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Guided Imagery's Effects on the Mathematics Teaching Efficacy of Elementary Preservice Teachers

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GUIDED IMAGERY'S EFFECTS ON THE MATHEMATICS TEACHING EFFICACY OF ELEMENTARY PRESERVICE TEACHERS

A Dissertation

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by

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Dedicated to my children,

Amberly, Taylor, Jordan, and Jonah,

in hopes that my commitment to education will inspire you to be life-long learners and to fulfill your highest potential of success, well-being, and happiness.

Love Always,

Mom

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Abstract

Teacher educators continually strive to find ways to improve the preparation of preservice teacher candidates. In the area of mathematics education, methods courses that follow National Council of Teachers of Mathematics (NCTM) standards for professional development have been successful. This study supports the notion that a mathematics methods course can improve mathematics teaching efficacy in the constructs of personal mathematics teaching efficacy (PMTE) and mathematics teaching outcome expectancy (MTOE). Findings also suggest that mathematics teaching efficacy is developmental in its nature with PMTE developing before MTOE.

Employing a quasi-experimental nonequivalent comparison groups pre- and posttest design, the present study examined the effects of guided imagery as an added component of a mathematics methods course and found no significant advantageous treatment effects on mathematics teaching efficacy. However, there were no detrimental effects on mathematics content knowledge and pedagogical skills either. Participation in a reform-based mathematics methods course did affect mathematics teaching efficacy for both groups in the study.

Mathematics teaching efficacy beliefs were measured by the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI), and data were analyzed by ANCOVA and paired-samples t-tests.

Recommendations for further research on the developmental nature of general teacher efficacy and mathematics teaching efficacy are included.

Chapter I

Introduction

Students in the United States are not doing as well as they should in mathematics. According to the National Center for Educational Statistics ([NCES], 2004) the Third International Mathematics Study (TIMSS) revealed that U. S. eighth graders scored below the international average in mathematics, and U. S. twelfth graders performed among the lowest scoring of 21 countries on the assessment of mathematics general knowledge. Furthermore, a recent National Assessment of Educational Progress (NAEP) report reveals that students are improving in mathematics, but are still not proficient (Manzo, 2001). Students achieving below proficient performance in mathematics will most likely have problems seeking to further their education or to pursue careers of their dreams. In 1995, 34% of freshmen entering two-year public colleges and 18% of freshmen entering four-year public institutions were placed in remedial mathematics courses (NCES, 2004). Not only are students ill-prepared for college mathematics, but they also lack the skills necessary to be successful in business and industry. For example, Scott, Quinn, and Daane (1996) found that high school graduates were not prepared to satisfy industry's needs because they lacked mathematical skills. Additionally, Ornstein and Levine (2003) explain that American students graduate from high school and cannot reason and perform complex tasks required in our technology-based world economy.

One way to advance the improvement of students' mathematics achievement calls for changes in the teaching of mathematics. Since reforming mathematics education is so important, it is necessary that teachers have the training to do the job. If teachers are to bring forth the change needed in the teaching of mathematics, they must seek opportunities to learn new methods of teaching the subject. "Teachers must experience a broader version of mathematics themselves in order to break free of their traditional views" (Aquarelli & Mumme, 1996, p. 479). The National Council of Teachers of Mathematics' (NCTM) *Professional Standards for Teaching Mathematics* asserts that "teachers are key figures in changing the ways in which mathematics is taught and learned in schools" (1991, p. 2). Therefore, teachers must also understand and appreciate the necessary changes in the way math should be taught. Students will ask teachers why certain algorithms work when solving problems. Teachers must develop conceptual understanding of mathematics in order to answer these questions. Surprisingly, some preservice teachers who performed well in math courses throughout their lives have been found to have difficulty explaining mathematical concepts (Ball, 1990; Reinke, 1997).

Weaknesses in the mathematical skills of preservice elementary candidates are not surprising since these students did not necessarily choose to teach mathematics. Although they did not choose to teach mathematics, elementary education majors will be certified to teach all subjects. Most teacher educators realize that something should be done to help develop stronger mathematical skills for their teacher candidates. In order for the reform of mathematics education to be successful, teachers must be trained in the new pedagogy for teaching mathematics. Mathematics teachers must also be willing to make the necessary changes in the way they teach mathematics. Findell (1996) writes, "If we expect teachers to implement all these reforms, then it is obvious that teacher training institutions, both in-service and preservice, must change their curricula and methods to reflect these changes" (p. 10). Among other researchers, Steele and Widman (1997) propose that teacher educators need to provide preservice teachers with alternative models for teaching mathematics.

Although it is clear that teacher preparation institutions must implement programs to help preservice teachers improve their conceptual understanding of mathematics and increase their mathematical content knowledge, doing so is still not enough. For example, there is a strong relationship between affective characteristics and achievement in mathematics. This suggests that the affective domain should be considered. In fact, NAEP (1995) included attitudes about mathematics and their relationship to student proficiency in mathematics as a new aspect of its assessment. Additionally, X. Ma (1997) found that the feeling of enjoyment directly improves mathematics achievement. In order to pass the feeling of enjoyment on to their students, teachers themselves need to enjoy and appreciate mathematics.

This feeling of enjoyment begins at an early age. Trujillo and Hadfield (1999) conclude that prevention of math anxiety for young children requires positive early classroom experiences with mathematics. These results support the need for professional development for preservice and inservice teachers to learn to provide positive experiences for children in mathematics classrooms. Through in-depth interviews with preservice teachers, Trujillo and Hadfield found that most participants struggled in elementary school mathematics, and the mathematics anxiety worsened in middle and high school. Participants also expressed disappointment in the fact that most of their teachers could never explain why problems and algorithms worked. In addition to negative experiences in school, participants had little positive support at home.

Although teachers' characteristics in the affective domain have been found to determine the differentiation between "more effective" and "less effective" teachers, the affective component of teacher education is typically neglected (Anderson & Ching, 1987). Most teacher education programs focus on knowledge and skills with curricula emerging from the knowledge and expertise of individual professors (Alkin, 1992). Since affective characteristics have been found to determine teacher effectiveness, it follows that teacher education programs should consider this domain. Self-efficacy, a teacher attribute in the affective domain that has been found to be connected with teacher effectiveness (Ross, McKeiver, & Hogaboam, 1997) should certainly be addressed.

Literature includes research that has measured various levels of improvement in preservice teachers' mathematical knowledge and skills after completing mathematics methods courses (Mewborn, 2000; Poole, 2000; Quinn, 1997; Steel & Widman, 1997; Vacc & Bright, 1999). However, the research is lacking when it comes to finding ways to improve preservice teachers' efficacy. In one study, Bolton (1996) found that performance assessment makes a significant impact on teacher efficacy. In another study, Huinker and Madison (1997) found that a combination mathematics and science methods course with a fieldwork component improved preservice elementary teachers' efficacy. However, the results of this study beg the question of whether it was the fieldwork component or other characteristics of the course that contributed to the increase in efficacy.

Purpose and Rationale of this Study

The purpose of this study is to investigate the impact of a mathematics methods course, including confluent interventions as an integral component, on the mathematics teaching efficacy beliefs of preservice elementary teachers. Although there is scant research regarding self-efficacy as it relates to teaching mathematics, the literature regarding the broader concept of efficacy is plentiful. The discussion of efficacy should begin with the theoretical background regarding this construct. Efficacy is tied to the theoretical work of Bandura (1986, 1993, 1997). In his social cognitive theory, Bandura theorizes that efficacy beliefs influence the way people feel, think, motivate themselves, and behave. If one has a strong perceived sense of efficacy, it is likely that high goals will be set and commitment to the goals will be strong. Self-efficacy also plays a role in self-motivation by how much effort people expend, how long they persevere in the face of difficulties, and their resilience to failures (Bandura, 1993). Furthermore, there is an emotional mediator of self-efficacy. For example, inefficacious thinking can lead to stress that impairs one's level of functioning. On the other hand, strong self-efficacy helps one become bold in taking on threatening activities.

Self-efficacy plays an important role in teaching and learning. Past failures for students and teachers alike can cause anxiety about future scholastic demands. In order to alleviate scholastic anxiety, Bandura (1993) recommends building a strong sense of efficacy through the development of cognitive capabilities and self-regulative skills for managing academic task demands and self-debilitating thought patterns. In order to overcome the many challenges in schools today, teachers need to build a strong sense of teaching efficacy.

> To teach to the best of their abilities, teachers need to construct and maintain conscious beliefs that link their teaching actions to their students' learning, that project a measure of control over their difficult and complex work setting, and that allow them to persist in the face of obstacles (Smith, 1996, p. 390).

Teachers who have a strong sense of teaching efficacy have been found to devote more class time to learning, provide students with the assistance they need, and praise them with confidence (Gibson & Dembo, 1984).

Hoover-Dempsey, Bassler, and Brissie (1987) define teacher efficacy as "teachers' beliefs that they are effective in teaching, that the children they teach can learn, and that there is a body of professional knowledge available to them when they need assistance" (p. 421). Deemer and Minke (1999) report that teacher efficacy is associated with teachers' instructional practices and attitudes toward students. According to Ross, McKeiver, and Hogaboam (1997), teacher efficacy is a construct connected to teacher effectiveness, specifically referring to the extent to which a teacher anticipates that he or she will be able to bring about student learning. “Teachers’ beliefs in their personal efficacy to motivate and promote learning affect the types of learning environments they create and the level of academic progress their students achieve” (Bandura, 1993, p. 117). In a synthesis of research on teacher efficacy, Shahid and Thompson (2001) reveal a strong correlation between teacher efficacy and student achievement.

After examining preservice teachers’ attitudes about mathematics, Cornell (1999) concluded that “increasing the effectiveness of math instruction and ensuring a pool of capable and enthusiastic teachers means considering both content and affective factors...” (p. 229). Affective factors are considered in other works as well. For example, NCTM (1991) refers to teachers’ attitudes and beliefs in *Professional Standards for Teaching Mathematics*: “Teachers are in a constant state of ‘becoming’.... Their growth is deeply embedded in their philosophies of learning, their attitudes and beliefs about learners and mathematics, and their willingness to make changes in how and what they teach” (p. 125).

Anderson and Ching (1987) recommend that affective teacher education should be a key component of teacher education programs. Tsui and Cheng (1997) describe total teacher effectiveness as including three domains: cognitive, affective, and behavioral. And, according to Bolton (1996), attention to self-efficacy that shapes motivation, persistence, and attitude is an important part of preparing effective teachers. Furthermore, the accrediting agency recognized by the U.S. Department of Education, the National Council for Accreditation of Teacher Education ([NCATE], 2000), includes dispositions in its standards for teacher education programs. When applying for NCATE accreditation, teacher educators are required to show evidence that candidates have knowledge, skills, and dispositions necessary to help all students learn.

Despite the importance of addressing the affective domain in preparing teachers, most teacher training programs focus on cognitive and behavioral components (Anderson & Ching, 1987). Knowledge, including content knowledge and pedagogical knowledge, and skills, including general methodology and content methodology are considered. Although research has supported the importance of teachers' affective characteristics, this domain is often left out of teacher education programs. Since affective characteristics are important to overall teacher effectiveness, it is important for teacher educators to determine ways to improve those characteristics.

What interventions can improve these affective characteristics? Anderson and Ching (1987) suggest future research studies should focus on teacher affect as a necessary component for teacher behavior. A few studies have focused on teacher affect. For example, D'Emidio-Caston (1993) suggests "confluent" (p. 1) interventions, interventions that address the affective domain, as a means of influencing the way preservice teachers feel about mathematics and ultimately how they teach the subject. Further study is needed to support the claim. In addition, Huinker and Madison (1997) found a combination math and science methods course with a fieldwork component to improve efficacy. Comparison studies of preservice teachers enrolled in separately taught science or mathematics methods courses are suggested to assess the effect generated by the collaboration of the subjects. This study will extend existing research and inform the practice of teacher educators.

Statement of the Problem

In the year 2004, a decade after *Goals 2000* called for students in the United States to be first in the world in mathematics and science, American students are still lagging behind, performing below the international average. Furthermore, teachers are considered change agents with regard to student performance. Yet, many preservice elementary teacher candidates have negative dispositions about mathematics. NCTM (1989, 1991, 2000) has encouraged reform in mathematics teaching and learning and has included attitudes and beliefs about mathematics in its recommendations. Additionally, NCATE (2000) has required teachers to be prepared in the areas of knowledge, skills, and dispositions for teaching. Specifically, when they reference mathematics, NCATE guidelines state, “Programs should prepare teacher candidates to become confident in their ability to do mathematics and to create an environment in which students become confident learners and doers of mathematics” (p. 72).

Self-efficacy, a construct of Bandura’s social cognitive theory, is one affective characteristic to consider when examining dispositions. In spite of the fact that we know that efficacy affects performance, more research is needed to determine what kinds of treatments might improve efficacy in preservice elementary teacher candidates. The time has come for teacher educators to recognize the importance of the affective domain in the preparation of effective teachers and to find ways to enhance efficacy of teacher candidates.

Theoretical Framework

Mathematics teaching efficacy beliefs of preservice elementary teacher candidates is the area of interest in the present research. Specifically, this study will examine strategies that might change efficacy beliefs. Self-efficacy is a construct of Bandura’s social cognitive theory. Bandura (1986, 1993, 1997) theorizes that building a strong sense of efficacy is important for alleviating scholastic anxiety. He suggests the development of cognitive capabilities and self-regulative skills for managing academic task demands and self-debilitating thought patterns which might make one’s efficacy low.

Additionally, both sections of the mathematics methods course that will serve as the independent variables will be structured around Social Development Theory and Constructivism. Vygotsky (1978) theorizes that social interaction plays a significant role in cognitive development. Furthermore, cognitive development is limited to a certain range at a given age, and full cognitive development is dependent upon social interaction (Vygotsky, 1978).

Definition of Terms

The present study investigated whether the confluent intervention of guided imagery impacted mathematics teaching efficacy beliefs and mathematics content knowledge and pedagogical skills of preservice elementary teacher candidates. For the purpose of this study, the terms confluent intervention, guided imagery, mathematics teaching efficacy beliefs, and pedagogical skills are defined as follows.

Confluent Intervention

The term confluent education is often misunderstood. A formal language conceptual analysis of the term confluent education was conducted to clarify its meaning. The definition formed was the following: “Confluent education is defined as the deliberate and purposeful evocation by responsible and identifiable agents of knowledge, skills, attitudes, and feelings that flow together to produce wholeness in the person and society” (Shapiro, 1975, p. 119). Confluent educators distinguished confluent education as different from affective education, environmental education, and the like. “The defining essence of confluent education is captured in its aim of achieving integration of cognitive and affective dimensions of learning” (Hackbarth, 1999, p. 8). For the purpose of this study, confluent intervention will refer to instructional strategies that aim at integrating the cognitive and affective dimensions of learning. Although there are numerous ways to integrate the cognitive and affective dimensions of learning, this study will incorporate guided imagery.

Guided Imagery

The term guided imagery identifies a technique that uses the power of the mind and imagination to help overcome challenges or alter existing behaviors (Gothelf, 2003).

Mathematics Teaching Efficacy Beliefs

As mentioned above, Hoover-Dempsey, Bassler, and Brissie (1987) define teacher efficacy as "teachers' beliefs that they are effective in teaching, that the children they teach can learn, and that there is a body of professional knowledge available to them when they need assistance" (p. 421). Additionally, teacher efficacy refers to the extent to which a teacher anticipates that he or she will be able to bring about student learning (Ross, McKeiver, & Hogaboam, 1997). This study will focus on teacher efficacy specifically for teaching mathematics. Therefore, for the purpose of the present study, mathematics teaching efficacy beliefs will be defined as elementary preservice teachers' beliefs that they are effective in teaching mathematics, that the students they teach can learn mathematics, and that there is a body of professional knowledge about mathematics and its teaching available when they need assistance. Furthermore, mathematics teaching efficacy beliefs will refer to the extent to which a preservice elementary teacher candidate anticipates that he or she will be able to bring about student learning of mathematics.

Pedagogical Skills

Pedagogy is defined as "the profession or function of a teacher; teaching" or as "the art or science of teaching" (Guralnik, 1979, p. 1046). Pedagogical is defined as the adjective form of pedagogic, "of or characteristic of teachers or of teaching" (ibid). For the purpose of this study pedagogical skills will refer to preservice elementary teacher candidates' ability to explain and model mathematical problems and solutions.

Research Questions

The research questions in the present study examine the impact of the confluent intervention of guided imagery on the mathematics teaching efficacy beliefs, content knowledge, and pedagogical skills of preservice elementary teacher candidates. The research questions are as follows:

> Question 1. Are there differences in the Mathematics Teaching Efficacy Beliefs Instrument posttest scores between elementary preservice teacher candidates who completed a mathematics methods course including the confluent intervention of guided imagery and those who completed a mathematics methods course without the confluent intervention of guided imagery?

If a specified amount of time is spent on an added intervention, in this case the confluent intervention of guided imagery, there might be a concern that the attainment of other objectives of the course may be diminished. More specifically, fifteen minutes of class time was dedicated to guided imagery sessions for ten of the class meetings during this study. However, course expectations remained the same. Despite the time spent with guided imagery in the experimental group, preservice teacher candidates still studied the topics of number sense; concepts and operations of rational numbers and real numbers; algebra across the curriculum; geometry and spatial sense across the curriculum; data analysis and probability; and integration of technology. Additionally, candidates in both course sections were expected to meet all course objectives as listed on the course syllabus which is included in Appendix A. Consequently, a secondary question was considered to determine whether the extra time for class instruction and activity gave the comparison group an unfair advantage. Therefore, the second question in this study is as follows.

> Question 2. Are there differences between the mathematics content knowledge and pedagogical skills performance assessment scores of elementary preservice teacher candidates who completed a mathematics methods course including the confluent intervention of guided imagery and those who completed a mathematics methods course without the confluent intervention of guided imagery?

