study was able to compare efficacy measures of preservice teachers who participated in fieldwork to those who did not. Both the control and the experimental group's personal mathematics teaching efficacy scores significantly increased. If the control group were not part of the study, and if an ANOVA or t-test were the only statistical test used on the experimental group's data, the conclusion may have indicated that fieldwork did, in fact, impact personal mathematics teaching efficacy. But, because both groups experienced statistically significant increases in personal mathematics teaching efficacy scores, the increase in efficacy cannot be attributed to fieldwork. It should be noted that the methods course itself had positive impacts on personal mathematics teaching efficacy.

Results indicate that fieldwork did, however, influence preservice teachers' mathematics teaching outcome expectancy scores. The experimental group's mathematics teaching outcome expectancy scores significantly increased while the control group's mathematics teaching outcome expectancy scores remained the same. The Mann-Whitney U-test revealed that the distribution of the two groups' posttest scores were not significantly different, but one group's mathematics teaching outcome expectancy scores significantly changed while the other group's scores did not. This suggests that the change may be a result of one group participating in fieldwork while the other group did not.

Teaching efficacy research using control and experimental groups is limited as most studies are carried out at the university level during student teaching, making a control group impossible. Further investigation should be done, prior to student teaching, using comparison groups to determine what factors influence mathematics teaching outcome expectancy.

Discussion of Findings

A discussion of research must take into account the different nuances that each study offers. Some studies involved preservice teachers who participated in a methods course, while other studies involved both the methods course and fieldwork, for example. Therefore, this discussion section has been organized by grouping like-research together. Discussion of this study's findings will be interwoven throughout the relative research.

Methods coursework.

All three instructors in this study, for both the experimental and control groups, promoted a constructivist philosophy in the mathematics for teachers courses. Constructivist mathematics methods coursework has been shown to have a positive impact on teaching efficacy (Swars, n.d.; Cooper & Robinson, 1991; Vinson 2001;

Strawhecker 2005; Quinn 2001; Huinker and Madison 1997; Utley, Moseley, & Bryant, 2005; Palmer, 2006). Preservice teachers' attitudes toward mathematics as well as their pedagogical content knowledge of mathematics improve significantly as a result of the methods course (Quinn, 2001). Preservice teachers' personal teaching efficacy and outcome expectancy both significantly increased during a methods course in which emphasis was placed on shifting thinking from traditional to constructivist (Huinker & Madison, 1997).

Unlike most preservice teachers represented in the literature who were studied as they went through student teaching, preservice teachers who participated in field experiences did so during their first two years of college. Swars found that preservice teachers who were engaged in fieldwork and professional development prior to student teaching increased in personal teaching efficacy, and had stable outcome expectancy beliefs during their student teaching experience (2010). Fieldwork before student teaching contributes to outcome expectancy beliefs remaining stable (Swars, Hart, Smith, Smith, & Tolar, 2007; Swars, 2010) during student teaching.

Methods coursework and fieldwork.

Concurrent enrollment in a constructivist methods course and fieldwork has also been shown to have positive impacts. Preservice teachers who took part in fieldwork while concurrently enrolled in a mathematics methods course showed greater ownership of and more responsibility for their own learning, had a clearer picture of their future as teachers, and had greater understanding of their coursework than those preservice teachers who did not participate in the fieldwork experience (Moyer and Husman, 2006).

Concurrent enrollment in a constructivist methods course and fieldwork, when teacher efficacy is being investigated, reveals inconclusive results. Woolfolk and Hoy found that during a methods course and student teaching, student teachers' personal teaching efficacy improved but outcome expectancy—termed general teaching efficacy in their study—decreased during student teaching. Results of a study by Plourde showed no change in personal teaching efficacy but a decrease in outcome expectancy for preservice teachers enrolled in a concurrent methods course and student teaching experience (2002).

Huinker and Madison established that personal teaching efficacy as well as outcome expectancy significantly increased in both mathematics and science efficacy beliefs for preservice teachers (1997). Swars also found that both personal teaching efficacy and outcome expectancy significantly increased (2007).

Utley, Mosely, & Bryant discovered that preservice teachers' mathematics and science beliefs moved in similar directions at similar times. During the course itself, both personal teaching efficacy and outcome expectancy for mathematics and science increased. However, during student teaching, there was no change in personal teaching efficacy yet outcome expectancy increased (2005).

From these research findings, during a methods course and/or fieldwork, personal efficacy either remained stable or increased. No study found that personal efficacy decreased. During a methods course and/or fieldwork, outcome expectancy either increased or decreased, but never remained unchanged.

Personal Efficacy

The literature suggests that personal efficacy can be influenced by a methods course alone. In this study, the personal mathematics teaching efficacy scores for preservice teachers in the control group significantly increased. Preservice teachers in the control group were only required to participate in the course itself, and were not required to participate in a field experience. The findings in this study suggest, as well, that a methods course alone can influence a preservice teachers' personal teaching efficacy.

This seems logical as personal teaching efficacy beliefs deal with an individual's perceived ability to effectively teach a concept. In the methods courses for this study, topics were taught with an emphasis on constructivist methodology. Preservice teachers regularly investigated mathematical concepts, interacted with and supported one another, and relearned content in a developmental sequence. For these preservice teachers, the course itself was enough to positively impact their beliefs about their ability to teach mathematics. Excerpts from preservice teachers in the control group's end-of-course student surveys indicate that preservice teachers felt they were in a safe environment and were free to ask questions, and responded positively to the constructive environment. This is evidence that a constructivist methods course can, by itself, positively impact personal teaching efficacy.

Outcome Expectancy

Preservice teachers' mathematics teaching outcome expectancy scores have been found to decline (Woolfolk & Hoy, 1990; Plourde, 2002). In these studies, the decrease was attributed to reality setting in, which may have caused preservice teachers to second-guess their initial beliefs about effectively impacting students' learning. Yet, Huinker and Madison (1997), and Utley, Moseley, and Bryant (2005) found that mathematics teaching outcome expectancy increased, which may have been caused by preservice teachers having good experiences in the field which solidified positive beliefs.

In either case, explanation was attributed to the experiences that preservice teachers had in the field. In this study, mathematics teaching outcome expectancy significantly increased for the experimental group. A look at preservice teachers' reflection journals revealed that most had positive experiences in the field, which, from the studies prior to this, seems to be a determining factor of whether outcome expectancy increases or decreases.