Finally, both the experimental group and the comparison group experienced a mathematics methods course that included field experience. The third question, as follows, was designed to find out whether the mathematics methods course with the field component, and with or without the confluent intervention of guided imagery, made any difference in participants' mathematics teaching efficacy beliefs.

> Question 3. Are there differences between the Mathematics Teaching Efficacy Beliefs Instrument pretest scores and Mathematics Teaching Efficacy Beliefs Instrument posttest scores of elementary preservice teacher candidates who completed a mathematics methods course?

Overview of the Study

Variables and Instrumentation

Mathematics teaching efficacy beliefs. Mathematics teaching efficacy beliefs describe how one feels about his or her ability to teach mathematics to students. This dependent variable was measured with the *Mathematics Teaching Efficacy Beliefs Instrument* (MTEBI). The MTEBI is made up of two subscales, personal mathematics teaching efficacy (PMTE) and mathematics teaching outcome expectancy (MTOE). Cronbach's alpha coefficients of 0.88 for

PMTE and 0.77 for MTOE have been reported by Enochs, Smith, and Huinker (2000). The MTEBI has been used in various ways in other studies (Barta & Ostrogorsky, 2004; Bingham, 2004; Swars, 2005; Utley, 2004). The instrument has also been translated into the Arabic language with internal reliability and construct validity sustained (Alkhateeb, 2004).

Mathematics methods course. The mathematics methods course was the independent variable with two levels. In the experimental group, the confluent intervention of guided imagery was employed to specifically target the affective domain. Detailed descriptions of the guided imagery interventions can be found in Appendix D. In the comparison group, the same mathematics content knowledge and pedagogical skills were addressed, but the guided imagery interventions were not implemented.

Mathematics content knowledge and pedagogical skills. Mathematics content knowledge and pedagogical skills were taught throughout the semester and assessed at the end of the semester in both mathematics methods courses. Both courses addressed content knowledge and pedagogical skills through classroom instruction and field experience in elementary schools. This variable was assessed by completion of a mathematics content knowledge and pedagogical skills performance assessment given as an oral examination. The course instructor developed this instrument, and the researcher checked construct validity.

Procedure for the Selection of the Sample

This study involves preservice elementary teacher candidates enrolled in a mathematics methods course. Convenience sampling as suggested by McMillan and Schumacher (1997) was used because preservice teachers enrolled in two sections of a mathematics methods course were used as participants. The experimental group and comparison group were randomly assigned to the two sections of the mathematics methods course. The study was explained to candidates enrolled in the classes during the first week of the semester and asked to participate. The decision to participate or not had no bearing on participants' grades for the course.

Significance of the Study

This study is significant because if affective characteristics differentiate more effective teachers from less effective teachers, teacher educators must address affect in their programs. Results of this study may suggest confluent interventions as a way to enhance the affective characteristic of mathematics teaching efficacy, an affective characteristic of teachers.

As educational reform continues to advocate standards-based instruction and accountability, teacher educators strive to prepare teacher candidates in the areas of knowledge, skills, and dispositions as suggested by NCATE (2000). Most teacher education programs clearly address the acquisition of knowledge and skills upon completion of their programs (Anderson & Ching, 1987); however, making a difference in the affective dimension is often just happenstance. Since dispositions are considered important in national teacher preparation standards (NCATE, 2000) and other affective characteristics, such as, teacher efficacy are known to enhance teacher effectiveness (Ross, McKeiver, & Hogaboam, 1997), finding empirical evidence of specific ways to enhance affective characteristics is important to teacher educators.

Delimitations

In this research, only mathematics teaching efficacy beliefs, mathematics content knowledge, and mathematics pedagogical skills were examined. Other outcomes of participation in a mathematics methods course will not be considered for this study.

Another delimitation of the research is the selection of guided imagery as the confluent intervention. Although numerous strategies for integrating the cognitive and affective dimensions of learning exist, only guided imagery was considered in this study.

Chapter II

Review of Related Literature

In the year 2004, students in the United States are far from the goal of being first in the world in mathematics and science. On the contrary, students in the United States are performing below the international average and are often under-prepared for college and careers (Manzo, 2001; NCES, 2004). Furthermore, in the state of Louisiana, students are performing below the national average in mathematics (NCES, 2004). One way to improve student achievement in mathematics is to reform the teaching of mathematics. As the major change agents in the process of reform, teachers must possess the knowledge, skills, and dispositions associated with effective mathematics pedagogy (NCTM, 1991). The primary purpose of this study is to investigate the impact of a mathematics methods course, including confluent interventions as an integral component, on the mathematics teaching efficacy beliefs of preservice elementary teacher candidates. The second purpose is to determine whether time spent on the affective domain will diminish the acquisition of mathematics content knowledge and pedagogical skills.

This chapter presents a review of related literature. The major components of this literature review are: history of educational reform, students' mathematics performance in Louisiana, mathematics education reform, constructivism, teacher education, efficacy, confluent education, and guided imagery.

History of Educational Reform

Tracing the roots back to the Soviet launching of *Sputnik* in 1957, educational reform has focused on reexamining the focus of schooling. American pride was damaged by the thought of being behind the Soviets technologically (Ornstein & Levine, 2003). Consequently, the National Defense Act was established. The act stressed programs in science, mathematics, and modern languages, and encouraged guidance counselors to steer young learners into those fields in college (Ornstein & Levine, 2003). In 1983, the National Commission on Excellence in Education reported, in *A Nation at Risk: The Imperative for Educational Reform*, that American education was mediocre at best because of things such as, low standardized test scores, low expectations, and low graduation requirements. Again, tougher standards were suggested. Later, in 1990, President Bush called for the creation of national education goals. Congress passed *Goals 2000*, a reform initiative outlining eight educational goals for the nation's schools, in 1994. The eight goals encompassed all aspects of schooling including school readiness, graduation rates, student achievement and citizenship, teacher education and professional development, mathematics and science, adult literacy and lifelong learning, school safety, and parental involvement. Goal 5 specifically reached for United States students to be "first in the world in mathematics and science achievement" (United States Department of Education, 1994).

As a result of implementing the increased focus on rigorous content as suggested in the *National Defense Act* and *A Nation at Risk,* new problems arose for students who were not exceptionally bright or who were considered disadvantaged. Thus, a shift in concern from the 1960s to the 1980s was toward students with disabilities bringing a focus to special education by the 1990's. In 1991, the Individuals with Disabilities Education Act (IDEA) called for inclusion, in the least restrictive environment, of students with disabilities. Equity in education became an issue of concern. Still today, one major issue of educational reform is the idea that teachers must learn how to address the individual needs of each child in order to improve academic performance, particularly that of children who are economically disadvantaged (Ornstein & Levine, 2003; Rozycki, 2004). For example, the current No Child Left Behind (NCLB) act focuses on narrowing achievement gaps between demographic groups. Critics believe, however, that because of the way that progress is measured, NCLB will fail leaving the children who need help the most without it (Mathis, 2004; Rose, 2004; Starnes, 2004). Rose (2004) went so far as to say that without major revision, NCLB will prove useless in the effort to improve student achievement. Mathis (2004) contends that because the success of schools depends on the quality of human experiences, analysis of test scores will not clearly describe a school's success. Finally, Starnes (2004) calls NCLB "a masterpiece of language manipulation" and claims that students will not benefit from the act.

Accountability has made schools, teachers, and administrators responsible for student achievement measured by standardized test scores. Consequently, high stakes testing and standards-based education have brought frustration to many teachers. According to Hargrove, Walker, Huber, Corrigan, and Moore (2004), frustration begins when teachers experience inconsistencies between the ways in which they are expected to teach and the ways in which their students are assessed. "Teachers become technicians preparing students for the test instead of professional decision-makers in the classroom helping students realize the fullness of the curriculum" (Hargrove, et al., p. 570). This frustration and discouragement is the last thing we need in American education. Already, a major problem in American public education is teacher retention rates. The National Commission of Teaching and America's Future (NCTAF) presented evidence in 2002 that there is a nationwide teacher retention crisis leading to a shortage in qualified teachers (Hargrove, et al.).

According to Ingersoll and Smith (2003), the teacher retention crisis is especially problematic with beginning teachers. They collected data regarding attrition of beginning teachers in their first several years of teaching. Ingersoll and Smith's data suggest that 40 to 50 percent of all beginning teachers leave the profession after just five years. Additionally, data show that there are several reasons for attrition. In particular, school administrator support, student discipline problems, faculty decision-making power, and low salaries, are all associated with higher rates of turnover (Ingersoll, 2000).

In an attempt to remedy the problem of teacher attrition, teacher induction and mentoring programs have been designed and implemented across the country. The good news is that many new teachers are now receiving the foundation they need to make the transition from preservice to inservice teaching. Ingersoll and Smith (2004) examined offerings of formal induction and mentoring for new teachers and found that the number of teachers who receive some kind of formal induction and mentorship has dramatically expanded in recent years. In fact, they found that the majority of new teachers are provided opportunities to participate in formal induction and mentoring activities.

Students' Mathematics Performance in Louisiana

Results from the National Assessment of Educational Progress (NAEP) provide information about what students know and are able to do. Achievement levels in NAEP are basic, proficient, and advanced. Students scoring at the *basic* level are determined to have partial mastery of content; *proficient* indicates solid academic performance; and the *advanced* label reveals superior performance (NCES, 2004). For Louisiana students, mathematics results have been disheartening. In 2003, 33% of fourth grade students who took the NAEP test in mathematics in Louisiana scored below the *basic* level, and only 2% scored in the *advanced* category. Even worse, 43% of eighth grade students in Louisiana scored below the *basic* level in mathematics, and only 2% scored at the *advanced* level in 2003 (NCES, 2004). Louisiana's students do not compare favorably to students from other states in the nation, but how do they perform on the state's own criterion-referenced tests?

Tables 1 – 3 summarize selected data published on the Louisiana Department of Education website (Louisiana Department of Education, 2004). Evidence shows that students in Louisiana's public schools are seriously struggling with mathematics. For the purpose of consistency, only data from 2003 and 2004 were presented for the Graduate Exit Exam (GEE) because in those years the achievement levels matched those listed for grades four and eight. Data from 2000 to 2004 are presented for grades four and eight.

A close look at Table 1 reveals the fact that although there is a slight increase in achievement from 2003, in 2004, 23% of Louisiana's tenth-grade students taking the mathematics test for the first time score an unsatisfactory rating on the GEE. Furthermore, only 8% of Louisiana's tenth-grade students taking the GEE for the first time achieved at the advanced level in mathematics in 2004. Mathematics achievement is not increasing rapidly in Louisiana.

Table 1

Percent of Students Achieving at Each Performance Level on Louisiana's Criterion-Referenced Test (GEE) in Mathematics: 10th Grade First Time Test Takers

YEAR	PERFORMANCE LEVELS				
	Advanced	Mastery	Basic	Approaching Basic	Unsatisfactory
2003	7	15	37	16	25
2004	8	15	38	15	23

Table 2 illustrates a slight but steady decrease in the percentage of 8th grade students who achieved at the unsatisfactory level in mathematics from 2000 to 2004. Unfortunately, though, the percentage of 8th grade students in Louisiana scoring at the advanced level (i.e., one to three percent) is significantly low for all five years for which data is available.

Table 2

Percent of Students Achieving at Each Performance Level on Louisiana's Criterion-Referenced Test (LEAP 21) in Mathematics: All 8th Grade Test Takers

YEAR	PERFORMANCE LEVELS				
	Advanced	Mastery	Basic	Approaching Basic	Unsatisfactory
2000	3	5	39	21	32
2001	2	4	40	23	31
2002	1	3	37	28	30
2003	3	5	39	23	30
2004	2	5	46	22	25

Finally, Table 3 depicts 4th grade student performance on Louisiana's criterion-referenced test, LEAP 21. In the year 2004, 24% of Louisiana's 4th grade students scored at the unsatisfactory level in mathematics. Also, as seen in 8th and 10th grades, percentages of students who scored in the advanced level in mathematics are very low (i.e., 2-3 percent).

In recent years, Louisiana has taken serious steps toward improving students' mathematics performance. For the purpose of improving reading and mathematics achievement of kindergarten through third grade students in Louisiana public schools, the Louisiana Legislature allocated its Department of Education $125, 716, 456, between 1997 and 2004. Funding was allocated specifically to improve instruction and to develop intervention programs for students at risk for failure in reading and mathematics (Louisiana Department of Education, 2004). “The K-3 Reading and Mathematics Initiative provides resources to assist districts in developing a sound academic foundation in the early grades, making later success possible for more children.” (Louisiana Department of Education, 2004).

Table 3

Percent of Students Achieving at Each Performance Level on Louisiana’s Criterion-Referenced Test (LEAP 21) in Mathematics: All 4th Grade Test Takers

YEAR	PERFORMANCE LEVELS				
	Advanced	Mastery	Basic	Approaching Basic	Unsatisfactory
2000	2	10	37	23	28
2001	2	11	41	23	23
2002	2	10	38	25	25
2003	3	13	42	23	19
2004	2	13	38	23	24

Another initiative aimed at improving mathematics achievement in Louisiana’s public schools is the Mathematics and Science Partnerships (MSP), a Title II Part B program that has been instituted to foster collaboration between higher education departments of mathematics and education and K-12 schools (Louisiana Department of Education, 2004). The goal of MSP is to improve mathematics achievement by increasing the content knowledge of classroom teachers. These programs are geared to teachers in grades six through eight. The next section outlines reform efforts across the United States beginning with efforts of NCTM.

Mathematics Education Reform

In 1989, NCTM published *Curriculum and Evaluation Standards for School Mathematics* as an attempt to develop and articulate explicit standards for teachers and policymakers. This document was followed by the release of NCTM's *Professional Standards for School Mathematics* in 1991 and *Assessment Standards for School Mathematics* in 1995. With these three documents, NCTM accomplished the first attempt by a professional organization to put forth explicit and extensive goals for teaching and learning.

Committed to continuous improvement in mathematics education, NCTM established an ongoing process of examining, evaluating, field testing, and revising the standards. In 1995, NCTM appointed the Commission on the Future of the Standards to oversee revision projects, collect and synthesize data from within and outside NCTM, and develop a plan for dissemination, interpretation, implementation, evaluation, and subsequent revision of future *Standards* documents (NCTM, 2000). In October 1998, after much collaboration and study, a draft version of updated standards was written and entitled *Principles and Standards for School Mathematics: Discussion Draft*. Input and influence from many different sources led to the publication of *Principles and Standards for School Mathematics,* which is now available in print and electronically.

Steele and Widman (1997) believe that teachers have particular beliefs about mathematics as a subject, about how students learn mathematics, and about how to teach mathematics. A teacher's approach in a mathematics classroom is greatly affected by what he or she believes about the nature of knowing and whether he or she believes mathematics is a body of absolute truth or a set of arbitrary conventions (Goldin, 1990; Dykstra, 1996). Also important is that teachers understand and appreciate the necessary changes in the way math should be taught in schools, because they are the key figures in making these changes (NCTM, 1991). According to Blank and Engler (1992), national commission reports highlight the inadequacy of preparation for math teachers. In order to improve the inadequacy, teacher educators need to provide alternative models for teaching mathematics for preservice teachers (Steele & Widman, 1997). Radical changes must take place in the way mathematics is taught. One major theory driving reform in mathematics education is constructivism.

Constructivism

According to von Glasersfeld (1990), teachers must encourage *meaningful* rather than *rote* learning. A constructivist perspective is proposed to reform teaching and learning of mathematics. Goldin (1990) reports that Radical Constructivism is a school of epistemology that emphasizes that we can never have access to a world of reality. He explains that one can only understand what we ourselves construct out of our own experience. Von Glasersfeld (1988) builds on Giambattista Vico's work as he reports that Vico declared that one can only reason about and govern the world of his experiences and not the world as God might have made it. The emphasis of experience in constructing knowledge has also been discussed in the writings of many educators and philosophers including John Dewey, John Locke, and Jean Piaget. Ideas of constructivism come from the work of Jean Piaget concerning precisely the child's *construction* of concepts and conceptual relations (von Glasersfeld, 1992). An active view of the learner in the classroom and increased emphasis on guided discovery and a way of teaching that acknowledges learners as active knowers are important in constructivism (Confrey, 1990; Goldin, 1990; Noddings, 1990).

Von Glasersfeld (1988, 1990, 1995) refers to radical constructivism as a theory of knowing that is *radical* because it differs radically from traditional theories of knowledge. According to von Glasersfeld (1988), "ready-made" pieces of knowledge, absolute mathematical reality do not exist independent of one's mental operations. Therefore, it is the task of the constructivist teacher to give students the opportunity to construct knowledge and make accommodations. A continual process of *assimilation* and *accommodation* is important in the constructivist theory of knowing. Cognitive assimilation comes about when one compares an experience into a conceptual structure it already has (von Glasersfeld, 1995). Then, adaptation or "accommodation" occurs as a result of "perturbation" in order to maintain equilibrium. From the constructivist perspective, problems are approached differently by different cognizing subjects; therefore, *intersubjective corroboration* is important (von Glasersfeld, 1995).

Constructivism claims that understanding will not necessarily result when information is passed on to a set of learners. This theory challenges the traditional idea that people acquire information from those who know more (von Glasersfeld, 1992, 1995; Schifter, 1996). According to radical constructivism, knowledge is not passively received but constructed by the cognizing subject, and the function of cognition is adaptive and serves as the organization of the experimental world (von Glasersfeld, 1995). Constructivist theory provides an alternative to direct instruction that does assume that learners can develop understanding by absorbing information that has been passed to them. As Confrey (1990) reports, constructivism commits educators to teaching students how to create more powerful constructions. Confrey (1990) offers a statement of a constructivist goal of instruction:

> An instructor should promote and encourage the development for each individual within his/her class of a repertoire for powerful mathematical constructions for posing, constructing, exploring, solving and justifying mathematical problems and concepts and should seek to develop in students the capacity to reflect on and evaluate the quality of their constructions. (p. 112)

Constructivist theory, according to von Glasersfeld (1995) offers a theoretical basis for creative, innovative teaching that will hopefully encourage students to study and learn for the purpose of gaining knowledge and becoming more competent.

Constructivist teachers encourage students to think critically and to develop their own solutions to problems. They do not simply give directions and offer explanations. Constructivist teachers use questioning to pose problems, and they expect the students to find their way to solutions. As students make suggestions about solving a problem, the teacher does not indicate whether they are right or wrong. This practice is clearly demonstrated in Kamii's (1985) book and video entitled *Young Children Reinvent Arithmetic: Implications of Piaget's Theory*. Furthermore, constructivist teachers listen and watch and pose questions that lead through puzzlement to the construction of important mathematical concepts (Schifter, 1996).

Many teachers claim to adopt constructivism, but the connection between theory and practice in their classrooms is not made. In order to determine whether teachers actually bridged the gap between theory and practice regarding constructivism, Brewer and Daane (2002) conducted a study. By interviewing eight female primary-grade teachers who considered themselves constructivists, they discovered that "four main themes emerged concerning the teachers' perceptions of constructivist theory as they believed it applied to their own classrooms. These were (a) learning is an active, constructive process, (b) new knowledge is built on prior knowledge, (c) autonomy is promoted, and (d) social interaction is necessary for knowledge construction and active learning" (p. 418). These positive results support the incorporation of constructivist teaching and learning practices. There are many benefits of practicing constructivism, but teachers need to understand its components. Draper (2002) explains that constructivism offers educators a platform with which they can analyze the way students think and come to know. She states, "Constructivist pedagogy requires that teachers take into consideration what students know, what they want to know, and how to move students toward desired knowledge. Because what students want to learn may shift and because the experiences necessary for students to explore ideas may vary, constructivist teachers find themselves in unpredictable and tenuous situations" (p. 527).

Despite the great benefits of implementing constructivist reform efforts, many attempts have failed. Even teachers who believe in constructivism, sometimes have a hard time practicing constructivist instructional practices. According to Elkind (2004), constructivist reform is different from other reform movements because of what generates it. Constructivist reform, according to Elkind, is not initiated by political events, social events, or a political agenda. Instead, he believes, constructivist reform is inspired by genuine pedagogical concerns and motivations. Since this inspiration comes from pedagogy, its foundation is developed in teacher education programs, the topic of the next section in this review of literature.

Teacher Education in Mathematics

As mentioned in Chapter I, research has measured various levels of improvement in preservice teachers' knowledge and skills after completion of mathematics methods courses with various components. Some studies have reported affective outcomes. Several studies are described in the following paragraphs.

Mewborn (2000) advocates the incorporation of field experiences in mathematics methods courses. Although she did not conduct an extensive research study, she explains that anecdotal data from her course at the University of Georgia suggest positive outcomes of including field experiences in mathematics methods courses. Candidates in her course participated in seven weeks of 45 minute one-on-one tutoring with young children. Mewborn's candidates met with their students once a week. Some of the positive outcomes experienced by candidates were improved confidence; learning about the role of teachers' expectations and the influence of home life on students' performance; and realizing the impact of cultural differences on learning.

Poole (2000) conducted a qualitative study in which preservice teachers participated in a mathematics methods course involving a specific email activity that linked them to elementary students in a mathematical problem solving activity. The difference in involvement between preservice teachers with high and low mathematical anxiety levels was also considered in Poole's study. Poole concluded that a specific email activity could qualify as an authentic activity for preservice teachers. Poole's preservice teachers reported several positive outcomes of the activity. Preservice teachers felt that the activity prepared them to teach mathematics; increased their comfort levels in dealing with mathematics; and increased their understanding of how to develop the mathematical problem solving skills of elementary children.

Quinn (1997) studied the effects of elementary and secondary mathematics methods courses on preservice teachers' attitudes about mathematics and mathematics content knowledge. He found that an elementary mathematics methods course can improve attitude toward mathematics, as well as the meaningful knowledge of mathematical content, of preservice elementary teachers. Quinn did not find significant changes in the secondary mathematics preservice teachers. However, this group began his study with considerably higher scores both on attitude and meaningful mathematical content knowledge. Furthermore, his results revealed that even though there was improvement, weaknesses in mathematics content knowledge of preservice teachers were still present.

Steel and Widman (1997) studied 19 preservice teachers at the University of Florida in a 15-week elementary mathematics methods course that was based on constructivist learning principles. They found that preservice teachers went from considering mathematics simply as learning to compute to discussing their understanding of the meaning of rules and procedures and why the procedures actually worked. Participants in Steel and Widman's study became risk-takers and were able to explain answers to challenging problems, and they also learned to use manipulatives and diagrams to model their mathematical thinking.

Vacc and Bright (1999) researched the effects of teaching preservice teachers to use Cognitively Guided Instruction (CGI) as part of a mathematics methods course. Their sample was comprised of 34 subjects, and they studied these preservice teachers for 2 years. Vacc and Bright found that significant changes in preservice teachers' beliefs and perceptions about mathematics instruction occurred. However, preservice teachers' use of knowledge of children's mathematical thinking was limited. Therefore, they concluded that preservice teachers may acknowledge the tenets of CGI and yet be unable to use them in their teaching.

Although some of these studies found improved affective components, such as, confidence, beliefs, and perceptions, none addressed the construct of efficacy. The next section of this review of literature examines efficacy.

Efficacy

Self-efficacy is a construct of Bandura's (1993) Social Cognitive Theory. Bandura theorizes that efficacy beliefs influence the way people feel, think, motivate themselves, and behave. Three principal ways in which self-efficacy contributes to academic development are explained. According to Bandura, academic development is affected by students' beliefs in their efficacy to control their learning and to achieve certain tasks, individual teacher's beliefs in their efficacy to motivate their students and promote learning and a school faculty's collective sense of efficacy in the success of their school. Children with the same level of cognitive skill development have been found to differ in their intellectual performance depending on their self-efficacy (Bandura).

Although affective characteristics of teachers have been found to determine the differentiation between ‘more effective’ and ‘less effective’ teachers, the affective component of teacher education is typically neglected (Anderson & Ching, 1987). Most teacher education programs focus on knowledge and skills with curricula emerging from the knowledge and expertise of individual professors (Alkin, 1992).

Based on current research, building positive teacher efficacy should be a necessary component of preservice teacher education. After examining preservice teachers’ attitudes about mathematics, Cornell (1999) concluded that “increasing the effectiveness of math instruction and ensuring a pool of capable and enthusiastic teachers means considering both content and affective factors...” (p. 229). Affective factors are considered in other works as well. For example, NCTM (1991) refers to teachers’ attitudes and beliefs in *Professional Standards for Teaching Mathematics*: “Teachers are in a constant state of ‘becoming’.... Their growth is deeply embedded in their philosophies of learning, their attitudes and beliefs about learners and mathematics, and their willingness to make changes in how and what they teach” (p. 125). Another national organization, the National Council for the Accreditation of Teacher Education ([NCATE], 2000), also refers to the affective domain when it states that “Programs should prepare teacher candidates to become confident in their ability to do mathematics and to create an environment in which students become confident learners and doers of mathematics” (p.72). It is time for teacher educators to recognize the importance of the affective domain in the preparation of effective teachers.

Self-efficacy, a construct of Badura's social cognitive theory, is one affective characteristic to consider. In spite of the fact that we know that efficacy affects performance, more research is needed to determine what kinds of treatments might improve efficacy in preservice mathematics teachers. Previous research on improving teacher efficacy in mathematics is scant. However, some studies did show positive results on teacher efficacy in mathematics (Alkhateeb & Abed, 2003; Huinker & Madison, 1997; Swars, 2005; Utley, Moseley, & Bryant, 2005).

By examining ways to improve teacher efficacy, teacher educators can enhance teacher preparation programs. This study deals with preservice teachers' mathematics teaching efficacy beliefs in the context of a mathematics methods course including the confluent intervention of guided imagery as an integral component. The results of this study will provide suggestions for teacher educators and staff developers to find ways to enhance the mathematics teaching efficacy beliefs of elementary school teachers.

Confluent Education

Confluent education has been defined as "a deliberate, purposive evocation by responsible, identifiable agents of knowledge, skills, attitudes, and feelings which flow together to produce wholeness in the person and society" (Shapiro, 1975, p. 115). As explained in his model of confluent education, Hackbarth (1997, 1999) believes the defining goal of confluent education in schooling is the integration of cognitive and affective/psychomotor dimensions of learning. "One means of achieving it is to engage students in spirited, culturally enriched quests for personally and socially significant knowledge employing methods that characterize the academic disciplines, with the aim of applying what is learned in ethical, culturally sensitive ways" (Hackbarth, 1999, p. 10).

In the late 1960's, Brown (1971) pulled together ideas and experiences from the Human Potential movement and applied them to education. His work was supported by a Ford-Esalen grant and evolved into the Confluent Education program at the University of California, Santa Barbara. The program lasted for more than twenty-five years and resulted in numerous grants, books, master's degrees, and doctorates.

In the early stages of the program, confluent education was often misunderstood, and its meaning had to be clarified. After conducting a language conceptual analysis of the term confluent education, the definition stated earlier was written. The determination was made that confluent education is different from affective education, environmental education, and the like. According to Hackbarth (1999), "The defining essence of confluent education is captured in its aim of achieving integration of cognitive and affective dimensions of learning" (p. 8).

Hackbarth (1999) explains this integration further. He writes, "Within the context of confluent education, integration of the various dimensions of learning is a sensible aim when the cognitive is thought of in terms of knowledge (not a faculty of the mind nor just information), the affective in terms of purpose, intentionality, and value (not just moods and feelings), and the behavioral (psychomotor) in terms of intentional, purposeful, systematic actions of aware agents (not just whimsical, passive, nor even high spirited activities)" (p. 8). Hackbarth's (1999) conception of confluent education is as "engagement of students in spirited inquiry along the paths continuously being mapped by scholars in each of the academic disciplines. The affective/psychomotor dimension of their experiences is embodied in their systematic modes of exploration. The cognitive dimension is embodied in subject matter and the emergence of new levels of comprehension and application, both for the individual and for humanity" (p. 1).

According to Shapiro (1983), a practicing humanistic clinical psychologist turned professor of confluent education, continual emphasis on awareness and responsibility is a characteristic of confluent education. He claims that confluent education helps people become more aware and more responsible. Shapiro summarizes the effects of confluent education in the following categories:

1. A personal growth-oriented , affective impact resulting in increased self-awareness, raised consciousness, more in touch with feelings, personal development, and feeling in control of one's life.

2. Improved general self-concept and academic self concept.

3. A relationship-oriented effect that results in significant improvement in attitudes, relationships with others, empathy, relationships with authority, understanding of people with divergent views, warmth, openness, and feeling closer to others.

4. Changes in teaching styles, curriculum, and classroom environment which resulted in greater relaxation, informality, spontaneity, trust, student centeredness, honesty, and closer interpersonal relations between teachers and students and among students.

5. A reflective philosophical effect that influenced life-meanings issues.

6. Direct effects on school or teacher environment. Ten of fifteen studies did not show significant measurable effects (p. 88).

Effects one, two, and four apply to the goal of this study. This study searched for a program that would help teacher candidates become aware of their feelings about mathematics and work toward personal and professional development in the area of mathematics teaching. The program should also help candidates improve their own academic self-concept in the area of mathematics and develop teaching styles and classroom environments that will nurture positive academic self-concepts in mathematics for the students they teach.

Confluent education has been used in other fields such as nursing where it has been introduced for topics related to pain assessment and management. Francke and Erkens (1994) used confluent education in their *Pain Assessment and Management in Surgical-Oncological Patients* program because they believe that nurses need to have the knowledge about pain assessment tools and medication as well as the ability to value patients' feelings, ideas, and perceptions related to pain. The authors urge nurse educators to remember that "nurses' interventions are also affected by more affective ways of knowing" (p. 360).

Simpson (1976) describes confluent education as "a synthesis of some of the Deweyian ideals with two other cultural forces: the tradition of the Humanities and the aims and techniques of mental health education" (p. 9). She offers several examples of confluent education as she has seen them in practice. Some methods include: role-playing, shared goal setting and progress evaluation, peer tutoring, small group experiences, simulation exercises, using language as a symbol system, contextual learning, using the body for physicalization of abstract concepts, and the expression of the creative unconscious. Other examples of confluent techniques are described in *Human Teaching for Human Learning* (Brown, 1971). Also, an expanded version of confluent education with six domains is presented by Hamann (2002). She claims that confluent education encompasses six domains: cognitive, affective, social, psychomotor, inter-personal and intra-personal.

In conclusion, many studies have been conducted on various effects of confluent education. As mentioned earlier, Shapiro (1983) summarized the results of research in confluent education into six categories of effects. In another study, Hamann (2002) analyzed teacher candidates' reflections and determined that teacher candidates engaged in reflective thinking that encompassed confluent education. Although there are numerous techniques for addressing the affective dimension, guided imagery will be considered in this study. This technique will be discussed in the paragraphs that follow.

Guided Imagery

Guided imagery is one confluent teaching strategy that can be used to effectively buffer stressful circumstances. By imagining desired behaviors, participants of guided imagery can alter their existing behaviors or responses to stress and positive consequences can result (Gothelf, 2003). As Gothelf explains, stressors can be associated with a variety of sources, such as, social relationships, fears, a change in routines, or sensory stimuli. For preservice elementary teacher candidates who fear mathematics, the idea of teaching mathematics to students can certainly be a stressor.

One guided imagery technique, the personal life map, requires participants to imagine a certain point in their life, paying close attention to their feelings. They also imagine where they would like to go and any obstacles that may exist. A follow-up discussion is then conducted. Participants are asked to close their eyes and draw an imaginary road map on the inside of their eyelids. The facilitator would say:

> On the left side of the map is where you are now, not so much in terms of location but where you are in your life- your feelings, your awareness of yourself. On the right side of the map is where you want to go. Get in touch with both of those things. In the middle of your map you may have noticed some obstacles that block you from getting where you want to go. See if there is anything you can do about them now. If not, don't try to change them. Just be aware of what they are and how you feel about them now (Brown, 1971, p. 36).

Since one major theme that emerged from my pre-dissertation study involved early life experiences with mathematics, it was thought that this exercise may help candidates come to terms with their feelings about mathematics. Candidates could be asked to reflect on their early math experiences to try to determine when their attitudes about mathematics were formed.

Much research has been done to study the use of guided imagery in the medical field. Guided imagery has been used as a form of treatment for patients with ailments such as arthritis, cancer, and asthma. In one study, a significant reduction of pain was found in patients with osteoarthritis who participated in guided imagery sessions (Baird & Sands, 2004). Participants in the guided imagery group also reported less mobility difficulties than those in the comparison group. In another study, Roffe, Schmidt, and Ernst (2005) summarized and evaluated research on the use of guided imagery as a sole adjuvant cancer therapy and found guided imagery to be psycho-supportive and useful in increasing patient comfort. Children with asthma also found comfort after using guided imagery techniques, according to Peck, Bray, and Kehle (2003) who studied the effects of relaxation and guided imagery as an intervention for school-aged asthmatics.

Guided imagery has also been used as an intervention to help patients with stress, anxiety, and hopelessness. Hammer (1996) researched the effects of guided imagery on stress and anxiety with patients in a chemical dependency unit. Data showed that patients who participated in the guided imagery sessions had a marked reduction in perceived stress and anxiety. Additionally, hopelessness can be reduced with the use of guided imagery. Crow and Banks (2004) found that a “Waiting Room” guided imagery intervention helped nursing home patients expand and revive their repertoire of hope and find peace. They called the intervention “Waiting Room” because they found that patients in a nursing home were awaiting death with feelings of hopelessness and despair. Nursing home patients felt that little meaning was left in their lives. The “Waiting Room” intervention which includes recalling life’s memories, releasing burdens, and accepting peace, helped patients handle their nursing-home situations better. In support of their use of the intervention, Crow and Banks suggest, “With our inherent human predisposition to sooth ourselves, this type of guided imagery may be used to assist people, especially the elderly, to find meaning and peace at the end of their lives” (p. 6).

Furthermore, guided imagery was found to enhance self-esteem. Omizo, Omizo, and Kitaoka (1998) used guided affective and cognitive imagery to increase self-esteem in Hawaiian children. In this study, ten weekly guided affective and cognitive imagery sessions were administered to children in grades 4-6 in one elementary school. Research results revealed that children who participated in the intervention strategy had significantly higher scores on some areas of self-esteem than children who did not participate in the guided affective and cognitive imagery intervention.

Guided imagery has also been used as a teaching tool in various educational settings including elementary schools, high schools, colleges, and childbirth classes. Rose and Sweda (1997) used guided imagery with elementary students. They refer to guided imagery as an art and suggest that the strategy can stimulate children to write, however, their results did not provide statistical significance. They found that the guided imagery process actually decreased students’ writing fluency rather than increasing it. On the other hand, results showed that the guided imagery interventions decreased the number of off-task non-related behavioral disruptions in the class. Additionally, Herr (1981) claims that guided imagery can improve the learning and behavior of low-achieving students.

In higher education settings, guided imagery has been employed as a teaching tool in college nursing classrooms and clinical settings to decrease anxiety and increase performance (Krejci, 1997). Krejci also describes an innovative use of imagery as a teaching strategy to increase critical thinking in nursing education. For example, research findings show that guided imagery can be a successful teaching tool in helping lower nursing students' anxiety about performing injections for the first time (Speck, 1990). Guided imagery has been found useful in nursing education as well as in nursing practice. Interventions discussed above have helped nursing students in learning situations and have enhanced treatment for patients with various health problems. These findings suggest implications for including guided imagery in nursing curricula. In fact, Antall and Kresevic (2004) believe that including guided imagery in nursing education is critical.

Finally, guided imagery has been used as an instructional tool in childbirth classes. Schardt (2003) suggests that guided imagery provides a simple, yet effective tool to enhance pregnancy, labor, and childbirth. Furthermore, guided imagery has been used to increase lactation in mothers with premature infants (Freeman & Lawlis, 2001).