The literature suggests that outcome expectancy will be positively or negatively affected by a field experience. In this study, the mathematics teaching outcome expectancy scores for preservice teachers in the experimental group, who participated in a field experience, significantly increased while the mathematics teaching outcome expectancy scores for the control group, who did not participate in a field experience, did not significantly change. This suggests that participating in a methods course is not enough to impact teaching outcome expectancy.

This also seems logical as outcome expectancy beliefs deal with the level to which an individual believes that one's teaching will have a positive effect on student learning. Preservice teachers who participated in fieldwork had the opportunity to actually teach and as a result, received feedback from the children they worked with. The feedback came from the day-to-day informal exchanges that happen in a class, yet it was feedback nonetheless. The following are excerpts from journals of preservice teachers who had positive experiences in the field. The quotes illustrate how participating in fieldwork impacted mathematics teaching outcome expectancy.

"As a result of this (fieldwork), I learned that I can teach math."

"When a child understands what I am trying to teach, and when I see eyes light up with understanding, my heart swells because I was able to put the lesson into words they could understand."

"I know I made a difference. The proof is in the children's work. Many of the children that I am tutoring were having difficulty with multiplying two digits by two digits…now they are multiplying three by three digits with no problems!"

Time on Task

Quinn (2001) concluded that the more time that preservice teachers spend in methods courses observing sound pedagogy, the more positive change can be affected in preservice teachers' pedagogical content knowledge and attitudes. This study did not measure pedagogical content knowledge or attitude. However, the notion of time on task relative to developing positive qualities in preservice teachers is worth noting.

This study found "format" to be a significant factor of personal teaching efficacy. Those preservice teachers who enrolled in the 8-week format began with higher levels of personal mathematics teaching efficacy than did the preservice teachers in the 16-week format, which may be an artifact of the type of student that enrolls in a faster-paced course. However, the rate of growth in personal mathematics teaching efficacy was much greater for the preservice teachers in the 16-week format than it was for the preservice teachers in the 8-week format. This suggests that the length of term, or time on task, is an important factor in the development of personal mathematics teaching efficacy.

Age

This study also took into consideration preservice teachers' ages and found that age was not a significant factor in mathematics efficacy beliefs. This contradicts a finding by Bingham which showed that preservice teachers' ages did have a significant relationship with their mathematics efficacy beliefs, as measured by the Mathematics Teaching Efficacy Beliefs Instrument (2004). In this study, participant age nearly achieved statistical significance (alpha = 0.05, age test statistic = 0.062). The ages in this study ranged from less than 20 years of age to over 50 years of age. Because of the wide range of ages in a community college setting, perhaps a larger sample would have shown age to be a contributing factor in mathematics teaching efficacy.

Categories of Preservice Teachers

With respect to the categories of preservice teachers, Swars, Hart, Smith, Smith, & Tolar found no relationship between preservice teachers' content knowledge and personal teaching efficacy or teaching outcome expectancy (2007). This indicates that preservice teachers could have high levels of efficacy yet low levels of content knowledge. With students categorized into high/low groups based on efficacy and content knowledge, it became evident in this study that some preservice teachers do, in fact, have high efficacy beliefs yet low content knowledge while others have low efficacy beliefs and high content knowledge. Results from this study indicate that preservice teachers in all four categories increased in their personal mathematics teaching efficacy beliefs.

Even though all categories of students benefitted from the course and fieldwork, each category showed a different rate of growth. A low/high, for example, gained more than a high/low from certain experiences of the course or fieldwork. Anecdotal evidence indicates that a preservice teacher with high efficacy and low content knowledge has different learning needs than does a preservice teacher with low efficacy and high content knowledge. Further inquiries could be made to investigate what experiences best served each category of preservice teachers, which may result in finely-tuned learning experiences for preservice teachers. How mathematics efficacy is developed in various categories of preservice teachers is an area in need of further study.

Implications

The methods course

Since the control group was not required to participate in fieldwork, and since the control group's personal mathematics teaching efficacy scores significantly increased, the mathematics methods course, without fieldwork, can be viewed as a factor that positively impacts preservice teachers' personal efficacy. This finding supports already-established research about the impact a methods course can have on personal efficacy beliefs (Swars, n.d.; Cooper & Robinson, 1991; Vinson 2001; Strawhecker 2005; Quinn 2001; Huinker and Madison 1997; Utley, Moseley, & Bryant, 2005; Palmer, 2006). The importance of a constructivist methods course is emphasized. Not only are preservice teachers gaining a new learning perspective on mathematics content, along with strategies on how to teach the subject, but their beliefs about their ability to effectively teach are also being positively impacted.

Preservice teachers believing in their ability to effectively teach has profound implications. According to Bandura's Theory of Self-Efficacy (1994), cognitively, people with high self-efficacy believe they are capable of achieving, which will result in high goal setting, firm commitment to those goals, mentally rehearsed successes, and analytical thinking in stressful situations. According to this theory, preservice teachers whose self-efficacy has been positively impacted will be more likely to show a high level of commitment to teaching and persist until success is achieved, because they believe they are capable. Conversely, preservice teachers with a low self-efficacy may view themselves as unable to control aspects of teaching, and as a result give up.

Clearly then, methods courses are capable of having a profound impact on preservice teachers efficacy beliefs. However, it cannot be determined from this study how stable the changes in preservice teachers' efficacy beliefs were. Although durability of the changes in preservice teachers' efficacy beliefs was not investigated in this study, Palmer found that preservice teachers' efficacy beliefs increased as a result of participation in a methods course and subsequent field experience (2006). By using a pretest with two subsequent posttests, Palmer was able to determine that the changes in preservice teachers' efficacy beliefs were maintained for a period of at least eight to eleven months.

Fieldwork

Changes in preservice teachers' personal teaching efficacy—or self-efficacy—resulted from their participation in the course itself. Those preservice teachers who participated in the fieldwork showed a significant increase in their mathematics teaching outcome expectancy scores. This finding leads to the conclusion that fieldwork is a necessity if outcome expectancy beliefs are to be impacted. Because of the variety of meanings fieldwork has come to mean, it is worth noting again that fieldwork must entail meaningful experiences in order to be effective. The benefit of field experiences depends on: (1) the quality of the mentorship, (2) the rigor of the pedagogical expectations, and (3) the willingness of the preservice teacher to engage in content and pedagogy (Capraro, Capraro, Parker, Kulm, & Raulerson, 2005).

It is possible that a field experience be set up prior to student teaching that entails these needed qualities, although most preservice education programs have some formal fieldwork incorporated as a required component, but possibly not until the student teaching experience.