Regardless of the purpose of using guided imagery, facilitators of the intervention must prepare participants for the experience, lead them through the experience, and process the journey following the experience (Houston Independent School District, 1991). In order to maximize the guided imagery experience, participants must be relaxed and balanced. Breathing exercises are suggested to help accomplish this state of relaxation. Sitting in a circle with hands in a meditative position, palms up and eyes closed, is the suggested arrangement of the class (Houston Independent School District). Additionally, the environment should be distraction-free, warm, and comfortable for the participants (Schardt, 2003).

Benefits of guided imagery have been discussed above and are listed in the *Handbook on Group Counseling and Group Guidance* (Houston Independent School District). Several of those benefits are of particular interest to this study, including: frees participant to voice fears, difficulties; opens up closed territory in mind; and enhances self-concept.

Chapter III

Methodology

Overview

This study examined the effects of a mathematics methods course including the confluent intervention of guided imagery on the mathematics teaching efficacy beliefs of preservice elementary teacher candidates. A quasi-experimental nonequivalent comparison group pre-and post-test design was used. According to McMillan and Schumacher (1997), this is the design used in education when random assignment of subjects is impossible and when there are two levels of the independent variable. Pre-and post-tests of mathematics teaching efficacy beliefs were given to all participants. Additionally, a mathematics content knowledge and pedagogical skills performance assessment was given to all participants at the end of the semester. The experimental group participated in the mathematics methods course including guided imagery while the comparison group participated in a mathematics methods course without the specific intervention. All other aspects of the courses were the same.

Analysis of covariance (ANCOVA) was used to determine the confounding effects of pre-existing variance between the experimental group and the comparison group. More specifically, ANCOVA was used to determine the confounding effects of pre-existing variance in mathematics teaching efficacy beliefs between the groups. Also, in order to determine whether the time spent with the confluent interventions adversely affected the acquisition of knowledge and skills, results of a final performance assessment that measured mathematics content knowledge and pedagogical skills necessary for teaching the content to children were compared, and the confounding effects of pre-existing differences in mathematics content knowledge were considered. Finally, paired samples t-tests were used to determine whether the courses had any effects on the mathematics teaching efficacy beliefs of the preservice teacher candidates who participated in the study.

The primary purpose of this study was to compare type of instruction (i.e., with or without specific confluent interventions) to changes in mathematics teaching efficacy beliefs for elementary teacher candidates enrolled in mathematics methods courses at a university in southeast Louisiana. Second, this study determined whether the inclusion of specific confluent interventions diminished the acquisition of mathematics content knowledge and pedagogical skills. Third, differences in mathematics teaching efficacy beliefs after completing a mathematics methods course were examined for all of the elementary preservice teachers in the study.

Research Questions

The research questions are:

1. Are there differences in the MTEBI posttest scores between elementary preservice teacher candidates who completed a mathematics methods course including confluent interventions and those who completed a mathematics methods course without the confluent interventions?
2. Are there differences between the mathematics content knowledge and pedagogical skills performance assessment scores of elementary preservice teacher candidates who completed a mathematics methods course including confluent interventions and those who completed a mathematics methods course without the confluent interventions?
3. Are there differences between the MTEBI pretest scores and MTEBI posttest scores of elementary preservice teacher candidates who completed a mathematics methods course?

Research Hypotheses

The first null hypothesis states that there is no difference in the adjusted mean post-test levels of mathematics teaching efficacy beliefs for candidates enrolled in the two sections of the mathematics methods course. That is, Ho: $u'_1 = u'_2$. In this hypothesis, the type of course (e.g., with or without confluent interventions) is the independent variable; the pretest given at the beginning of the semester served as the covariate; and the posttest at the end of the semester served as the dependent variable. The alternative hypothesis states that there is a difference in the adjusted mean posttest levels of mathematics teaching efficacy beliefs for candidates enrolled in the two sections of the mathematics methods course. That is, H_1: $u'_1 \neq u'_2$.

The second null hypothesis states that there is no difference in the adjusted mean scores on the mathematics content knowledge and pedagogical skills performance assessment between candidates enrolled in the two sections of the mathematics methods course. That is, Ho: $u'_1 = u'_2$. In this hypothesis, the type of course (e.g., with or without confluent interventions) is the independent variable, and scores on the mathematics content knowledge and pedagogical skills performance assessment given at the end of the semester served as the dependent variable. The PRAXIS I math scores of the participants served as the covariate. The alternative hypothesis states that there is a difference in the adjusted mean scores on the mathematics content knowledge and pedagogical skills performance assessment between candidates enrolled in the two sections of the mathematics methods course. That is, H_1: $u'_1 \neq u'_2$.

The third null hypothesis states that there is no difference between MTEBI pretest scores and MTEBI posttest scores for candidates enrolled in the two sections of the mathematics methods course. That is, Ho: $u'_d = 0$. In this hypothesis, the pretest score is the independent variable, and posttest scores served as the dependent variable. The alternative hypothesis states that there is a difference between MTEBI pretest scores and MTEBI posttest scores for candidates enrolled in the two sections of the mathematics methods course. That is,

H_1: $u'_d \neq 0$.

Research Design

This study employs a quasi-experimental nonequivalent comparison groups pre- and posttest design (McMillan & Schumacher, 1997, 2006; Creswell, 2002). Random assignment was not possible because elementary preservice teacher candidates registered for the sections of the mathematics methods course based on their personal schedules. Registration for these sections of the course took place prior to the beginning of the study. Random assignment of subjects was not possible; however, random assignment of the treatment was made. The researcher randomly assigned the experimental and comparison groups to intact groups of candidates enrolled in the two different sections of a mathematics methods course for elementary teacher candidates.

One section, the comparison group, was taught around the themes of NCTM, focusing on content knowledge and pedagogical skills for teaching mathematics. The experimental group was taught the same mathematics content knowledge and pedagogical skills with the confluent intervention of guided imagery addressing mathematics teaching efficacy beliefs. Both sections included field experiences in which candidates taught lessons at a local elementary school. The same instructor taught both sections of the course. The course syllabus that was used in both sections is included in Appendix A. Both groups were given the MTEBI (Enochs, Smith, & Huinker, 2000) as a pretest at the beginning of the semester and the MTEBI again as a posttest at the end of the semester. The MTEBI pretest served as a covariate measuring initial differences between the groups in mathematics teaching efficacy beliefs. A copy of the MTEBI is included in Appendix B.

The study design is illustrated as follows:

O	X_1	O
O	X_2	O

For the first question, in this diagram, O represents the pre-test, which was administered to both groups in the beginning of the semester. The results of the pre-test served as a covariate in this study. The second O represents the post-test, which was administered to both groups at the end of the semester. The post-test of the MTEBI served as the dependent variable in this study. The pre-test and post-test were the same instrument. The independent variable, type of instruction, is represented by X in the diagram. The X_1 represents the methods course with confluent interventions administered in the experimental group and X_2 represents the methods course without confluent interventions.

The second question in this study addressed the attainment of mathematics content knowledge and pedagogical skills. A performance assessment of mathematics content knowledge and pedagogical skills was given at the end of the semester. Scores were compared to assure that the extra time spent with the intervention did not diminish attainment of the other objectives of the course. The design for this segment of the study is the same as the first design with the exception of the instruments. The second design follows:

O	X_1	O
O	X_2	O

In this diagram, the first O represents the covariate, PRAXIS I math scores. The X represents the type of course, X_1 being the mathematics methods course with confluent interventions and X_2 being the mathematics methods course without the confluent interventions. The second O represents scores on the mathematics content knowledge and pedagogical skills performance assessment, which was administered to both groups at the end of the semester.

The third question in this study examined differences between pretest and posttest scores on the *Mathematics Teaching Efficacy Beliefs Instrument* for each subject in the study. Each group was analyzed separately but not compared. The design for this part of the study follows:

O X O

In this diagram, the first O represents the pretest scores. The X represents the mathematics methods course, both with and without the guided imagery intervention. The second O represents the posttest scores.

Sampling Procedure

The sample was selected from preservice elementary teacher candidates enrolled in two sections of an elementary mathematics methods course at a university in Southeast Louisiana. The investigation took place during the spring 2005 semester. Because of suggested sampling guidelines, the researcher's goal was to have at least 15 candidates enrolled in each of the two sections of the mathematics methods course. Although McMillan and Schumacher (1997) suggest that eight to ten subjects in each group would be acceptable in highly controlled experiments, they encourage researchers to have at least fifteen subjects in each group. Additionally, 15 participants per group is the approximate number needed for quasi-experimental designs according to Creswell (2002).

Subjects' ages ranged from 20 to 50 years. Participants in this study were college students pursuing a degree in elementary education. Taking a mathematics methods course is part of the requirements for graduation with the bachelor's degree in elementary education. Each participant had completed core curriculum requirements and was in the department of curriculum and instruction. Some of these candidates were full-time college students; others were working while pursuing their degree on a part-time basis. Furthermore, participants were all females thus reflecting the population of preservice teacher candidates. According to Whittington (2002), in the *2000 National Survey of Science and Mathematics Education: Status of Middle School Mathematics Teaching*, 70% of middle school mathematics teachers are female.

Instrumentation

Mathematics Teaching Efficacy Beliefs Instrument

The *Mathematics Teaching Efficacy Beliefs Instrument* (MTEBI) was used to measure mathematics teaching efficacy beliefs (Enochs, Smith, & Huinker, 2000). Validity of the MTEBI was tested in a study with 324 subjects recruited from three different college and university settings in California, South Carolina, and Michigan. Modified from the Science Teaching Efficacy Beliefs Instrument (Enochs & Riggs, 1990), MTEBI was subjected to rigorous confirmatory factor analysis. The MTEBI is made up of two subscales, personal mathematics teaching efficacy (PMTE) and mathematics teaching outcome expectancy (MTOE). Analysis of reliability produced Cronbach alpha of 0.88 for the PMTE. For the MTOE scale the alpha coefficient was found to be 0.77. Additionally, confirmatory factor analysis indicated that the two subscales are independent which adds to the construct validity of the instrument (Enochs, Smith, & Huinker, 2000).

A copy of the MTEBI and its scoring instructions are included in Appendix B. In general, the rating scale includes strongly agree, agree, uncertain, disagree, and strongly disagree, which will be scored using the numbers five, four, three, two, and one respectively. As suggested by Enochs, Smith, and Huinker (2000), eight of the items were reversed scored in order to produce high scores for those high and low scores for those low in PMTE and MTOE.

Scores on the MTEBI range from 21 to 105 with higher scores indicating higher levels of mathematics teaching efficacy. After a breakdown into continuous data ranges, scores on the MTEBI can be interpreted as follows: 21.00 – 31.49 indicates low mathematics teaching efficacy; 31.50 – 52.49 indicates moderately low mathematics teaching efficacy; scores in the 52.50 – 73.50 range are neutral; 73.51 – 94.50 indicates moderately high mathematics teaching efficacy; and 94.51 – 105.00 indicates high mathematics teaching efficacy.

Of the 23 items on the MTEBI, 13 items are considered to address one's beliefs about personal ability to teach mathematics effectively. These items make up the PMTE subscale and can be found in Table 4. Scores on the PMTE range from 13 to 65; as in the MTEBI, higher scores indicate higher levels of personal mathematics teaching efficacy. PMTE scores were also divided into continuous data ranges and can be interpreted as follows: 13.00 – 19.49 indicates low personal mathematics teaching efficacy; 19.50 – 32.49 indicates moderately low personal mathematics teaching efficacy; scores in the 32.50 – 45.50 range are neutral; 45.51 – 58.50 indicates moderately high personal mathematics teaching efficacy; and 58.51 – 65.00 indicates high personal mathematics teaching efficacy.

The eight items on the MTEBI that are not included in the PMTE subscale are considered to address one's beliefs that there will be a positive effect on student learning if there is effective teaching. These items make up the MTOE subscale and can be found in Table 5. Scores on the

MTOE range from 8 to 40; as in the MTEBI and PMTE, higher scores indicate higher levels of mathematics teaching outcome expectancy. MTOE scores were also divided into continuous data ranges and can be interpreted as follows: 8.00 – 15.99 indicates low mathematics teaching outcome expectancy; 16.00 – 19.99 indicates moderately low mathematics teaching outcome expectancy; scores in the 20.00 – 28.00 range are neutral; 28.01 – 36.00 indicates moderately high mathematics teaching outcome expectancy; and 36.01 – 40.00 indicates high mathematics teaching outcome expectancy.

Table 4

Personal Mathematics Teaching Efficacy (PMTE) Subscale Items

Item Number on MTEBI	Item
2	I will continually find better ways to teach mathematics.
3	Even if I try very hard, I will not teach mathematics as well as I will most subjects.
5	I know how to teach mathematics concepts effectively.
6	I will not be very effective in monitoring mathematics activities.
8	I will generally teach mathematics ineffectively.
11	I understand mathematics concepts well enough to be effective in teaching elementary mathematics.
15	I will find it difficult to use manipulatives to explain to students why mathematics works.
16	I will typically be able to answer students' questions.
17	I wonder if I will have the necessary skills to teach mathematics.
18	Given a choice, I will not invite the principal to evaluate my mathematics teaching.
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.
20	When teaching mathematics, I will usually welcome student questions.
21	I do not know what to do to turn students on to mathematics.

Table 5

Mathematics Teaching Outcome Expectancy (MTOE) Subscale Items

Item Number on MTEBI	Item
1	When a student does better than usual in mathematics, it is often because the teacher exerted a little extra effort.
4	When the mathematics grades of students improve, it is often due to their teacher having found a more effective teaching approach.
7	If students are underachieving in mathematics, it is most likely due to ineffective math teaching.
9	The inadequacy of a student's mathematics background can be overcome by good teaching.
10	When a low-achieving child progresses in mathematics, it is usually due to extra attention given by the teacher.
12	The teacher is generally responsible for the achievement of students in mathematics.
13	Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching.
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.

The MTEBI has been used in other studies in various ways. In a qualitative study, Swars (2005) used MTEBI scores to identify the two preservice teachers with the lowest mathematics teaching efficacy scores and the two with the highest mathematics teaching efficacy scores that she then interviewed. Barta and Ostrogorsky (2004) used the MTEBI with inservice teachers to measure the effects of a new mathematics problem-solving curriculum on mathematics teaching efficacy. In their study, teachers used the Teacher to Teacher problem solving curriculum to teach mathematics to elementary and middle school students. Results indicated that teachers using the curriculum increased their mathematics teaching efficacy beliefs on both the personal teaching efficacy and outcome expectancy subscales. Teachers in the comparison group showed increases, but they were not statistically significant (Barta & Ostrogorsky).

Alkhateeb and Abed (2003) used the MTEBI to identify student teachers' beliefs about problem solving and to detect whether these beliefs were affected by their teaching efficacy beliefs. In this study, statistically significant differences between the means of their problem solving beliefs were attributed to subjects' mathematics teaching efficacy beliefs and the interaction between those beliefs and achievement.

Christie et al. (2001) used the MTEBI , among other instruments, to determine the effects of various aspects of their teacher development project in which teachers designed mathematics and science units for their own use and Web dissemination. They implemented a pretest-posttest design and found significant increases in their subjects' personal mathematics teaching efficacy as well as in their mathematics teaching outcome expectancy.

Utley, Moseley, and Bryant (2005) used the MTEBI along with other instruments to measure the effects of methods courses and student teaching. They found that mathematics teaching efficacy beliefs increased significantly as the methods course progressed. Further examination of data from this study reveals that science teaching outcome expectancy did not significantly increase, however, mathematics teaching outcome expectancy did.

Stuessy (1993 in McGinnis, Parker, & Roth-McDuffie, 1999), used the MTEBI to indicate the effects of a combination science and math methods course in preparing preservice teachers to teach math and science and showed significant differences between pre-and posttest scores on MTEBI, showing positive gains after the course.

Final Exam Oral Performance Assessment

In addition to the MTEBI, at the end of the semester, a performance assessment was given to participants to determine their ability to solve mathematics problems and explain solutions using manipulatives. Performance assessment is the assessment method of choice because this research set out to determine whether preservice elementary teacher candidates can model and communicate their understanding of mathematical problems and solutions. Stiggins (1997) suggests the use of performance assessment for asking students to perform in certain ways and claims that this method is a dependable source of evaluation. "The observation of students in action can be a rich and useful source of information about their attainment of very important forms of skill achievement" (Stiggins, 1997, p. 190). Another benefit of using performance assessment is that it serves as an authentic experience for preservice teacher candidates. "When the assessment is authentic, it has meaning beyond the assessment setting…. a learning experience that will help prepare learners to succeed beyond the classroom" (Tanner, 2001, p.56). Explaining and modeling mathematical problems and solutions will help prepare preservice elementary teacher candidates to teach these concepts to their students.

To determine whether the time spent on the confluent intervention of guided imagery in the experimental group diminished the effects of teaching mathematics content knowledge and pedagogical skills, groups' final exam performance assessment scores were compared. The course instructor designed the performance assessment tasks in alignment with course objectives. The performance assessment can be found in Appendix C.

Several measures were taken in order to add credibility to the performance assessment. Inter-rater reliability was established for the scoring and content validity was checked for the performance assessment. Both the course instructor and researcher used the rating scale to score the performance of four preservice teachers during the fall 2004 semester. Ratings were compared to establish inter-rater reliability of the rating scale. By carefully comparing the mathematics content knowledge and pedagogical skills performance assessment tasks to course objectives, content validity was established (Creswell, 2002).

Table 6 presents the alignment of course objectives and performance assessment tasks. Course syllabi and the performance assessment can be found in Appendices A and C. Course Objectives 1 and 4 are assessed in the performance assessment. All other course objectives are assessed in other exercises throughout the course of the semester. In Objective 1, candidates demonstrate strategies for teaching and enhancing acquisition of concepts and computational skills using a variety of materials and methods. Every task on the performance assessment allowed candidates to demonstrate strategies for teaching and enhancing acquisition of concepts and computational skills when they modeled and explained the problems using manipulatives. Using a variety of materials and methods was assessed because the performance assessment required candidates to use at least three different manipulatives overall to model and explain the problems (See performance assessment in Appendix C).

Table 6

Alignment of Course Objectives and Performance Assessment Tasks

Course Objective	PA Task
1. Demonstrate strategies for teaching and enhancing acquisition of concepts and computational skills using a variety of materials and methods.	All tasks
4. Identify and explore sophisticated strategies adaptable for any population of students.	All tasks

Objective 4 was assessed in the overall performance of all tasks on the performance assessment. As mentioned above, candidates were required to use at least three different manipulatives to model and explain the problems, thus enhancing their ability to explore various sophisticated strategies. If, in fact, candidates are successful in modeling and explaining problems in a variety of ways on the performance assessment, they will be more likely to be able to adapt instruction for any population of students.

Further alignment of course content and the performance assessment is presented below in Table 7 that shows alignment between course topics and performance assessment tasks. Every task included on the mathematics content knowledge and pedagogical skills performance assessment is included as a topic to be studied on the course syllabi included in Appendix A. Topics that are not included in Table 7 were assessed in other course exercises.

Table 7

Alignment of Course Topics and Performance Assessment Tasks

Course Topic	Performance Assessment Task
4. Subtraction	8 and 9
15. Operations with Fractions	2, 3, 4, 5, 6, 7, and 8
16. Division by Fractions	3 and 6
17. Meaning of Decimals	1 and 9
18. Operations with Decimals	1 and 9

As evidenced in Table 7, the topic addressed most heavily on the final exam performance assessment was operations with fractions. According to L. Ma (1999), preservice teachers in the United States have little understanding of the meaning of fractions and operations with fractions. For this reason, the course instructor stresses this topic most in the mathematics methods courses for preservice elementary teachers.

Scores on the final exam range from zero, for not taking the exam, to a perfect score of 50 points. Scores were divided into continuous data ranges for interpretation purposes. The course instructor requires candidates to make at least a C on the final exam in order to pass the course according to the course syllabus that can be found in Appendix A. For this reason, scores ranging from 0.00 to 36.99 are considered unacceptable. Scores ranging from 37.00 to 43.99 are acceptable; 44.00 – 46.99 is good; and 47.00 – 50.00 is excellent.

Internal Validity

Selection is the most serious threat to internal validity of research conducted with the quasi-experimental pre- and post-test design (McMillan & Schumacher, 1997). Pre-test MTEBI scores were used to adjust the groups statistically on mathematics teaching efficacy. Additionally, PRAXIS math scores were analyzed to adjust the groups statistically on mathematics content knowledge. ANCOVA was used to control the confounding effects of any pre-existing differences that may have been present between the two groups.

In addition to selection, a number of other threats to internal validity are considered when conducting research with a quasi-experimental pre- and post-test design. Other threats may include subject attrition and diffusion of treatment (McMillan & Schumacher, 1997). Subject attrition could have been a threat to internal validity in this research design if subjects were to drop out of the course during the semester of the study (McMillan & Schumacher, 1997). However, high drop-out rates did not occur. Additionally, diffusion of treatment could have been a threat to internal validity if the subjects communicated with one another about the treatment. In order to diminish the chances of threats to internal validity, the course instructor and the researcher explained to the subjects in the experimental group the importance of keeping secret the confluent interventions that were completed in their section of the course. Subjects in the experimental group were asked not to share anything about those interventions with peers that are enrolled in the comparison group course. Furthermore, the researcher and course instructor monitored diffusion of treatment throughout the duration of the study.

Additionally, several threats to internal validity could occur as a result of the instruments and course instructors used in the study (McMillan & Schumacher, 1997, 2006). These threats include instrumentation and experimenter effects. First, instrumentation was not likely to threaten internal validity of this research because validity and reliability of all instruments had been established. The MTEBI has been deemed valid and reliable (Enochs, Smith, & Huinker, 2000). The performance assessment has been aligned with course objectives to establish validity and inter-rater reliability was established on the scoring. Second, experimenter effects did not reduce internal validity because the same instructor taught both groups. Additionally, the researcher met regularly with the course instructor and periodically observed both class sections to ensure that both groups were treated the same in all aspects of the course with the exception of the intervention.

External Validity

The scope of this study is mathematics teaching efficacy beliefs of preservice elementary teacher candidates enrolled in a mathematics methods course at a university in southeast Louisiana. Results of this study are only generalizable to populations with similar characteristics as those of the subjects in this research.

Research Procedures

The researcher explained the study to candidates enrolled in the two sections of the mathematics methods course during the first week of the semester. Candidates voluntarily participated in the study by signing a consent form. An MTEBI pre-test was given to participants to measure their initial mathematics teaching efficacy beliefs.

The experimental group and comparison group were randomly assigned to the two course sections. One section of the methods course was considered the comparison group and participated in course activities that employed the use of manipulatives, addressed knowledge and pedagogical skills for mathematics teaching with emphasis on NCTM principles and standards, and incorporated field experiences in real classroom settings. The other section was the experimental group which experienced all the same activities plus the guided imagery sessions. Table 8 shows the guided imagery activities that were implemented in each class throughout the semester. A detailed description of the interventions is included in Appendix D. All guided imagery sessions were handled in the same way; however, the topic changed according to class topics and objectives. The instructor's scripts for several of the guided imagery sessions are included in Appendix D as examples.

At the end of the semester, participants took an MTEBI posttest to reassess their mathematics teaching efficacy beliefs. They also completed a performance assessment that evaluated their mathematics content knowledge and pedagogical skills. This performance assessment was the final examination for the course and was completed orally. Candidates were required to answer questions and solve problems using manipulatives, then explain the answers to the course instructor. Copies of the performance assessment and scoring guide are included in Appendix C.

Comparison of the final examination performance assessment results determined whether the extra time spent on the affective dimension with the guided imagery sessions affected the mathematics content knowledge and pedagogical skills acquisition of participants. The comparison group spent 15 minutes of ten class sessions on guided imagery exercises that correlated to topics to be discussed in the class.

Table 8

Activities Associated with Guided Imagery Sessions

CLASS	ACTIVITY
1	Explanation of the study; Signing of consent forms
2	MTEBI Pre-test
3	Guided Imagery 1 (NCTM Standards)
4	Guided Imagery 2 (Assessing Student Progress)
5	Guided Imagery 3 (Problem Solving)
6	Guided Imagery 4 (Problem Solving)
7	Guided Imagery 5 (Whole Numbers)
8	Guided Imagery 6 (Number Sense)
9	Guided Imagery 7 (Field Experience Preparation)
10	Guided Imagery 8 (Fractions)
11	Guided Imagery 9 (Operations with Fractions)
12	No guided imagery
13	Guided Imagery 10 (Operations with Fractions)
14	Final Exam Oral Performance Assessment
15	MTEBI Post-test

Data Analysis Procedures

Data were analyzed to determine whether the interventions made a significant difference in mathematics teaching efficacy beliefs for elementary preservice teacher candidates. SPSS 11.5 for Windows was used to analyze data. The independent variable was the type of instruction delivered in the course (e.g., with confluent interventions or without confluent interventions), and mean MTEBI post-test scores served as the dependent variable. MTEBI pre-test scores served as the covariate.

Analysis of covariance (ANCOVA) is employed to adjust statistical differences in groups on uncontrolled variables related to the dependent variable (McMillan & Schumacher, 1997; Creswell, 2002). Since intact groups were randomly assigned the experimental and comparison groups, initial differences in mathematics teaching efficacy beliefs and mathematics content knowledge were controlled. In order to minimize the effects of existing differences between groups, ANCOVA was used. In the primary part of the study, in order to consider the confounding effects of pre-existing differences in mathematics teaching efficacy beliefs, MTEBI pre-test scores served as a covariate. Mean MTEBI pre-test scores and mean MTEBI post-test scores were calculated for the experimental group and the comparison group. The researcher used ANCOVA to statistically adjust MTEBI post-test scores by differences that may have existed in MTEBI pre-test scores. In the secondary part of the study, pre-existing differences in mathematics content knowledge were measured by collecting Praxis I math as a covariate. Mean praxis I math scores and adjusted mean scores on the mathematics content knowledge and pedagogical skills performance assessment were statistically analyzed using ANCOVA.

Additionally, paired-samples t-tests were used to determine whether participation in the mathematics methods course affected mathematics teaching efficacy beliefs of all preservice teacher candidates. When the same subjects are tested twice, paired-samples t-tests are used to determine the probability of rejecting the null hypothesis that the mean scores are the same (McMillan & Schumacher, 2006). Pre- and posttest scores were compared for all candidates to determine whether there were significant differences in their scores over time.

Summary

This study compared experiences in a mathematics methods course of two groups of elementary preservice teacher candidates. The experimental group participated in the course section that included confluent interventions of guided imagery while the comparison group participated in the course section that did not include confluent interventions. All other course content was the same for both groups. The population for this study is all elementary preservice teacher candidates who take a mathematics methods course for graduation requirements. The sample was elementary preservice teacher candidates who enrolled in two sections of the mathematics methods course in the college of education at a university in southeast Louisiana for the spring 2005 semester. Data collected for this study were quantitative, consisting of scores from the MTEBI, mathematics Praxis I scores, and scores from the final exam performance assessment that measured mathematics content knowledge and pedagogical skills. Analyses of data were performed with SPSS 11.5 for Windows. ANCOVA and paired-samples t-tests were used to determine the significance of differences between groups that were revealed by descriptive statistics. Additionally, qualitative data were collected as part of course requirements and can be found in Appendix H.

Chapter IV

Results and Data Analysis

Introduction

This chapter presents the results of statistical analyses of data collected in this study. Data were collected and analyzed as proposed in Chapter III. The primary purpose of this study was to compare type of instruction (i.e., with or without guided imagery interventions) to changes in mathematics teaching efficacy beliefs for elementary teacher candidates enrolled in mathematics methods courses at a university in southeast Louisiana. Second, this study determined whether the inclusion of guided imagery interventions affected the acquisition of mathematics content knowledge and pedagogical skills. Third, changes in mathematics teaching efficacy beliefs after completing a mathematics methods course were examined for all of the elementary preservice teachers in the study. Quantitative data, including PRAXIS I mathematics scores; pre- and post-MTEBI, PMTE, and MTOE scores; and final exam performance assessment scores, were collected in this study. A sample of the MTEBI and its scoring instructions can be found in Appendix B, and the final exam performance assessment can be found in Appendix C. Results were analyzed using SPSS 11.5 for Windows. Additionally, qualitative data, including written reflections about the guided imagery experiences, were collected as part of the course requirements and can be found in Appendix H.

Sample

Thirty-eight female preservice teacher candidates enrolled in the two sections of the mathematics methods course used in this study. Twenty-two candidates were enrolled in one section, randomly assigned as the experimental group, and 16 candidates were enrolled in the section randomly assigned as the comparison group. All candidates enrolled in the course agreed to participate in the study by signing consent forms. A copy of the consent form can be found in Appendix E.

Numbers of subjects in the study vary according to data available for each question analyzed. These differences in sample size, due to attrition and missing data, are described next. First, of the original 22 candidates in the experimental group, four dropped the course early in the semester, leaving 18 subjects. Additionally, there were two candidates in the experimental group who completed the semester but had not taken the PRAXIS I math test so they were eliminated from analysis of Question 2 in the study. Finally, there was one candidate in the experimental group who left one question blank on the posttest of the MTEBI. According to George and Mallory (as cited in Creswell, 2002), mean scores can be substituted for up to 15% of missing data without altering the overall findings. Therefore, rather than eliminate this subject from the study because of insufficient data, the subject's average rating on all non-missing items was used as the rating for the missing data.

There were originally 16 candidates in the comparison group. All 16 candidates completed the course; therefore, data for all subjects were analyzed for Questions 1 and 3. However, one subject in the comparison group was eliminated from the analysis of Question 2 because that candidate did not take the PRAXIS I math test.

Research Questions

This research attempted to answer the following research questions:

1. Are there differences in the MTEBI posttest scores between elementary preservice teacher candidates who completed a mathematics methods course including confluent interventions and those who completed a mathematics methods course without the confluent interventions?

2. Are there differences between the mathematics content knowledge and pedagogical skills performance assessment scores of elementary preservice teacher candidates who completed a mathematics methods course including confluent interventions and those who completed a mathematics methods course without the confluent interventions?
3. Are there differences between the MTEBI pretest scores and MTEBI posttest scores of elementary preservice teacher candidates who completed a mathematics methods course?

Descriptive Statistics

Descriptive statistics for all instruments used in this study can be found in Table 9. Separate discussions of these statistics for the total group, experimental group, and comparison group for each scale follow.

MTEBI

MTEBI scores were used to answer Questions 1 and 3 in this study. The MTEBI was administered in the beginning of the study and again at the end of the study. MTEBI scores were calculated as described by Enochs, Smith, and Huinker (2000). A copy of the scoring instructions for the MTEBI is included in Appendix B. There are 21 items on the MTEBI, and each item is rated with a likert scale from 1 to 5. This results in possible scores ranging from 21 to 105. Score ranges have been described as low, moderately low, neutral, moderately high, and high, as described in Chapter III.

An examination of Table 9 above reveals a moderately high level of mathematics teaching efficacy beliefs on both the pretest (M=78.76) and posttest (M=82.93) with posttest MTEBI scores being higher by about four points (≈ 5%) for the total group. The standard deviations associated with both pre- and posttest scores for the total group represent approximately 9% of the scoring range and are considered moderate.

Table 9

Descriptive Statistics for MTEBI, PMTE, MTOE, PRAXIS and Final Exam by Group

	Total			Experimental			Comparison		
Variable	n	M	SD	n	M	SD	n	M	SD
MTEBI									
Pretest	34	78.76	7.05	18	76.83	7.40	16	80.94	6.15
Posttest	33	82.93	8.44	17	81.64	7.04	16	84.31	9.75
PMTE									
Pretest	34	48.91	6.05	18	46.78	6.85	16	51.31	3.98
Posttest	33	51.64	7.14	17	51.41	6.36	16	51.88	8.09
MTOE									
Pretest	34	29.85	3.61	18	30.06	4.01	16	29.63	3.22
Posttest	33	31.30	3.57	17	30.23	3.36	16	32.44	3.52
PRAXIS	31	176.55	4.98	16	174.94	5.04	15	178.27	4.45
Final Exam	33	39.79	6.99	17	39.59	7.77	16	40.00	6.31

Table 9 also indicates that for the experimental group, moderately high MTEBI posttest scores (M=81.64) were higher than the moderately high pretest scores (M=76.83) by about five points (≈ 6%). Standard deviations associated with these scores represent about 8% of the scoring range, indicating moderate variation in scores.

Likewise, although both moderately high, MTEBI posttest scores (M=84.31) for the comparison group were higher than their pretest scores (M=80.94), a difference of about three points (≈ 4%). Standard deviations for these comparison group scores represent about 7% – 12% of the total scale, indicating moderate levels of variation.

The comparison group scored higher than the experimental group on both the pretest and the posttest. All scores were in the moderately high range. The difference between the experimental group and the comparison group on the MTEBI pretest was about 4 points (≈ 5%) with the comparison group (M=80.94) scoring higher than the experimental group (M=76.83). Likewise, the comparison group (M=84.31) scored higher on the posttest than the experimental group (M=81.64) by about two points (≈ 2%). Standard deviations across these scores represent about 7% – 12% of the total scale, again indicating moderate levels of variation.

As described in Chapter III, the MTEBI is made up of two subscales, personal mathematics teaching efficacy (PMTE) and mathematics teaching outcome expectancy (MTOE). Of the 21 items on the MTEBI, 13 items are considered to address one's beliefs about personal ability to teach mathematics effectively (Enochs, Smith, & Huinker, 2000). These 13 items make up the PMTE subscale; they can be found in Table 4 in Chapter III. The 8 items on the MTEBI that are not included in the PMTE subscale are considered to address one's beliefs that there will be a positive effect on student learning if there is effective teaching (Enochs, Smith, & Huinker, 2000). These 8 items make up the MTOE subscale; they can be found in Table 5 in Chapter III. The next two sections discuss descriptive statistics for the PMTE and MTOE subscales.

PMTE

PMTE scores were calculated as described in the scoring instructions provided by Enochs, Smith, and Huinker (2000) and can be found in Appendix B. The 13 items and 5-point likert scale ratings result in possible PMTE scores ranging from 13 to 65. Examination of Table 9 reveals moderately high personal mathematics teaching efficacy on the pretest (M=48.91) as well as on the posttest (M=51.64) with the posttest being higher by about three points (≈ 6%). The standard deviations for the total group indicate moderate levels of variation as they represent approximately 12% – 13% of the scoring range.

Table 9 also reveals growth in PMTE for both the experimental group and the comparison group. The experimental group showed moderately high PMTE on both the pretest (M=46.78) and posttest (M=51.41) with the posttest being about four points higher (≈ 9%).

Standard deviations for the experimental group indicate moderate levels of variation as they represent about 12% – 13% of the scoring range.

Likewise, the comparison group showed moderately high PMTE on both the pretest and the posttest. However, the PMTE pretest (M=51.31) and posttest (M=51.88) were almost the same with a difference of less than one percent of the total scale. Standard deviations for the comparison group represent approximately 8% – 15% of the scoring range, indicating moderate levels of variation.

Further examination of Table 9 reveals that PMTE posttest scores for the comparison group (M=51.88) were almost the same as those of the experimental group (M=51.41), a difference of less than one percent of the total scale. On the other hand, PMTE pretest scores were about four points higher (≈ 8%) for the comparison group (M=51.31) than for the experimental group (M=46.78). Data suggests that the experimental group showed more growth in PMTE because the comparison group started out higher and ended up about the same as the experimental group. Standard deviations across these scores represent about 8% – 15% of the total scale, again indicating moderate variation in scores.

MTOE

MTOE scores were also calculated as described in the scoring instructions provided by Enochs, Smith, and Huinker (2000) and can be found in Appendix B. The 8 items and 5-point likert scale ratings result in possible MTOE scores of 8 to 40. Furthermore, Table 9 indicates moderately high mathematics teaching outcome expectancy on the pretest (M=29.85) as well as on the posttest (M=31.30) with the posttest being higher by about one point (≈ 3%). The standard deviations for the total group represent about 11% of the scoring range, indicating moderate levels of variation.