Because preservice teachers enter their programs with well-established beliefs (Ball, 1990) which are malleable only during schooling and the first few years of teaching (Swars, Hart, Smith, Smith, & Tolar, 2007), the earlier preservice teachers' negative beliefs are challenged, the more time there is to modify them in a way that will adequately prepare them for successful experiences in their future classrooms. If preservice teachers do not have opportunity to be meaningfully engaged in elementary classroom settings until student teaching, then their outcome expectancy beliefs will not be impacted until they are basically finished with their education. If their outcome expectancy beliefs are not impacted until student teaching, then time that could have been spent in reflection and development of beliefs has been lost.

Categories of Preservice Teachers

Time lost for those preservice teachers who are highly efficacious and will succeed no matter what they experience may not be cause for concern. But, for those preservice teachers who enter their education with negative beliefs about their ability to teach mathematics along with their ability to effect positive change in their future students in mathematics, time lost is of great concern. By sectioning students into four categories—high/low efficacy and high/low content knowledge—this study discovered that all four groups increased in personal mathematics teaching efficacy.

The preservice teachers that experienced the most positive change in personal efficacy were the low efficacy/high content knowledge group. These preservice teachers actually had solid mathematics content knowledge as demonstrated by the Texas Assessment of Knowledge and Skills test (TAKS), but lacked beliefs in their ability to teach the content. There were twenty-two preservice teachers in this group, which accounted for close to 35% of the experimental group.

It is suspected that preservice teachers with the characteristic of high content knowledge and low personal efficacy need different aspects from the methods course and fieldwork than other categories of preservice teachers do. It may be beneficial to compare this statistic with a non-community college sample to investigate what types of students are comprised at each institution so that plans for better preparation might be achieved. "Teacher educators must be aware of their students' beliefs and plan for experiences which will have positive impact on teacher self-efficacy and outcome expectancy" (Enochs and Riggs, 1990, p. 701).

Limitations

The limitations of this study resulted from its use of non-randomized groups, aspects of the instrumentation, and the variability in fieldwork experiences. Two concerns arose due to this study's use of intact classes of students. First, the type of student that enrolled in an eight-week course may have been different than one who enrolled in a sixteen-week course. The eight-week format had the same requirements as the sixteen-week format, but course requirements were completed in half the amount of time. Preservice teachers who enrolled in the eight-weeks course format began the semester with higher personal mathematics teaching efficacy mean scores as well as higher mathematics teaching outcome expectancy mean scores than did those enrolled in the sixteen-weeks course format, which may be evidence that more efficacious students enroll in an eight-week format.

The second concern was the time of day of the class caused concern. Some students attended class during the day, while others attended evening classes. To minimize both selection-threat due to format, and setting-threat due to time of day, the control and the experimental groups were each composed of sections from day, evening, eight-week format, and sixteen-week format.

Because the sample in this study used existing sections of mathematics courses, there was concern that the lack of randomization may offset findings due to selection bias (Ary, Jacobs, Razavieh, & Sorensen, 2006). Steps were taken to eliminate this threat by using the Levene's test of equality of variances to ensure groups were initially equivalent on the dependent variable, and by using ANCOVA, which statistically adjusted posttest scores to account for initial differences.   In the case of non-equality of variance for mathematics teaching outcome expectancy, a non-parametric Mann-Whitney U-test was used so as not to violate test assumptions not being met.

Two concerns arose with respect to the Mathematics Teaching Efficacy Beliefs Instrument. The first concern was the threat of repeated exposure to the instrument, since taking a test repeatedly can sometimes result in higher scores. The initial design of this study was to include a pretest and two posttests. The pretest and first posttest would have been used to measure effects of the course on preservice teachers' personal mathematics teaching efficacy and mathematics teaching outcome expectancy scores. Preservice teachers in the eight-week format would have had the test twice in an eight-week period, then once again at the end of the semester. It was decided that danger from exposure to the instrument outweighed the benefit of investigating the main focus of this study, the effect of fieldwork on personal efficacy and outcome expectancy. Therefore, only one posttest was used.

The second concern in using the Mathematics Teaching Efficacy Beliefs Instrument was the nature of the instrument as a self-reported measure. An assumption was made that preservice teachers would take their time and answer questions honestly. Instructors allowed students ample time to take the survey and emphasized to students to read every question and answer as best they could. However, there is no guarantee that every student did this.

The last limitation consisted of the uncontrollable variables associated with the fieldwork itself. There was no way to know what experience preservice teachers had in the field. Efforts were made to control as much as possible: both the number of hours spent in the field and the type of work required—active involvement versus observation—were determined. Preservice teachers were placed in cooperating schools with experienced teachers, but no data were collected to describe what actually took place in the field. Although the preservice teachers' reflection journals revealed that most had a positive experience, some did not.

The unpredictable nature of fieldwork makes it a challenging element to include in research. Positive experiences in the field were likely to produce increases in efficacy beliefs; whereas negative experiences were likely to produce decreases in efficacy beliefs. Preservice teachers that had positive experiences in fieldwork noted that:

"Children are a lot smarter than I thought."

"They are teaching students harder concepts at a younger age...and they get it!"

"I realized how much I knew about a topic when I got to explain it to the kids."

"I found out I was able to explain mathematics concepts in several different ways."

"After this class (and fieldwork) I am now at ease with teaching mathematics."

Preservice teachers that reported some negative experiences noted that:

"I realized that students can be very difficult."

"Kids lose their focus very quickly."

"I noticed how easily students mix up when to use each operation with word problems."

"Some kids completely struggled."

From the research, one potential way to counteract the variability of the field is to offer a more controlled experience for preservice teachers. During the data collection phase of this dissertation, an article was found that supported the laboratory approach instead of the traditional apprentice approach. Phillip et al., (2007) designed a way for preservice teachers to gain the benefits of fieldwork, yet not be subject to the unpredictability of fieldwork placements. By watching and analyzing videos of children solving problems and then conducting problem-solving experiences with individual children, preservice teachers' beliefs about mathematics became more constructive than preservice teachers who were involved in traditional fieldwork.

Recommendations for Further Research

Based on the literature reviewed for this study, as well as the findings of this study, the following seven items are recommendations for further research.

First, time on task should be considered. ANCOVA results from this study showed that the only significant factor of preservice teachers' personal mathematics teaching efficacy was format, or length of the course. Preservice teachers enrolled in the 8-week format began with slightly higher personal mathematics teaching efficacy scores than their counterparts, but did not change as drastically as those preservice teachers who enrolled in the 16-week format. This may imply that efficacy is a construct affected by time. Or, it could be an artifact of the type of student that enrolls in a faster-paced course. The cause cannot be determined from this study.