As with the PMTE, Table 9 reveals growth from pretest to posttest in MTOE for both the experimental group and the comparison group. The experimental group showed almost the same moderately high MTOE on both the pretest (M=30.06) and posttest (M=30.23) with the posttest being less than one percent higher. Standard deviations for the experimental group represent about 9% – 13% of the scoring range, indicating moderate variation in scores.

The comparison group also showed moderately high MTOE on both the pretest and the posttest. However, the comparison group showed greater differences with the posttest (M=32.44) being about two points higher (≈ 6%) than the pretest (M=29.63). Standard deviations for the comparison group represent approximately 9% – 11% of the scoring range, indicating moderate levels of variation.

When comparing the experimental group to the comparison group, Table 9 reveals that the moderately high MTOE pretest scores for the experimental group (M=30.06) were about the same as those of the comparison group (M=29.63), a difference of less than one percent. On the other hand, MTOE posttest scores, although both moderately high, were higher (≈ 6%) for the comparison group (M=32.44) than for the experimental group (M=30.23), a difference of about two points. Standard deviations across these scores are considered moderate, representing about 11% – 13% of the total scoring range.

PRAXIS I

Mathematics scores from the Pre-Professional Skills Test (PPST) of PRAXIS I were collected to answer the second question in this study. As mentioned in Chapter III, examining differences in mathematics content knowledge between groups at the end of the study was important to determine whether time spent doing guided imagery affected the amount of pedagogical skills and content knowledge subjects gained in the course. Praxis I math scores were used as a covariate to control statistically any differences in students' mathematics content knowledge that might have been present initially and which might confound differences between groups in the study. The PRAXIS I mathematics test measures basic academic skills in the area of mathematics and is used by many states as part of the teaching licensing certification procedures (Educational Testing Service, 2006). PRAXIS I math scores were obtained from college files with permission from subjects in the study. A copy of the consent form to obtain PRAXIS I scores is included in Appendix F.

As mentioned earlier, three subjects were eliminated from the analyses of Question 2 because they had not taken the PRAXIS I math test. PRAXIS I math scores for subjects in the experimental group ranged from 170 to 185 while those in the comparison group ranged from 170 to 186. These scores can be interpreted relative to the minimum performance standard, a score of 170, required by the Department of Education in the state where this study was conducted. Because preservice teacher candidates had to meet their state's minimum performance standards on PRAXIS I prior to taking the course used in this study, the minimum PRAXIS I mathematics score for all subjects was 170.

For the total sample, PRAXIS I math scores averaged 176.55 with standard deviation of approximately five points. Further examination of Table 9 reveals that mean PRAXIS I math scores are higher for the comparison group (M=178.27) than for the experimental group (M=174.94) by about three points. There are also similar levels of variation across groups.

Final Exam

The final exam for both sections of the course was an oral performance assessment that measured mathematics content knowledge and pedagogical skills. Preservice teacher candidates enrolled in the course were required to complete the answers to the questions in writing and provide to the instructor oral explanations using manipulatives. A copy of this assessment can be found in Appendix C.

In the experimental group, scores on the final exam ranged from 20 to 50 while scores in the comparison group ranged from 29 to 49. An examination of Table 9 indicates that final exam scores were acceptable for the total group (M=39.79), the experimental group (M=39.59), and the comparison group (M=40.00) according to the score ranges defined in Chapter III. The comparison group scored approximately the same as the experimental group on the final exam, a difference of less than one-half point. The standard deviation for the final exam is moderate, representing about 12% - 14% of the scoring range, for the total sample and the experimental group. For the control group, the standard deviation is moderately high, representing about 16% of the total score range.

Summary

Descriptive statistics show small differences in mathematics teaching efficacy beliefs between groups at the end of the study. Examination of Table 9 reveals a difference in mean MTEBI posttest scores with the comparison group showing a higher sense of mathematics teaching efficacy (M=84.31) as compared to the experimental group (M=81.64). Likewise, Table 9 shows slight differences in mean PMTE and MTOE posttest scores. In their beliefs about their own ability to teach mathematics (PMTE), the comparison group (M=51.88) is slightly more confident than the experimental group (M=51.41). Regarding subjects' beliefs about whether they will make a difference in student learning (MTOE), the comparison group (M=32.44) is slightly more optimistic than the experimental group (M=30.23).

Additionally, Table 9 reveals that both groups performed about the same on the final exam despite the fact that the comparison group (M=178.27) scored higher than the experimental group (174.94) on the PRAXIS I math test. Furthermore, Table 9 shows differences between pre-and posttests on MTEBI, PMTE, and MTOE with MTEBI showing the greatest differences in both groups. However, differences between pre- and posttest scores are higher on the PMTE for the experimental group but higher on the MTOE for the comparison group. To further explore these differences between the experimental group and the comparison group and between pre- and posttest scores over time, inferential statistics, specifically analysis of covariance and paired-samples t-tests, were used.

Inferential Statistics

Question 1

MTEBI. As mentioned in Chapter III, ANCOVA is employed to adjust statistical differences in groups on variables related to the dependent variable (McMillan & Schumacher, 1997; Creswell, 2002). Since subjects were enrolled in course sections prior to the beginning of the study, intact groups were randomly assigned to experimental and comparison status. Therefore, initial differences in mathematics teaching efficacy beliefs were controlled by using MTEBI pretest scores as a covariate in order to consider the confounding effects of pre-existing differences in mathematics teaching efficacy beliefs.

An ANCOVA was used to analyze the data for Question 1. Data describing the mean scores on the MTEBI for the experimental and comparison groups can be found in Table 9. A brief examination of these scores indicates that all scores fall into the moderately high level of mathematics teaching efficacy; however, a difference of almost four points favoring the comparison group existed on the pretest. Additionally, the difference between the comparison group and the experimental group was approximately two points in favor of the comparison group on the posttest.

All assumptions of ANCOVA were met. The assumptions of the independence of observations and the normal distribution of scores were assumed to be true. Analysis of Variance (ANOVA) showed non-significant differences ($F_{1,32} = 3.05$, $p = .090$) between groups on the MTEBI pretest which served as the covariate. Homogeneity of regression was tested and found to be non-significant ($F_{4,10} = 0.72$, $p = .597$). Homogeneity of variance was tested using Levene's F-test and found to be non-significant ($F_{1,31} = 3.61$, $p = .067$). In addition, samples were approximately equal in size making the analysis robust to the violation of this assumption.

The results of the ANCOVA can be found in Table 10. The adjusted mean for the comparison group was 82.61, and the adjusted mean for the experimental group was 83.24. The differences between these adjusted means was non-significant ($F_{1,30} = 0.09$, $p = .765$). Observed power for this analysis was 0.06; partial eta-squared was 0.00.

Table 10

ANCOVA Summary Table for Posttest MTEBI Scores by Group

Source	Type I SS	df	MS	F
MTEBI Pretest	1279.29	1	1279.29	38.53*
Group	3.02	1	3.02	0.09
Error	996.17	30	33.21	
Total	2278.48	32		

* $p < 0.05$

The MTEBI is actually made up of questions that address two constructs, PMTE and MTOE. Consequently, results for PMTE and MTOE were also analyzed.

PMTE. As done with MTEBI scores, pretest scores for PMTE were used as a covariate and ANCOVA was used to examine adjusted mean scores on the PMTE posttest scores. Data describing the mean scores on the PMTE for the experimental and comparison groups can be found in Table 9. A brief examination of these scores indicates that all scores fall into the moderately high level of personal mathematics teaching efficacy; however, a difference of almost four points favoring the comparison group existed on the pretest. On the PMTE posttest, the difference between the comparison group and experimental group was almost the same with a difference of less than one-half point favoring the comparison group.

Again, all assumptions of ANCOVA were met. The assumptions of the independence of observations and the normal distribution of scores were assumed to be true. ANOVA was used to test for differences between groups on the covariate, PMTE pretest scores, and found to be significant ($F_{1,32} = 5.93$, $p = .027$). Homogeneity of regression was tested and found to be non-significant ($F_{6,9} = 1.15$, $p = .408$). Homogeneity of variance was tested using Levene's F-test and found to be non-significant ($F_{1,31} = 0.38$, $p = .543$). Additionally, approximately equal sample sizes make the analysis robust to the violation of this assumption.

The results of the ANCOVA can be found in Table 11. The adjusted mean PMTE score for the comparison group was 50.01, and the adjusted mean PMTE score for the experimental group was 53.17. The difference between these adjusted means was non-significant ($F_{1,30} = 2.60$, $p = .117$). Observed power for this analysis was 0.345; partial eta-squared was 0.08.

Table 11

ANCOVA Summary Table for Posttest PMTE Scores by Group

Source	Type I SS	df	MS	F
PMTE Pretest	720.881	1	720.881	25.80*
Group	72.62	1	72.62	2.60
Error	838.136	30	27.938	
Total	1631.64	32		

* $p < 0.05$

MTOE. Finally, results from the MTOE subscale were analyzed as described above for PMTE. As for MTEBI and PMTE, ANCOVA was used to analyze the MTOE subscale data for

Question 1. Table 9 includes data describing the mean scores on the MTOE for the experimental and comparison groups. Examination of these scores indicates that all scores fall into the moderately high level of mathematics teaching outcome expectancy. A difference, however, of about two points favoring the comparison group existed on the MTOE posttest while the MTOE pretest scores were almost the same with a difference of less than one-half point favoring the experimental group.

Assumptions of ANCOVA were met for MTOE as well. Again, the assumptions of the independence of observations and the normal distribution of scores were assumed to be true. ANOVA was used to determine whether there were significant differences between groups on the MTOE pretest, the covariate. Non-significant differences were found ($F_{1,32} = 0.12$, $p = .734$). Homogeneity of regression was tested and found to be non-significant ($F_{6,13} = 0.54$, $p = .770$). Levene's F-test was used to test for homogeneity of variance and found to be non-significant ($F_{1,31} = 2.66$, $p = .113$). Additionally, approximately equal sample sizes make the analysis robust to the violation of this assumption.

The results of the ANCOVA can be found in Table 12. The adjusted mean MTOE score for the comparison group was 32.53, and the adjusted mean MTOE score for the experimental group was 30.14. A significant difference between these adjusted means was found ($F_{1,30} = 6.14$, $p = .019$). Observed power for this analysis was 0.670; partial eta-squared was 0.17.

Table 12

ANCOVA Summary Table for Posttest MTOE Scores by Group

Source	Type I SS	df	MS	F
MTOE Pretest	130.49	1	130.49	17.05*
Group	47.02	1	47.02	6.14*
Error	229.572	30	7.65	
Total	407.08	32		

* $p < 0.05$

Question 2

To control statistically for any initial differences between groups in mathematics content knowledge which might have been present to confound differences between groups in final exam performance, ANCOVA was used. The PRAXIS I mathematics test is a test of basic academic skills that is required for teacher certification in the state in which this study took place (Educational Testing Service, 2006). In fact, preservice teacher education candidates must meet minimum score requirements on PRAXIS I before they can take certain methods courses in their program of study. Scores on the PRAXIS I mathematics test were used as a covariate so that initial differences in mathematics content knowledge could be considered.

Assumptions of ANCOVA were met. Again, the assumptions of the independence of observations and the normal distribution of scores were assumed to be true. ANOVA was used to determine whether there were significant differences between groups on the PRAXIS I mathematics test which served as the covariate. Non-significant differences between PRAXIS I scores were found ($F_{1,29} = 3.78$, $p = .062$). Homogeneity of regression was tested and found to be non-significant ($F_{3,16} = 0.67$, $p = .586$). Levene's F-test was used to test for homogeneity of variance and found to be non-significant ($F_{1,29} = 0.01$, $p = .922$). Additionally, approximately equal sample sizes make the analysis robust to the violation of this assumption.

The results of the ANCOVA can be found in Table 13. The adjusted mean final exam score for the comparison group was 38.59, and the adjusted mean final exam score for the experimental group was 40.26. A non-significant difference between these adjusted means was found ($F_{1,28} = 0.41$, $p = .525$). Observed power for this analysis was 0.095; partial eta-squared was 0.15.

Table 13

ANCOVA Summary Table for Final Exam Scores by Group

Source	Type I SS	df	MS	F
PRAXIS	180.44	1	180.44	3.89
Group	19.21	1	19.21	0.41
Error	1300.02	28	46.43	
Total	1499.68	30		

* $p < 0.05$

Question 3

MTEBI pre- and posttest scores were used to answer Question 3 which dealt with the issue of differences in mathematics teaching efficacy beliefs after completing a mathematics methods course. This question compared subjects' mathematics teaching efficacy beliefs before and after the course.

To determine whether the differences between pretest scores and posttest scores were significant, paired samples t-tests were used. As mentioned in Chapter III, paired-samples t-tests are used when the same subjects are tested twice as in this study (McMillan & Schumacher, 2006). These results are summarized in Table 14.

Experimental group. All assumptions for the paired-samples t-tests being reported were met. Paired-samples t-tests revealed significant differences (t_{16}= 3.67, $p < .05$) between mean pre-and posttest scores on the MTEBI for the experimental group. Significant differences (t_{16} = 3.39, $p < .05$) were also found for the PMTE subscale in the experimental group. However, differences in mean pre-and posttest scores for the MTOE subscale were not significant (t_{16} = 0.49, $p > .05$) for the experimental group.

Comparison group. On the other hand, for the comparison group, differences were not significant (t_{15} = 2.06, $p > .05$) between mean pre-and posttest scores on the MTEBI in the comparison group. Differences between PMTE subscale mean pre-and posttest scores for the comparison group were also non-significant ($t_{15} = 0.40$, $p > .05$). However, significant differences ($t_{15} = 2.96$, $p < .05$) were found between mean pre-and posttest scores for the MTOE subscale for the comparison group.

Results from paired-samples t-tests for the experimental group were opposite the results for the comparison group. Table 14 illustrates this interesting comparison between groups.

Table 14

Significant Differences Indicated by Paired Samples T-Tests by Group

	Experimental Group	Comparison Group
MTEBI2 – MTEBI1	*	
PMTE2 – PMTE1	*	
MTOE2 – MTOE1		*

*p < .05

Summary

Question 1. ANCOVA was used to test for differences between groups on posttest scores from the MTEBI and its subscales PMTE and MTOE. Pretest scores were used as the covariates in each comparison, and posttest scores served as the dependent variable. ANCOVA results revealed no statistically significant differences between the experimental group and the comparison group on the MTEBI and the PMTE subscale. However, significant differences on the MTOE subscale were found between treatment groups. For the MTEBI and the PMTE subscale, there is not enough evidence to reject the null hypothesis that the mean scores are equal. However, there is evidence to reject the null hypothesis for the MTOE subscale, indicating that the mean MTOE posttest scores between groups are different.

Question 2. ANCOVA was run on the final exam scores with the PRAXIS I math scores as the covariate. Although slight differences were evident with descriptive statistics, no statistically significant differences were found between groups on final exam scores. There is not enough evidence to reject the null hypothesis that the mean final exam scores are equal.

Question 3. Paired-samples t-tests were used to determine whether there were differences over time in MTEBI, PMTE, and MTOE. Since these analyses were testing for effects over time, not group comparisons, experimental group results and comparison group results will be discussed separately.

In the experimental group, significant differences were found between mean pretest scores and posttest scores on the MTEBI and its PMTE subscale. There is enough evidence to reject the null hypothesis, suggesting that pretest scores and posttest scores were different. On the other hand, differences between pretest scores and posttest scores for the experimental group on the MTOE subscale were found to be non-significant. There is not enough evidence to reject the null hypothesis that the pretest and posttest MTOE scores are the same.

Interestingly, as illustrated in Table 14, the comparison group results were just the opposite. On the MTEBI and its PMTE subscale, non-significant differences were found. There is not enough evidence to reject the null hypothesis, indicating that the pretest scores and posttest scores were the same. However, on the MTOE subscale, significant differences were found between the pretest and posttest scores for the comparison group. There is enough evidence to reject the null hypothesis, indicating a difference between pretest and posttest MTOE scores.

Chapter V

Discussion

Introduction

The purpose of this study was to investigate the impact of a mathematics methods course, including guided imagery, on the mathematics teaching efficacy beliefs of preservice elementary teachers. The Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) was used to assess the mathematics teaching efficacy beliefs of elementary preservice teacher candidates in this study. Subscales of the MTEBI were also considered to assess two constructs of mathematics teaching efficacy: candidates' personal mathematics teaching efficacy (PMTE) and mathematics teaching outcome expectancy (MTOE). Additionally, subjects' final exam performance assessment scores were compared and analyzed, with consideration of their PRAXIS I math scores, to assess content knowledge and pedagogical skills. Statistical findings were reported in Chapter IV. This chapter discusses the conclusions, interpretations, limitations and implications of the findings. Three implications for research and two implications for teacher education are discussed along with three recommendations for future research.

Conclusions

Descriptive Statistics

MTEBI, PMTE, and MTOE. Mathematics teaching efficacy beliefs (MTEBI), personal mathematics teaching efficacy (PMTE), and mathematics teaching outcome expectancy (MTOE) were measured. Descriptive statistics, as illustrated in Table 9 on page 62, indicate that all of the mean scores increased from the pretest to the posttest in both groups. Increases in efficacy are evident.

Furthermore, when examining descriptive data vertically to compare groups, differences in favor of the comparison group are evident. Mean scores of the comparison group were higher than the mean scores of the experimental group for all measures of efficacy except on the MTOE pretest. Mean MTEBI pretest scores were higher in the comparison group than in the experimental group, as were mean PMTE pretest scores. Additionally, all mean posttest scores (MTEBI, PMTE, and MTOE) were higher in the comparison group.

PRAXIS I. At the institution used in this study, preservice teacher candidates are required to have met minimum state standards on the PRAXIS I Pre-Professional Skills Tests before they enter the stage in their curriculum when they begin taking methods courses. For this reason, PRAXIS I math scores were used as an indication of subjects' mathematics content knowledge prior to taking the course involved in the study. Descriptive data in Table 9 reveals that the comparison group had higher mean scores for the mathematics section on PRAXIS I than the experimental group.

Final Exam. As described earlier, the final exam was an oral performance assessment used to measure the acquisition of mathematics content knowledge and pedagogical skills. Despite the fact that mean PRAXIS I math scores were higher in the comparison group than in the experimental group, mean final exam scores were almost the same. A difference of less than one-half point on the mean final exam scores is noteworthy, as it indicates that the experimental group was almost the same as the comparison group in terms of mathematics content knowledge and pedagogical skills at the end of the semester.

Inferential Statistics

Differences were found between groups and over time. Many of these differences were found non-significant. These results are discussed as they pertain to each research question.

Question 1. Vertical analysis comparing groups was used to answer Question 1. Negligible differences in the MTEBI and PMTE posttest scores between groups were found. However, the differences between the experimental group and the comparison group regarding MTOE were found to be significant. These significant differences in MTOE were in favor of the comparison group. Overall, the guided imagery intervention had no advantageous effect on MTEBI, PMTE, or MTOE.

Question 2. In Chapter I, a concern was expressed as to whether a specified amount of time spent on an added intervention would diminish the attainment of other objectives of the course. Because of this concern, Question 2 was investigated.

Insignificant differences were found between the mathematics content knowledge and pedagogical skills oral performance assessment (final exam) scores between groups. These findings suggest that although implementation of guided imagery sessions used 15 minutes of ten of the class periods during the semester, it did not take away from preservice teachers' attainment of mathematics content knowledge and pedagogical skills. Thus, the guided imagery intervention had no detrimental effect upon cognitive and pedagogical development.

Question 3. Horizontal analysis of effects on both groups over time was used to answer Question 3. For the experimental group, data revealed significant differences between MTEBI pretest and posttest scores and between PMTE pretest and posttest scores. However, non-significant differences between pre-MTOE scores and post-MTOE scores were found.

For the comparison group, differences between the MTEBI pretest scores and MTEBI posttest scores were found to be non-significant. Likewise, there were non-significant differences between the pre-and post- PMTE subscale scores. On the other hand, the comparison group showed significant increases in their MTOE scores after completing the course.

In summary, significant differences were found over time for both groups, but these differences were found on different constructs. For the experimental group, significant increases in subjects' overall mathematics teaching efficacy (MTEBI) and beliefs in their ability to teach mathematics (PMTE) were found, but differences in subjects' thoughts about whether their efforts could make a difference in student learning (MTOE) were non-significant. Alternatively, for the comparison group, non-significant differences in MTEBI and PMTE were found, while there were significant increases in MTOE.

Interpretations

Developmental Nature of Efficacy

One reasonable explanation of the opposite effects on MTEBI, PMTE, and MTOE found in analyzing Question 3 for the two groups is that teacher efficacy may be developmental in its nature. Evidence from this study suggests that personal mathematics teaching efficacy develops first, then mathematics teaching outcome expectancy develops. Table 14 on page 73 illustrates that preservice teacher candidates in the experimental group showed significant increases in their MTEBI and PMTE scores while the comparison group showed significant increases only in their MTOE scores.

The experimental group began the course with lower efficacy ratings and lower content knowledge than the comparison group. Because candidates in the comparison group already had higher levels of efficacy and content knowledge, they were ready to move to the next developmental level of efficacy. These findings are aligned with other empirical data that suggest that once preservice teachers begin working in real classrooms, their level of efficacy regarding student achievement decreases for a while. As described by Utley, Moseley, and Bryant (2005), preservice teachers can become confident in their ability to teach mathematics, yet not feel that they can make a difference in student achievement because of outside circumstances. Additionally, Spector (1990) found that preservice teachers' optimism tends to decrease when confronted with real students in real classroom situations where they are in charge of all aspects of teaching and learning.

Furthermore, the findings of Pigge and Marso's (1993) research, in which they studied the developmental nature of teachers' sense of efficacy, also relate to the findings of this study. Pigge and Marso were examining teacher efficacy in general, whereas this study examined teacher efficacy related to mathematics. However, similarities in findings suggest the developmental nature of teacher efficacy.

Although they did not find significant differences in overall efficacy between teachers at different stages of their careers, Pigge and Marso's work showed significant differences on individual constructs. One difference was that mid-career inservice teachers had a stronger belief than preservice teachers that they could help students do better than usual if they tried harder to teach them. Other results of their study indicate that preservice teachers had lower levels of personal teaching efficacy and higher levels of overall teaching efficacy than inservice teachers. Pigge and Marso describe personal teaching efficacy as "a sense of one's own efficacy as a teacher," which can be related to PMTE in this study, and overall teaching efficacy as "one's sense of the efficacy of teachers as a group," which can be related to MTOE (p. 5).

The developmental nature of teaching efficacy suggests that preservice teacher candidates must first improve their beliefs in themselves about their own teaching ability before they can consider whether their efforts will make a difference for students. It seems that because the comparison group in this study began with higher levels on MTEBI and PMTE and had higher scores on the PRAXIS I math test, they had moved through the first developmental stage.

Overall, they were already confident in their own abilities to teach and in their content knowledge; therefore, the comparison did not show significant improvement in these areas at the end of the course. However, since they had accomplished higher levels of PMTE and content knowledge (PRAXIS I math scores), they were ready to progress through the next developmental level of considering whether their efforts could make a difference in student outcomes (MTOE).

On the other hand, the experimental group began the study with lower levels of PMTE and content knowledge (PRAXIS I math scores) so they were still in the first developmental stage of teacher efficacy.

Mathematics Methods Courses Improve Efficacy

Bandura's (1986, 1997) theoretical model of one's sense of efficacy suggests that successful teacher preparation and teaching experiences should increase teachers' efficacy. This study showed that participation in a mathematics methods course had positive results on teacher efficacy in mathematics. Descriptive statistics showed increases in MTEBI, PMTE, and MTOE. Inferential statistics showed significant increases in MTEBI and PMTE for the experimental group and significant increases in MTOE for the comparison group. These findings support other empirical evidence about the effectiveness of mathematics methods courses on mathematics teaching efficacy (Alkhateeb & Abed, 2003; Huinker & Madison, 1997; Swars, 2005; Utley, Moseley, & Bryant, 2005).

Limitations

In this section, limitations of the study will be discussed. As explained by Creswell (2002), limitations of a research study are problems or weaknesses of the study that are recognized by the researcher. To help readers make decisions about the generalizability of the results of this study, the following limitation related to sample size is included.

As mentioned in Chapter III, McMillan and Schumacher (1997) suggest that eight to ten subjects in each group would be acceptable in highly controlled experiments, but they encourage researchers to have at least 15 subjects in each group. Additionally, 15 subjects per group is the approximate number needed according to Creswell (2002). This study began with 38 subjects who agreed to participate in the study. However, because of attrition, only 34 samples were used in the Analyses of Questions 1 and 3. Where posttest data were involved, only 33 samples were included because one subject did not complete the posttest. Additionally, in the analyses of Question 2, only 31 samples were used because of missing PRAXIS I math scores. Although the sample sizes met minimum requirements as suggested by educational researchers, the small sample size (N = 31 – 34) in this study affects the generalizability of the results.

Implications for Research

Developmental Nature of Efficacy

More studies are needed to support the assumption that teaching efficacy is developmental in nature. This study supports the notion that teachers progress through their own beliefs about what they can do as teachers before they can work on their thoughts about how their teaching effectiveness impacts student outcomes. This and other studies (Pigge & Marso, 1993; Spector, 1990; Utley, Moseley, and Bryant, 2005) have supported the notion that teaching efficacy is developmental in nature, and further research in this area would validate this assumption.

MTEBI

This study used the MTEBI to compare groups on mathematics teaching efficacy and to evaluate changes in mathematics teaching efficacy over time. Although the MTEBI was used in other studies as mentioned in Chapter II, this study used the instrument in a different way. The current research implies that the MTEBI can be used to compare groups and to determine changes in mathematics teaching efficacy over time.

Sample Size

A methodological implication of this study is that the impact of any discrete add-on component to a course will be minimal; therefore, a larger sample size is needed to determine treatment effects. Guided imagery was only one add-on intervention within the reform-based mathematics methods course used in this study. Other components of the course naturally impact efficacy; therefore, the effect of guided imagery in particular is small.

Implications for Teacher Education

Mathematics Methods Course

As mentioned in Chapter II, elementary education majors will be certified to teach all subjects, including mathematics. Teacher educators must help their preservice teacher candidates develop stronger mathematical content knowledge and pedagogical skills and more positive mathematical attitudes. In order for the reform of mathematics education to be successful, teacher training institutions, both in-service and preservice, must change their curricula and methods to reflect changes in the teaching and learning of mathematics (Findell, 1996). Including at least one mathematics methods course in the curriculum for elementary education majors is a necessity. Results of the present study validate the importance of mathematics methods courses in teacher training programs.

As described in Chapter IV, participation in both sections of the mathematics methods course in this study had an effect on improving candidates' mathematics teaching efficacy, content knowledge, and pedagogical skills. These findings support other empirical evidence that mathematics methods courses are helpful in improving affective constructs about mathematics

(Mewborn, 2000; Poole, 2000; Quinn, 1997; Vacc & Bright, 1999; Vinson, Haynes, Brasher, Sloan, & Gresham, 1997) and mathematics content knowledge (Poole, 2000; Quinn, 1997; Steel & Widman, 1997).

Developmental Nature of Efficacy

If in fact teaching efficacy is developmental in nature, teacher educators must design courses that will enhance candidates' content knowledge and pedagogical skills, thus improving their personal teaching efficacy. Additionally, field experiences should be required so that candidates can begin to improve their efficacy about student outcomes as well.

Recommendations for Future Research

Developmental Nature of Efficacy

Future studies in mathematics teaching efficacy should measure changes in PMTE as compared to changes in MTOE at various stages in preservice teacher development. Similar studies on general teaching efficacy and in content areas other than mathematics would also be helpful in validating the notion that teacher efficacy is developmental in nature. Additionally, parallel studies with inservice teachers in graduate methods courses or in professional development programs should be done to determine whether growth in teacher efficacy continues to be developmental beyond preservice preparation.

Guided Imagery

Future studies using guided imagery in educational studies with preservice teachers and with elementary students might verify its usefulness as an intervention strategy. Birkeland (1987) suggested that more research that validates the use of guided imagery in educational settings is needed to legitimize the use of this strategy. As mentioned earlier, guided imagery produced no significant advantageous treatment effects on mathematics teaching efficacy in this study, but no detrimental effects on content knowledge and pedagogical skills were found either. Furthermore, qualitative data found in Appendix H did suggest that there is merit in using guided imagery in mathematics methods courses. For these reasons, more research is needed on the use of guided imagery in teacher education.

In the present study, there was explicit operationalization of the independent variable. Guided imagery was implemented by the course instructor exactly as the researcher planned. However, there are other ways to implement guided imagery. Suggestions for ways to modify the implementation of guided imagery are included in Appendix H.

MTEBI

Future studies could use retrospective pretesting with the MTEBI. A retrospective pretest is given after the posttest, and participants are asked to recall how they felt prior to the start of the study. Cantrell, Young, and Bruce (2006) used retrospective pretesting with the MTEBI and other instruments. Analyzing data from the MTOE subscale, they found non-significant treatment effects with the traditional pretest, but with the retrospective pretest, treatment effects were found to be significant (Cantrell, Young, & Bruce). More investigation to validate retrospective pretesting as a methodology is needed.

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Appendix A

Methods and Materials for Teaching Elementary Mathematics

Syllabus – SPRING 2005

Course Description

In this course we will work on mathematical topics appropriate for you, as well as focus on the teaching of elementary school mathematics for grades K-8. This course is designed to facilitate disciplined reflective inquiry into the education process through the interaction of theory and practice. Throughout the course you will be encouraged to reflect on your learning as a tool for thinking about how learning happens.

The philosophy of this course is that people, of all ages and many learning styles, learn best in an environment where they explore topics and come to their own understanding. This environment includes working cooperatively with others from diverse backgrounds in heterogeneous settings and is consistent with the College of Education and Human Development's mission to prepare professionals who practice in culturally diverse settings.

Texts and Materials

1. *Helping Children Learn Mathematics*- Reys
2. *Principles and Standards for School Mathematics*- (www.nctm.org)
3. *Bring the NCTM Standards to Life: Exemp. Practices for Middle Grades*-Germain-McCarthy
4. Cuisenaire's Manipulative Kit
5. *Mathematics Assessment: Myths Models/Good Questions*- Loan from Instructor
6. Calculator

Course Objectives: Students will be able to:

1. Demonstrate strategies for teaching and enhancing acquisition of concepts and computational skills using a variety of materials and methods.
2. Develop and apply alternative assessments to analyze a child's understanding.
3. Develop and teach reform-based lesson plans to children based on the Louisiana Component of Effective Teaching (LA CET).
4. Identify and explore sophisticated strategies adaptable for any population of students.
5. Develop understandings of classroom management and motivational techniques for multicultural classroom settings through teaching experiences in the elementary schools.
6. Discuss the scope and sequence for teaching K-8 mathematics as reflected in the Louisiana Frameworks and the NCTM Standards.

Mathematics Topics- Number sense; Concepts and Operations of rational numbers, real numbers; Algebra across the curriculum; Geometry & Spatial Sense across the curriculum, Data Analysis and Probability, Technology.

Themes and Strategies

The Learning Environment - Fostering mathematical understanding, reasoning and communication through a variety of teaching strategies

Assessing Children's Mathematical Understanding – Implementing alternative assessment procedures to evaluate students and inform instruction.
Mathematical Connections **-** Integrating math across the curriculum and within itself.
Mathematics as Problem Solving - Selection, use and design of worthwhile tasks emphasizing multiple representations.
Technology as Tools – Integrating calculators, computers, videotapes, Internet

OVERVIEW OF COURSE

Requirements are delineated by course.
Course:

	Requirements	Points	#For Portfolio	Grade
1.	Attendance: -3 for each absence	0		
2.	Lateness: -2 for each lateness	0		
3.	Class Participation	10		
4.	Initial Journal	6	1	
5.	Class & Reading Reflect. (5)	15	3	
6.	NCTM Article Review	6	1	
7.	Internet Lesson	6	1	
8.	Two Peer Teaching	20	1	
9.	Board Problems; Kit Work	15	6	
10.	Portfolio: Revised Journal	6	1	
11.	Portfolio Components	4		
12.	Summative Reflection	6	1	
13.	Portfolio Assess	6	1	
14.	Manipulative Oral Final	50		
	TOTAL	150		

Field Component:

	Requirements	Points	# for Portfolio	Grade
1.	Attendance: -5 for each absence			
2.	Lateness: -3 for each lateness			
3.	Teaching and Participation	25		
4.	Lesson Study Lesson	45	4	A: 93 - 100
5.	Assessment Applications lessons	24	2	B: 87 - 91
6.	Assessment Analysis	6	1	C: 73 – 86
7.	TOTAL	100		

Most activities are part of your portfolio. We will select topics from a course calendar according to your preferences. Do all assigned readings and assignments on the date assigned, whether or not a topic is discussed in class, or class is held.

Administrative Information Related to Course Requirements

Note that all of the course requirements must be completed in order to attain a passing grade, as well as a C or better on the oral and written exam. All assignments are expected on the designated due date and are to be completed in a professional, appropriate manner. Assigned work may not be done in pencil. Please note that a grade on a project is neither a judgment of you as a person or of the amount of time or effort you spent on these items, but rather of the quality of your work.

Grades: A: 138 – 150, with at least B average on Oral; B: 130 – 137, with at least C on Oral C: 110 – 129 with at least a C on Oral.

DESCRIPTION OF ASSIGNMENTS

The assignments outlined below become part of your working portfolio out of which you will build your portfolio. A portfolio is a collection of your work which represents and documents your accomplishments in a given field. A portfolio does not include everything that you do in a field; instead, it should showcase what you are capable of doing, and it should show your growth over time. In this course you will compile a portfolio of your mathematical work, together with your assessment of that work and a reflection of yourself as a future mathematics teacher.

The items to consider for placement in your portfolio are described below, though you may include additional work that you feel is worthwhile. Each assignment should be completed on the due date, as class activities may warrant discussion of the assignments. They are to be turned in to the instructor for grading according to the schedule established on the course calendar.

1. Class Participation

Throughout the course, you will be informally evaluated on your contributions to class discussions and group work.

2. Class Attendance

Attendance in class is mandatory. Copying someone else's notes cannot duplicate discussions or idea sharing. There will be point deductions for lateness and for every class missed. Call a classmate for missed information. After three absences, please drop the course.

3. Initial Journal (Typed)

For the second class session, do the readings and submit a journal that reflects the educational experiences you have had. Write about your strengths and weaknesses and address each of the following questions: How have math courses you have taken in mathematics departments impacted your understanding, feelings or perception of mathematics? What is your teaching philosophy? What is your mathematical teaching philosophy? Why will you succeed in this course? What personal and professional qualities do you have that will enhance your learning throughout the semester? What do you bring to the community of learners who have chosen this course? What expectations do you have of the community of learners who chose this course? Rate your level of math anxiety on a scale of 0 to 10. Explain why you chose that score. After I read and comment on your submission, this journal will be the first entry in your portfolio. To receive full credit, answer all of the questions.

4. Five reflections on readings and class (Not typed but in ink)

You will be reflecting on your growth throughout the course. While this assignment is designed as an assessment of your learning, it also gives you the opportunity to reflect upon the experiences you have in this course as well as other experiences connected with the course. Research shows that reflecting on one's performance and knowledge base, as well as sharing reflections with others, is critical to professional growth. You should reflect on (1) all of the course readings-outline important points; (2) your reactions to our class, looking at yourself as a learner of mathematics and reflecting upon the processes you use to learn; (3) your learning about mathematics, your learning about learning and teaching, your confusion, new ideas, questions, etc.; (4) how you think you would use ideas and activities presented in class in your own classroom; (5) any modifications you would make to strategies suggested by others; and (6) resources that you find particularly helpful during the course. Each entry must be dated and numbered. Holistic scoring scale: Check Plus: complete and reflects all entries; Check minus: Some work missing, or lacking thoughtful connections.