Another topic for further investigation related to time on task is investigating how durable these changes in preservice teachers last. The amount of time preservice teachers spend in an elementary classroom increases as they advance in their education. Fieldwork may begin with an observeration, then move to working with a student or groups of students. A preservice teacher soon works with the class as a whole, and then finally enters student teaching. This would require a longitudinal study that tracks preservice teachers through their methods courses, through student teaching, and through their first few years of teaching.

What happens to their personal mathematics teaching efficacy and mathematics teaching outcome expectancy during these very different time periods is of interest as it may help educators of preservice teachers design programs that could offer support to their students as they move on into their early years of teaching.

Second, more comparative studies need to be done. Although it was possible to have a control and experimental group in this study, not all research designs will allow for that to occur. If an experimental and control group are not possible, then comparative groups can be set up much like the work of Phillip et al. (2007). In their study, preservice teachers participated in one of four different field experiences. Results indicated that each of the four groups had varying changes in efficacy. A comparative design allows insight into specific practices, and how those practices affect preservice teachers' efficacy beliefs. These comparisons should be done prior to student teaching, with all other aspects of the course held as constant as possible.

Third, preservice teachers should have opportunities to engage in meaningful field experiences before student teaching. By interacting with children early on in their education, preservice teachers will have opportunity to confront their beliefs before the student teaching experience. An early fieldwork experience would allow for preservice teachers to have time to reflect and possibly change held paradigms before going into teaching. Early fieldwork may help preservice teachers keep more positive outcome expectancy beliefs when they move on to student teaching. Swars found that early field experiences helped preservice teachers' outcome expectancy beliefs remain stable when they participated in student teaching (2010).

Fourth, most of the research reviewed for this study, as well as this study, used a quantitative approach to measuring teaching efficacy. The quantitative approach has given us a look into the broad view of teacher efficacy. We now know the significant role that teacher efficacy plays on student achievement and classroom environment, for example. But qualitative studies dealing with teacher efficacy are somewhat lacking in the literature. Qualitative studies may give us insight into deeper understandings of what factors affect teacher efficacy.

Fifth, the model used in this research only accounted for 19.3% of the variation, which means there are other variables that affected personal mathematics teaching efficacy and mathematics teaching outcome expectancy. More investigation needs to be done on what those other factors may be. This recommendation should be considered in conjunction with the fourth recommendation. Qualitative studies may give us insight as to what factors contribute most for impacting teaching efficacy.

Sixth, looking at possible relationships between preservice teachers' efficacy and content knowledge is important. This study demonstrated that some preservice teachers have high efficacy beliefs yet low content knowledge. This is cause for concern and interventions for this group of preservice teacher should be further investigated. Likewise, there were preservice teachers who had low efficacy and high content knowledge. They too should be researched further to find out what factors influence their beliefs. Out of the four groups that were formed in this study, the group that gained the most out of the course and the fieldwork were those with low efficacy and high content knowledge.

Lastly, more research needs to take place at community colleges. Community colleges are taking on more responsibility in training future teachers and need to be represented in the literature. Students at community colleges are typically different in demographics and educational backgrounds from those students in universities. Researching at a community college is needed also because students in a community college are an accessible sample for early fieldwork. This recommendation for further research should be considered in conjunction with recommendation number three, the early field experiences. The majority of preservice teachers bring negative views of mathematics with them. It may be that community college students have heightened negative views of mathematics, and need these early field experiences to begin to confront their own beliefs.

Conclusion

Reform in mathematics education continues to be on the forefront of research (Ball, Lubienski, & Mewborn, 2001) due in part to the call towards higher-level thinking and conceptual understanding promoted by the standards of the National Council of Teachers of Mathematics (NCTM, 2000). The call for classrooms to develop students who can solve complex problems as well as build arguments, implies that teachers are capable of fostering these deeper levels of knowledge in their students. Likewise, it implies that preservice programs be exposed to this kind of teaching in their methods courses.

Preservice teachers enter their mathematics methods courses with limited conceptual knowledge (Ball, 1990), which limits their ability to learn mathematics concepts at a deep level. This has the potential of causing preservice teachers to doubt in their ability to teach—personal efficacy—and their effectiveness as teachers in mathematics—outcome expectancy (Huinker & Madison, 1997). Results from this study, along with others, suggest that a constructivist methods course, even taken without fieldwork, has the potential to positively impact personal teaching efficacy.

Self-Efficacy Theory supports the notion that a methods course can positively impact personal efficacy. Self-efficacy is a measure of one's beliefs, and is therefore a construct that can be influenced. One of the four main sources of influence is enactive experiences, an individual's competence being strengthened by success (Bandura, 1994). In a constructive methods course, preservice teachers are immersed in positive learning experiences that encourage them to move beyond merely getting an answer, to investigating all of the fine distinctions that occurred in a given context. Most times, when preservice teachers grasp the foundations of a concept, their competence increases, which causes them to feel and be more successful.

Another source of influence in self-efficacy is social persuasion, which deals with an individual's receiving feedback from others, which consequently increases or decreases efficacy beliefs (Bandura, 1994). The influencer of social persuasion is demonstrated in the research within one of the dimensions of teaching efficacy—outcome expectancy. During fieldwork, preservice teachers' outcome expectancy beliefs either significantly increased or decreased, but never remained the same. In this study, preservice teachers who participated in fieldwork experienced a significant increase in their mathematics teaching outcome expectancy scores. The Mathematics teaching outcome expectancy scores of preservice teachers who did not participate in fieldwork did not change. This provides further evidence that in order to positively impact outcome expectancy beliefs, preservice teaching must be engaged in a meaningful field experience.

Although the sources of influence help explain why personal efficacy can be developed in a methods course, and why outcome expectancy relies on fieldwork, they do not offer explanation as to why personal mathematics teaching efficacy may be a function of time on task. In this study, preservice teachers who enrolled in the 16-week format had a higher gain in personal efficacy than did preservice teachers enrolled in the 8-week format. This researcher is aware of no other study that looked at teacher efficacy when length of term was a variable.

It is possible that the processes of change from Bandura's Theory of Self-Efficacy may offer explanation. One of the four processes of change is acquisition, which deals with the initial development of self-beliefs (1997). Because preservice teachers have had a lifespan of experiences which affect how they think about mathematics (Ball, 1988; Phillip et al., 2007), it is possible that time is a factor because it may be that to effectively undo the negative beliefs, preservice teachers need time to reacquire new, more positive beliefs.

Because efficacy beliefs have been shown to have a significant predictive impact on both students and their teachers (Esterly, 2003), it remains important to continue researching and discovering ways to further improve mathematics education. An early field experience allows preservice teachers the opportunity to begin developing healthy beliefs about their ability to effectively teach mathematics before they reach the end of their education.

Results of this study indicate that time may be a factor in developing personal teaching efficacy. Since many elementary and middle school teachers do not initially feel competent in their mathematics ability, and since "elementary education majors were shown to possess more negative attitudes toward mathematics than the general college sample" (Rech, Hartzell, & Stephens, 1993, p. 143), it is imperative that early interventions are made available to preservice teachers so that time is allowed for positive beliefs to develop.

Any construct that is associated with classroom dynamics (Staub & Stern, 2002; Raudenbush, Rowan, & Cheong, 1992; Tschannen-Moran, Woolfolk & Hoy, 1998; Guskey, 1982, 1987; Ashton & Webb, 1986) teachers' attitude towards students, and beliefs about control in the classroom (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998), the instructional activities chosen (Pajares, 1997), the level of fairness a teacher displays, teacher behavior in the classroom, the goals a teacher sets, and the level of enthusiasm a teacher brings to the classroom (Tschannen-Moran, Woolfolk Hoy, and Hoy, 1998), and student achievement (Armor, et al., 1976; Ashton & Webb, 1986) should be considered paramount to teacher education, and should be included as early as possible in a preservice teachers' educational career.

References

Adler, J., Ball, D., Krainer, K., Lin, F., & Novotna, J. (2005). Reflections of an emerging field: Researching mathematics teacher education. *Educational Studies in Mathematics, 60*, 359-381. doi: 10.1007/s10649-005-5072-6

Ambrose, R. (2001). *Catalyzing change in preservice teachers' beliefs: Effects of the mathematics early field experience.* Paper presented at the annual meeting of the American Educational Research Association, Seattle, Washington.

Armor, D., Conroy-Oseguera, P., Cox, M., King, N., McDonnell, L., Pascal, A., et al. (1976). *Analysis of the schoolpreferred reading programs in selected Los Angeles minority schools* (Report No. R-2007-LAUSD). Santa Monica, CA: RAND. (ERIC Document Reproduction Service No. 130 243).

Ary, D., Jacobs, L., Razavieh, A., & Sorensen, C. (2006). *Introduction to Research in Education (7th ed.).* Belmont, CA: Thomson Wadsworth.

Ashton, P.T. (1984). Teacher efficacy: A motivational paradigm for effective teacher education. *Journal of Teacher Education, 35*(5), 28-32.

Ashton, P.T. & Webb, R.B. (1986). *Making a Difference: Teacher's sense of Efficacy and Student Achievement.* New York: Longman.

Ball, D.L. (1988). Unlearning to teach mathematics. *For the Learning of Mathematics,* 8, 40-48.

Ball, D.L., Lubienski, S.T., Mewborn, D.S. (2001). Research on teaching mathematics: The unsolved problem of teachers' mathematics knowledge. In V. Richardson, *Handbook on Research and Teaching (4th ed.).* New York: Macmillan.

Ball, D., & Wilson, S. (1990). *Knowing the subject and learning to teach it: Examining assumptions about becoming a mathematics teacher*. Paper presented at the meeting of the American Research Association, Boston, MA.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215.

Bandura, A. (1994). Self-efficacy. *Encyclopedia of Human Behavior, 4,* 71-81. New York: American Press.

Bandura, A. (1997). Self-Efficacy: The exercise of control. New York: W. H. Freeman and Co.

Battista, M.T. (1994). Teacher beliefs and the reform movement in mathematics education. *The Phi Delta Kappan, 75*(6), 462-470.

Beck, R., King, A., & Marshall, S. (2001). Effects of videocase construction of preservice teachers; observations of teaching. *The Journal of Experimental Education, 70*(4), 345-361.

Bingham, A. (2004). Relationships between preservice teachers' characteristics, high-stakes testing, and mathematics efficacy beliefs in a former community college teacher preparation program in florida. Unpublished doctoral dissertation, Florida Atlantic University.

Bright, G. (1994). Changes in undergraduate preservice teachers' beliefs during an elementary teacher-certification program. Speeches/Meeting Papers. (ERIC Documentation Service No. ED375087).

Burton, M. (2006). *Effects of a combined mathematics methods and content course on mathematics content knowledge and teacher efficacy of elementary preservice teachers.* Unpublished doctoral dissertation, University of Alabama.

Capraro, R.M., Capraro, M.M., Parker, D., Kulm, G., & Raulerson, T. (2005). The mathematics content knowledge role in developing preservice teachers' pedagogical content knowledge. *Journal of Research in Childhood Education, 20*(2), 102-118.

Charalambos, Y., Philippou, G. & Kyriakides, L. (2007). Tracing the development of preservice teachers'efficacy beliefs in teaching mathematics during fieldwork. *Educational Studies in Mathematics, 67,* 125-142. doi: 10.1007/s10649-007-9084-2

Cooper, S.E., & Robinson, D. (1991). The relationship of mathematics self-efficacy beliefs to mathematics anxiety and performance. *Measurement & Evaluation in Counseling & Development, 24*(1), 4-12.

Davis, E.A., Petish, D., & Smithey, J. (2006). Challenges new science teachers face. *Review of Educational Research, 93*, 189-217.

Emenaker, C. (1995). The influence of a problem-solving approach to teaching mathematics on preservice teachers' mathematics beliefs. Speeches/Meeting Paper. (ERIC Document Service No. ED391657).

Enochs, L.G., & Riggs, I.M. (1990). Further development of an elementary science teaching efficacy beliefs instrument: A preservice elementary scale. *School Science and Mathematics, 90,* 695-706.

Enochs, L.G., Smith, P., & Huinker, D.M. (2000). Establishing factorial validity of the Mathematics Teaching Efficacy Beliefs Instrument. *School Science and Mathematics, 100*(4), 194-202.

Esterly, E.J. (2003*). A multi-method exploration of the mathematics teaching efficacy and epistemological beliefs of elementary preservice and novice teachers*. Unpublished dissertation, Ohio State University, Ohio.

Fleener, M. (1995). *A study of preservice teachers' metaphors for the different roles of the mathematics teacher*. Paper presented at the annual meeting of the North American chapter of the international group for the psychology of mathematics education. (ERIC Documentation Service No. ED389596).

Fosnot, C.T. (1996). Teachers construct constructivism: The center for constructivist teaching/teacher preparation project. In C.T. Fosnot*, Constructivism: Theory, perspectives, and practice* (p. 205-216). New York: Teachers College Press.

Frykholm, J., & Glasson, G. (2005). Connecting science and mathematics instruction: Pedagogical content knowledge for teachers. *School Science and Mathematics, 105*(3), 127-141.

Gall, M., Gall, J., & Borg, W. (2003). *Educational research an introduction.* Boston, Massachusetts: Pearson Education.

Gibson, S., & Dembo, M. (1984). Teacher efficacy: A construct validation. *Journal of Educational Psychology, 76*(4), 669-682.

Guskey, T. (1982). *Differences in teachers' perceptions of personal control of positive versus negative student learning outcomes*. Contemporary Educational Psychology, 7, 70-80.

Guskey, T. (1984). *The influence of change in instructional effectiveness upon the affective characteristics of teachers*. American Educational Research Journal, 21, 245-259.

Guskey, T. (1987). Context variables that affect measures of teacher efficacy. *Journal of Educational Research, 81*(1), 41-47.

Guskey, T., & Passaro, P. (1994). Teacher efficacy: A study of construct dimensions. *American Educational Research Journal, 31,* 628-643. doi: 10.3102/00028312031003627

Hill, H. C., Rowan, B., & Ball, D. (2005). Effects of teachers' mathematics knowledge for teaching on student achievement. *American Educational Research Association, 42*(2), 371-396.

Howell, D. C. (2008). *Fundamental statistics for the behavioral sciences (6th ed.).* Belmont, California: Thompson/Wadsworth.

Huinker, D., & Madison, S.K. (1997). Preparing efficacious elementary teachers in science and mathematics: The influence of methods courses. *The Journal of Science Teacher Education, 8*(2), 107-126.

Johnston, J. (2001). Using written reflection to identify preservice teachers' active instructional knowledge during mathematics mentoring. Speech/Meeting Paper. (ERIC Document Service No. ED460120).

Krainer, K. & Goffree, F. (n.d.) *European Research in Mathematics Education*. Available at http://www.prof-dr-berger.de/pap/cerme1-3.pdf#page=229. Retrieved on May 5, 2009.

Lancaster, J. & Bain, A. (2007). The design of inclusive education courses and the self-efficacy of preservice teacher education students. *International Journal of Disability, Development and Education, 54*(2), 245-256.

Lee, C. & Krapfl, L. (2002). Teaching as you would have them teach: An effective elementary science teacher preparation program. *Journal of Science Teacher Education, 13*(3), 247-265.

Ma, L. (1999). Knowing and Teaching Elementary Mathematics: Teachers' Understanding of Fundamental Mathematics in China and the United States. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Mearns, J. (2009). *The Social Learning Theory of Julian B. Rotter.* Available at: http://psych.fullerton.edu/jmearns/rotter.htm. Retrieved on May 5, 2009.

Mohr, M. (2006). Mathematics knowledge for teaching. *School Science and Mathematics,* 219.

Moyer, P.S. & Husman, J. (2006). Integrating coursework and filed placements: The impact on preservice teachers' connections to teaching. *Teacher Education Quarterly*, 37-56.

National Council of Teachers of Mathematics (2000). *Principles and Standards for School Mathematics*. Reston, VA: National Council of Teachers of Mathematics. Available at: http://www.nctm.org/standards

O'Brian, M., Stoner, J., Appel, K., & House, J. (2007). The first field experience: Perspectives of preservice and cooperating teachers. *Teacher Education and Special Education, 30*(4), 264-275.

Ostos, R.A. (2011). Community college teacher education programs: A national profile. *Community College Weekly, 23*(12), 6-8.

Pajares, F. (1997). Current directions in self-efficacy research. *Advances in motivation and achievement*, 10, 1-49.

Palmer, D. (2006). Durability of changes in self-efficacy of preservice primary teachers. *International Journal of Science Education, 28*(6), 655-671. doi: 10.1080/09500690500404599

Phillip, R.A., Ambrose, R., Lamb, L. Sowder, J.T., Shappelle, B.P., Sowder, L., et al. (2007). Effects of early field experiences on the mathematics content knowledge and beliefs of prospective elementary school teachers: An experimental study. *Journal for Research in Mathematics Education, 38*(5), 438-476.

Plourde, L. (2002). The influence of student teaching on preservice elementary teachers' science self-efficacy and outcome expectancy beliefs. *Influence of Student Teaching, 29*(4), 245-253.

Quinn, R. (2001). Effects of mathematics methods courses on the mathematics attitudes and content knowledge of preservice teachers. *The Journal of Educational Research, 91*(2), 108-113.

Raudenbush, S.W., Rowan, B., & Cheong, Y.F. (1992). Contextual effects on the self-perceived efficacy of high school teachers. *Sociology of Education, 65*, 150-167.

Rech, J., Hartzell, J., & Stephens. L. (1993). Comparisons of mathematics competencies and attitudes of elementary education majors with established norms of a general college population. *School Science and Mathematics, 93*(3).

Ross, J. & Bruce, C. (2007). Professional development effects of teacher efficacy: Results of randomized field trial. *The Journal of Educational Research, 101*(1), 50-60.

Rotter, J.B. (1954). *Social Learning and Clinical Psychology.* Available at http://psych.fullerton.edu/jmearns/rotter.htm. Retrieved on May 15, 2009.

Shulman, L.S. (1986). Those who understand: Knowledge growth and teaching. *Educational Researcher, 15*, 4-14.

Shulman, L.S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 1*(22).

Siegle, D. & McCoach, D. (2007). Increasing student mathematics self-efficacy through teacher training. J*ournal of Advanced Academics, 18*(2), 278-312.

Spielman, L.J. (n.d.). A case in mathematics education using skits to connect preservice teachers' language and practices. *Education*, *128*(1), 125-137.

Staub, F.C., Stern, E. (2002). The nature of teachers' pedagogical content beliefs matters for students' achievement gains: Experimental evidence for elementary mathematics. *Journal of Educational Psychology, 94*(2), 344-355. doi: 10.1037/0022-0663.94.2.344

Steele, D. (1994). Helping preservice teachers confront their conceptions about mathematics and mathematics teaching and learning. Speech/Meeting Paper. (ERIC Document Reproduction Service No. ED390848).

Strawhecker, J. (2005). Preparing elementary teachers to teach mathematics: How field experiences impact pedagogical content knowledge. *JUMPST: The Journal, 4*. Available at: www.k-12prep.mathematics.ttu.edu.

Swars, S. (n.d.). Examining perceptions of mathematics teaching effectiveness among elementary preservice teachers with differing levels of mathematics teacher efficacy. *Journal of Instructional Psychology, 32*(2), 139-147.

Swars, S., Daane, C.J. & Giesen, J. (2006). Mathematics anxiety and mathematics teacher efficacy: What is the relationship in elementary preservice teachers? *School Science and Mathematics, 106*(7), 306-315.

Swars, S., & Dooley, C. (2010). Changes in teaching efficacy during a professional development school-based science methods course. *School Science and Mathematics, 110*(4), 193-202.

Swars, S., Hart, L.C., Smith, S. Z., Smith, M.E., & Tolar, T. (2007). A longitudinal study of elementary preservice teachers' mathematics beliefs and content knowledge. *School Science and Mathematics, 107*(8), 325-336.

Texas Education Agency (TEKS). *Technical Digest* (2003-2004). Available at: http://www.tea.state.tx.us.

Texas Statewide Systemic Initiative for Science and Mathematics Education (TSS) (1997). Guidelines for the mathematical preparation of prospective elementary teachers. (ERIC Document Reproduction Service No. ED436370).

Tschannen-Moran, M., Woolfolk Hoy A., & Hoy, W. (1998). Teacher efficacy: It's meaning and measure. *Review of Educational Research, 68*(2), 202-248. doi: 10.3102/00346543068002202

Utley, J., Moseley, C., & Bryant, R. (2005). The relationship between science and mathematics teaching efficacy of preservice elementary teachers. *School Science and Mathematics, 105*(2), 82-88.

Vail, K. (2005). What schools can do to make U.S. students more competitive in the global marketplace. *American School Board Journal*, April Issue, 42-45.

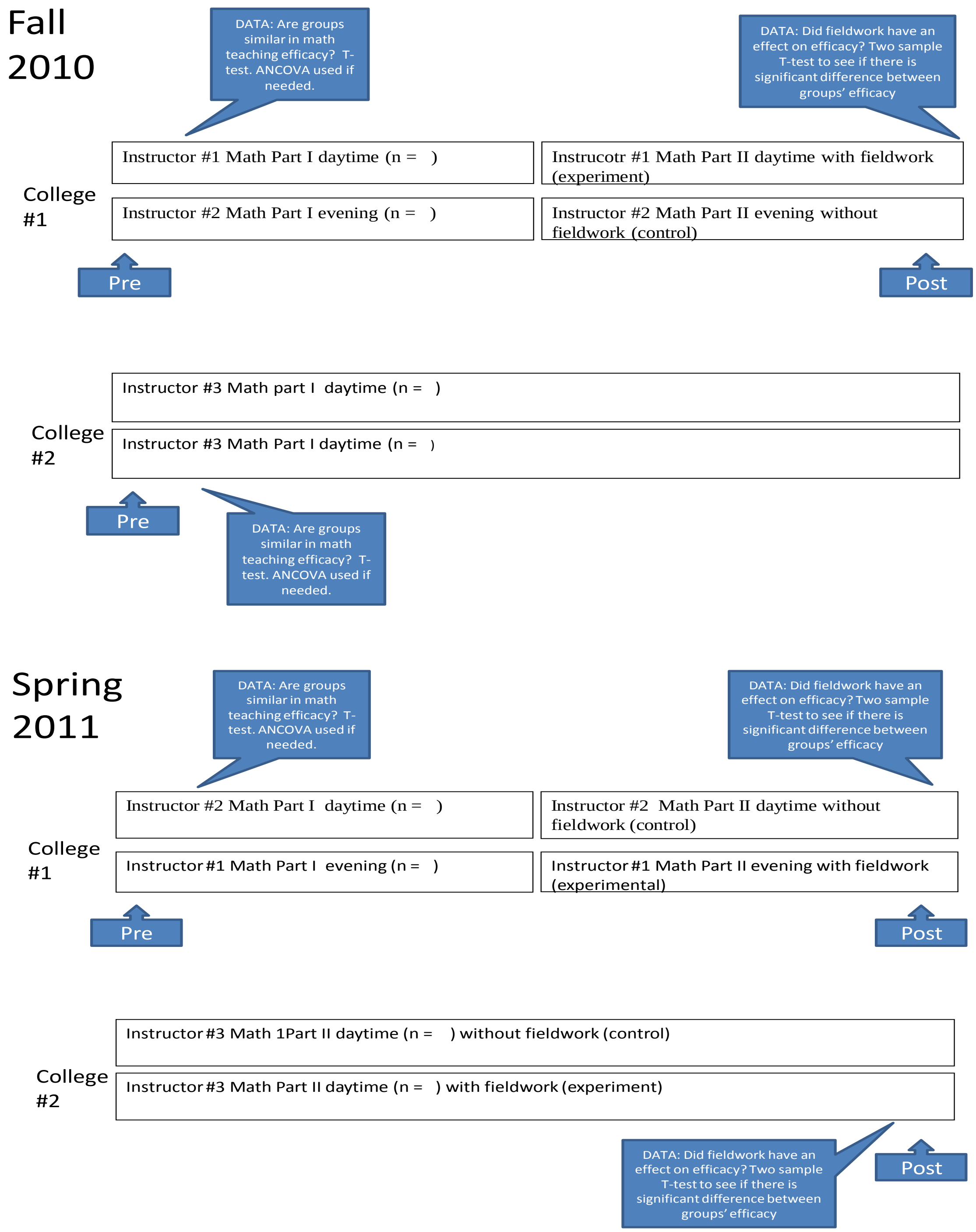
Vinson, B.M. (2001). A comparison of preservice teachers' mathematics anxiety before and after a methods class emphasizing manipulatives. *Early Childhood Education Journal*, *29*(2), 89-94).

Wilcox, S. (1991). The role of a learning community in changing preservice teachers' knowledge and beliefs about mathematics education. National Center for Research on Teacher Education. (ERIC Document Reproduction Service No. ED330680).

Wilson, J.D. (1996). An evaluation of the field experiences of the innovative model for the preparation of elementary teachers for science, mathematics, and technology. *Journal of Teacher Education*, *47*(1), 53-9.

Woolfolk, A.E., & Hoy, W.K. (1990). Prospective teachers' sense of efficacy and beliefs about control. *Journal of Educational Psychology, 82*(1), 81-91. doi: 10.3102/00346543068002202

Appendix A



Fall 2010
DATA: Are groups similar in math teaching efficacy? T-test. ANCOVA used if needed.
DATA: Did fieldwork have an effect on efficacy? Two sample T-test to see if there is significant difference between groups' efficacy
College #1
Instructor #1 Math Part I daytime (n =)
Instrucotr #1 Math Part II daytime with fieldwork (experiment)
Instructor #2 Math Part I evening (n =)
Instructor #2 Math Part II evening without fieldwork (control)
Pre
Post
College #2
Instructor #3 Math part I daytime (n =)
Instructor #3 Math Part I daytime (n =)
Pre
DATA: Are groups similar in math teaching efficacy? T-test. ANCOVA used if needed.
Spring 2011
DATA: Are groups similar in math teaching efficacy? T-test. ANCOVA used if needed.
DATA: Did fieldwork have an effect on efficacy? Two sample T-test to see if there is significant difference between groups' efficacy
College #1
Instructor #2 Math Part I daytime (n =)
Instructor #2 Math Part II daytime without fieldwork (control)
Instructor #1 Math Part I evening (n =)
Instructor #1 Math Part II evening with fieldwork (experimental)
Pre
Post
College #2
Instructor #3 Math 1Part II daytime (n =) without fieldwork (control)
Instructor #3 Math Part II daytime (n =) with fieldwork (experiment)
DATA: Did fieldwork have an effect on efficacy? Two sample T-test to see if there is significant difference between groups' efficacy
Post

Appendix B

SYLLABUS: Please include something in your syllabus to let students know they may participate in this study. "During Mathematics 1350 and 1351 you will have the opportunity to participate in a study that will capture your beliefs about teaching mathematics. If you choose to participate, your responses will be recorded over the course of the semester to see what changes may occur. Your name will be included on the survey for tracking purposes, but at no time will your individual responses be shared with your instructor or other classmates. Only the researcher will see your responses. At the end of the semester the researcher will share our class responses with us so we can see change over time. Your responses will not affect your grade in any way. The information you provide is part of a research project that will study preservice teachers' beliefs about teaching mathematics."

TIMELINE

1350 Day 1 or 2 – Give MTEBI to all students.

1350 Week 1 – Give 6th grade mathematics content test to all students.

1351 Day 1 or 2 – Give MTEBI to all students.

1351 Last week of class – Give MTEBI to all students.

DESCRIPTION / SCRIPTS

MTEBI – Give to all students during class time. If a student is absent the day of the test, administer the test the following day. Test should take about 10 minutes to complete. Please make sure students put their name on each administration of the MTEBI so individual student responses can be tracked. This is a paper and pencil test. This should not count toward a student's grade.

You may want to say…If you choose to participate in this study, you will be asked to complete a short survey to capture your beliefs about teaching mathematics. Read each question and indicate the degree to which you agree or disagree (refer to directions for numerical equivalents). Try not to think too long about a question. Give your first thought. Please make sure your name is on this survey. Thank you!

Content test – Give to all students during class time. If a student is absent the day of the test, please administer during office hours. The test should take about 45 minutes. Have students use included Scantron and make sure names are on Scantron. Students can write on the test if needed. No calculators.

You may want to say…This will count as one of your assignments (grade on completion or accuracy). If you choose to participate in the study, your results will be sent to the researcher for data collection. You have 45 minutes to complete this. Please make sure 1) your answers are clearly marked on your Scantron and 2) that your name is on your Scantron. Thank you!

Appendix C

Mathematics Teaching Efficacy Beliefs Instrument

Name_________________________________ Date:______________

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

1 **Strongly Disagree**	2 **Disagree**	3 **Uncertain**	4 **Agree**	5 **Strongly Agree**

1.	When a student does better than usual in mathematics; it is often because the teacher exerted a little extra effort.	1	2	3	4	5
2.	I will continually find better ways to teach mathematics.	1	2	3	4	5
3.	Even if I try very hard, I will not teach mathematics as well as I will most subjects.	1	2	3	4	5
4.	When the mathematics grades of students improve, it is often due to their teacher having found a more effective teaching approach.	1	2	3	4	5
5.	I know how to teach mathematics concepts effectively.	1	2	3	4	5
6.	I will not be very effective in monitoring mathematics activities.	1	2	3	4	5
7.	If students are underachieving in mathematics, it is most likely due to ineffective mathematics teaching.	1	2	3	4	5
8.	I will generally teach mathematics ineffectively.	1	2	3	4	5
9.	The inadequacy of a student's mathematics background can be overcome by good teaching.	1	2	3	4	5
10.	When a low-achieving child progresses in mathematics, it is usually due to extra attention by the teacher.	1	2	3	4	5
11.	I understand mathematics concepts well enough to be effective in teaching elementary mathematics.	1	2	3	4	5
12.	The teacher is generally responsible for the achievement of students in mathematics.	1	2	3	4	5

13. Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching.	1	2	3	4	5
14. If parents comment that their child is showing more interest in mathematics at school, it is probably due to the performance of the child's teacher.	1	2	3	4	5
15. I will find it difficult to use manipulatives to explain to students why mathematics works.	1	2	3	4	5
16. I will typically be able to answer students' questions.	1	2	3	4	5
17. I wonder if I will have the necessary skills to mathematics.	1	2	3	4	5
18. Given a choice, I will not invite the principal to evaluate my mathematics teaching.	1	2	3	4	5
19. When a student has difficulty understanding a mathematics concept, I will usually be at a loss as to how to help the student understand it better.	1	2	3	4	5
20. When teaching mathematics, I will usually welcome student questions.	1	2	3	4	5
21. I do not know what to do to turn students on to mathematics.	1	2	3	4	5

Appendix D

Informed Consent Form

Preservice Teachers in Mathematics 1350/1351

Have you wondered what it's going to be like to teach mathematics to elementary or middle school students? Would you share your thoughts with us about mathematics and allow us to investigate your beliefs while in this course?

If you choose to participate in this study, you will be asked to complete a survey in class. The survey takes approximately five minutes to complete and will require no outside of class work for you. Your responses will not be connected to your grade in any way.

The surveys will be turned in to your instructor, who will then give them to the researcher (another mathematics instructor). At the end of the semester, the researcher will share results with us. We will be able to see how the class as a whole changed over time, and you will be able to see how you as an individual have changed over time. Your individual results will not be shared with anyone but you.

Your participation in this study is voluntary and you may opt out at any time.

______ I agree to participate

_______ I do not want to participate

______________________________ ______________________

Student Signature Date