5. NCTM Math Article - Submit a copy of a current NCTM article (not from the internet) that is at least 3 pages long. Use a highlighter to underline important points and write a paragraph stating your opinion of the article and how/why you would/would not use the information in the classroom. The NCTM journals are: Teaching Children Mathematics, Mathematics Teaching in the Middle School, The Mathematics Teacher, Journal for Research in Math Education.

6. Internet Lesson -Use a search engine to find and submit a math lesson from the Internet that is at least three pages long. Use NCTM website or LaDOE. Write a review of the lesson's adherence to the NCTM Principles and Standards as described in Germain's book- See sample in the Sample Packet.

7. Peer Teaching (Typed)

You will create and teach two 20-minute TIMSS-based lessons from the manipulative kit. You are to FACILITATE your group's understanding of the chosen content. The lesson should model LACET. A sample lesson format will be discussed in class. For each member of your group, Xerox your plan and any materials needed for the lesson.

8. Lesson Study Lessons + Reflections (Typed)

For this activity, you will be working with classmates from a Lesson Study perspective to teach a small group of 4-6 students in a school. You will have to collaborate to prepare and revise lessons that meet your children's needs for each day that you teach. To do so, you will create assessment activities (described below) that will guide the development of a long-range form.

9. Assessment Applications (Typed)

You will assess your children's understanding of mathematical concepts in at least three different ways: Interviews, observations, and performance assessment. Each of these assessments will be used to guide your daily lesson planning. In addition, you will conduct "mini-assessments" as part of your daily lessons. For each assessment, indicate what you would recommend for further instruction based on the data. Details appear on a later page.

10. Assessment Analysis (Typed)

At the end of the fieldwork, you will write an analysis of what you discovered about the progress of each child in your group based on the data. Make 2 copies because your analysis will be given to your cooperating teacher to better serve her/his students.

11. Summative Reflection (Typed)

Look over the daily lessons and assessment of student work to see if you notice any patterns -write about them. Include the following points about the experience:

- A summary of what you have learned about teaching mathematics
- How the class discussions and readings helped or hindered
- A description of one incident with a child or teacher that stands out in your mind
- How it affected your level of mathematics anxiety (if applicable)
- Areas of professional development you need to pursue further

12. Board Work and Kit Summaries

Problems from the board will be assigned periodically and reviewed in class to extend practice with manipulatives used in class as well as short summaries of activities from the manipulative kit.

13. Oral Exam: Performance Task

An in-class manipulative oral exam to demonstrate facets of your conceptual understanding of the content and pedagogy discussed in class. A minimum grade of C is required on this exam.

16. Revised Journal- (Typed)

This journal will tie together all your experiences and growth up to the end of the class. It should not be a cut and paste of sections in the original journal. Rethink and rewrite your mathematical teaching philosophy, note connections you have made, the educational experiences you have had in this course, out of class enhancement activities, field experiences. Write about your strengths and weaknesses. What personal and professional qualities have enhanced your learning throughout the semester? What personal and professional qualities have limited your learning throughout the semester? What did you bring to the community of learners who have chosen this course? Were your expectations of that community of learners realized? How will the experiences gained from this course prepare you for teaching? Rate your level of math anxiety on a scale of 0 to 10. Explain why you chose that score. Since no course can uncover <u>all</u> that you will need to become a great teacher, what topics or methodologies discussed in the course do you need to pursue further?

17. Portfolio:

<u>Portfolio Components</u>

Refer to the table on page 2 for required elements. Your portfolio may include additional work that you feel is worthwhile. Present your portfolio in a three-ring binder with a cover page that includes your name, the course, etc. Please do not use plastic holders to encase your work. Use white paper only. (Colored section dividers are OK.)

You should revise the work selected for the portfolio.

<u>Portfolio Organization</u>

Each section must be numbered and labeled with a “tabbed” divider. Within each section, sequence the papers as listed in the “Section Contents” described below. Note that all of the work graded for the course will be in the binder. Those items NOT chosen for inclusion in the portfolio must be placed at the end of the respective section, not at the end of the binder. Thus, all graded work is contained in the binder.

Section portfolio components as follows:

1) Initial and Revised journal, Portfolio Assessment

2) Class/Reading Reflections
3) Articles and Peer teachings
4) Lesson study plans
5) Assessment applications and Analysis
6) Summative Reflection
7) Board work and Manipulative Kit reviews (keep for oral study, if necessary)
8) Other selected Work-reading summaries and other artifacts

A portfolio assumes that <u>Items Have Been Selected</u> from a working portfolio to create it. Items not selected are in the back of the appropriate sections-NOT AT THE END OF THE BINDER. You will lose 5 points for organization.

a. Components show accurate content knowledge by demonstrating appropriate instructional sequence and including revised work

b. The Portfolio assessment:

(1) Reflects on <u>all</u> sections (1-8) and for each item selected, indicates why chosen.

(2) Includes feelings about the quality of work and how the work represents knowledge and understanding.

c. Presentation - A three-minute presentation highlighting major impact of portfolio.

<u>Recommendation for Portfolio Requirements</u>

The number in the ( ) is the number of the selected work to be placed in the Portfolio Assessment from each category. Be sure to include any revisions from your selected work. All other work from each category that is not selected must be placed behind the selected work of each category.

<u>SECTIONS</u>

1) Initial Journal, Revised Journal, and Portfolio Assessment
   - (1) Initial Journal
   - (1) Revised Journal
   - (1) Portfolio Assessment

2) Class & Reading Reflections

   Select (3) Reflections from Class and Reading Reflections (place all other class/read. reflect. behind these 3.)

3) Article and Peer Teaching
   - (1) NCTM article with summary/reflection of article
   - (1) Internet article with its connections to NCTM
   - (1) Peer Teaching of your own (place your other peer teaching behind this one.

4) Field Lessons

   -Write a reflection on each lesson taught - attach the reflection to that lesson
   Place the rest of the lessons behind the lessons that you reflected

5) Assessment Applications and Analysis

   Select (2) Assessment Applications and reflect on these. (place other assessment application w/ its reflection behind these 2 assess. applications)

-Analysis: discuss the progress of students that you have been assessing throughout camp and final recommendations for each student. Make a copy for the school.

6) Summative Reflection
   - (1) Summative Reflection- discuss the field experience overall-See syllabus questions.

7) Board problems and Kit reviews

Select 3) Board problems and reflect on these. Place the others behind these 3.

-Place Kit reviews last

8) Other Selected work

-Add any other requirement or artifact you would like to keep with this binder for future use.

Working portfolios may be kept in a two-pocket folder and will be collected by groups. Students are assigned to groups according to the months of their birthdays:

Group A: January – April   Group B: May – August   Group C: Sept. – Dec

ASSESSMENT APPLICATION AND ANALYSIS

You will write three lessons that will be used as to inform instruction and evaluate students during your fieldwork. You will administer these in the order that makes the most sense for your students. The assessments should provide information about students' conceptual understanding of selected mathematics topics. (Assessments should NOT focus on procedures or recall.) Each assessment plan (written before the actual assessment) must be hands-on and should include:

- A description of what mathematics content you plan to assess.
- A copy of the assessment instrument, including directions for the students.
- A summary of what you, as assessor, will do during the assessment (questions you'll ask, prompts you'll give, etc.)
- A scoring guide (for performance and observation assessments)

You will then conduct the assessment with the students. You should collect students' work, "grade" it, and write an analysis, which includes:

- A statement as to whether or not the assessment produces the student responses you expected.
- A summary of how each student performed.
- A summary of what you learned.
- A statement of your instructional plans based on the assessment.
- A score for each student's paper (maximum 100%). You may choose NOT to share this score with students.

<u>Interview Assessment</u>

Give students problems while conducting an interview in order to determine strengths and weaknesses related to the chosen mathematical topic. Be sure to focus on the targeted mathematics. Record your students' responses and complete the directions above.

<u>Performance Assessment</u>

Create a task for students to complete. Create and use a rubric to score the students' performances. Complete the directions above.

<u>Observation Assessment</u>

Choose one particular mathematics topic, one behavioral characteristic, and one way to observe students. Create and complete an observation rubric for the lesson . Complete the directions above.

Additional Information Related to Course Requirements for ALL students:

A. Assigned work may not be done in pencil.

Please note that a grade on a project is neither a judgment of you as a person or of the amount of time or effort you spent on these items, but rather of the quality of your work. NOTE: All assignments for the course must be completed to earn a passing grade.

B. Statement on Academic Integrity

Academic integrity is fundamental to the process of learning and evaluating academic performance. Academic dishonesty will not be tolerated. Academic dishonesty includes, but is not limited to, the following: cheating, plagiarism, tampering with academic records and examinations, falsifying identity, and being an accessory to acts of academic dishonesty. Refer to the Judicial Code for further information.

C. Accommodations for Students with Disabilities

Students who qualify for services will receive the academic modifications for which they are legally entitled. It is the responsibility of the student to register with the Office of Disability Services (UC 260) each semester and follow their procedures for obtaining assistance.

D. Classroom Conduct

1. Be in class on time. Please do not come five, ten, or twenty minutes late. Distracting interruptions are inconsiderate, disrespectful, and time wasting. There is no excuse for repeatedly arriving late. Parking is often a hassle; allow enough time for it. Cell phones should be turned off before class begins.
2. Feel free to ask questions of the instructor or other students during class. But please do so when you have been recognized and "have the floor."
3. Students are expected to treat faculty and fellow students with respect. Any actions that purposefully and maliciously distract the class from the work at hand will not be allowed.

Civility in the classroom and respect for the opinions of others is very important in an academic environment. It is likely you may not agree with everything that is said or discussed in the classroom. Courteous behavior and responses are expected.

Tentative Course Calendar

Please READ all readings BEFORE the class for which they are assigned.

Reys Text = R   Standards = S (* = 3-6)   Germain Text = G   Mani Kit = MK

	Topics	Readings	Assignment
1/18, 19	• Introduction • NCTM		
1/25, 26	• Planning • Assessment • Assessment video	R: 1,2, 3, 4 S: Introduction G: 1, 2	• Initial Journal • Class/Reading Reflection 1 • Grp A
2/1, 2	• Problem solving • Inventing Algorithms • Kami Video	R: 5, 6 S*: Problem Solving, G: 11	Grp B • Board Work • Write notes on readings
2/8, 9	• No Class		
2/15, 16	• Whole numbers Number Sense	R: 7, 8, 9, G: 10 S*: Number & Operations	Grp C, Notes on readings • Internet Lesson
2/22, 23	• Number Sense • Place Value • Algorithms	R: 10, 11 G: 4	• Peer Teach 1 • Class/Reading Reflection 2 • Board Work, Grp A
3/1, 2	• Meaning of Fractions	R: 12 M:	• MK: 1-3, Board Work • NCTM Article, Grp B
3/8, 9	Operations with Fractions, FIELD EXP	R: 14 S*: Algebra G: 5	• Assessment 1 • Peer Teach 2 • Board Work, Grp C
3/15, 16 9:20, 10:20 10:45-12	Operations with Decimals • FIELD EXP	R: 15 S*: Geometry G: 6, 8	• Class/Reading Reflection 3 • Board Work, Grp A
3/22,23	• SPRING BREAK		
3/29, 30	• Ratios • Proport Reasoning FIELD EXP	R: 13	Class/Reading Reflection 4 • Board Work, Grp B

4/5, 6	• Measurement • FIELD EXP (NCTM)	R: 16, G: 3 S*: Measurement	Assessment 2, Grp C • Board Work, MK: 4-6,
4/12, 13	• Data / Probab • FIELD EXP	R: 17 S*: Data Analysis & Prob., G: 7	• Class/Reading Reflection 5 • Board Work, Grp A
4/19, 20	• Geometry • FIELD EXP	S: 8, Appendix G: 12	• Lesson 4 • Board Work • MK: 7-9, Grp B
4/26, 27	Algebra • FIELD EXP	Oral review	Assessment 3 Board Work
5/3, 4	Mixed review	Manipulative Final	• Assess Analy, Sum ref/ • Revised Journal, Portfolio
FINAL WEEK	• Course and self evaluation		

Appendix B

Mathematics Teaching Efficacy Beliefs Instrument

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

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

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

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

12. The teacher is generally responsible for the achievement of students in mathematics.	SA A UN D SD
13. Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching.	SA A UN D SD
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.	SA A UN D SD
15. I will find it difficult to use manipulatives to explain to students why mathematics works.	SA A UN D SD
16. I will typically be able to answer students' questions.	SA A UN D SD
17. I wonder if I will have the necessary skills to teach mathematics.	SA A UN D SD
18. Given a choice, I will not invite the principal to evaluate my mathematics teaching.	SA A UN D SD
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.	SA A UN D SD
20. When teaching mathematics, I will usually welcome student questions.	SA A UN D SD
21. I do not know what to do to turn students on to mathematics.	SA A UN D SD

Taken from Enochs, L. G.; Smith, P. L.; & Huinker, D. M. (2000). Establishing the factorial validity of the mathematics teaching efficacy beliefs instrument. *School Science and Mathematics, 90* 695-706.

Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) Scoring Instructions

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

Step 2. The following items must be reversed scored in order to produce consistent values between positively and negatively worded items. Reversing these items will produce high scores for those high and low scores for those low in efficacy and outcome expectancy beliefs. Reverse score Item 3, Item 6, Item 8, Item 15, Item 17, Item 18, Item 19, and Item 21.

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

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

Step 3. Items for the two scales are scattered randomly throughout the MTEBI. The items designed to measure Personal Mathematics Teaching Efficacy Beliefs (PMTE) are as follows: Items 2, 3, 5, 6, 8, 11, and Items 15 - 21. Items designed to measure Mathematics Teaching Outcome Expectancy (MTOE) are as follows: Items 1, 4, 7, 9, 10, and Items 12 – 14.

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

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

COMPUTE OESCALE = ITEM1 + ITEM4 + ITEM7 + ITEM9 + ITEM10 + ITEM12 + ITEM13 + ITEM14

Appendix C

Mathematics Content Knowledge and Pedagogical Skills Performance Assessment

Oral Manipulative Exam- Spring 2005

Name______________________________ Class__________ Date_______________

Use at least 3 different manipulatives overall to derive answers to the following problems. Identify the manipulative you used next to each problem.

(Problems 1- 4 are 8 points each.)

1) 1.3 X 2.1 _________ 2) $\frac{3}{4} - \frac{1}{3}$ _________

3) $\frac{1}{2} \div \frac{7}{8}$ _________ 4) 2 1/4 + 1/3 _________

Write a real world application for numbers 5 through 7. (Questions 5-7 are 4 points each.)

5) 2 1/4+ 1/3 ---

6) 1/2 ÷ 7/8 --

7) 3/4 x 1/3 ---

Use algorithms and show your work for 8 and 9. (Problems 8 and 9 are 3 points each.)

8) 3 1/2 – 1 5/8 9) 4.004 – 3.1235

Appendix D

Table 1D

Course Schedule Associated with Guided Imagery Sessions

CLASS	ACTIVITY
1	Explanation of the study; Signing of consent forms
2	MTEBI Pre-test
3	Guided Imagery 1 (NCTM Standards)
4	Guided Imagery 2 (Assessing Student Progress)
5	Guided Imagery 3 (Problem Solving)
6	Guided Imagery 4 (Problem Solving)
7	Guided Imagery 5 (Whole Numbers)
8	Guided Imagery 6 (Number Sense)
9	Guided Imagery 7 (Field Experience Preparation)
10	Guided Imagery 8 (Fractions)
11	Guided Imagery 9 (Operations with Fractions)
12	No guided imagery
13	Guided Imagery 10 (Operations with Fractions)
14	Final Exam Oral Performance Assessment
15	MTEBI Post-test

Guided Imagery Number 1 (NCTM Standards)

The facilitator asked participants to relax and close their eyes. After a pause, the facilitator said, “Let your imagination take you back to your early experiences with mathematics. Think about experiences you had learning mathematics. What did the teacher do? How did you feel? If those experiences were positive, relish the experience and remember details. If those experiences were negative, imagine ways that you would change them. What happened during that experience? What did you or participants do or say? How did that make you feel?”

The facilitator followed with positive and negative options to consider. “If positive, how could you make it happen for you or students? Imagine yourself doing that very clearly for your students. See your students’ response as eager learners who are happy and performing well. See students’ hands up to answer and ask questions. See yourself a dynamite teacher who presents fun and challenging activities for kids. See your kids leave the classroom with smiles on their faces still talking about the interesting math they just learned.”

“If negative, what could have happened to change it to a positive experience? How could you make it happen for your students? Imagine yourself doing that very clearly for your students. See your students’ responses as eager learners who are happy and performing well.”

After five minutes, the facilitator asked participants to open their eyes and come back to the present. When all had opened their eyes, she instructed them to reflect on their images in a five-minute writing session. Finally, she led a discussion about the experiences and discussed ways to make mathematical learning experiences positive for children, as described in the NCTM standards.

Guided Imagery Number 2 (Assessment)

The facilitator asked participants to relax and close their eyes. After a pause, the facilitator said, “Let your imagination take you back to your early experiences with mathematics. Think about experiences taking tests or completing assessments in mathematics. What did the teacher do? How did you feel? What happened during that experience? What did you or participants do or say? How did that make you feel?”

The facilitator then said, “If positive, how could you make it happen for you or students? Imagine yourself doing that very clearly for your students. See your students’ response as eager learners who are happy and performing well on your assessments. See yourself a dynamite teacher who presents fun and challenging assessments for kids. See your kids leave the classroom with smiles on their faces still talking about the interesting assessments they just experienced.”

“If negative,” the facilitator said, “what could have happened to change it to a positive experience? How could you make it happen for your students? Imagine yourself doing that very clearly for your students. See your students’ responses as eager learners who are happy and performing well on assessments.”

After five minutes, the facilitator asked participants to open their eyes and come back to the present. When all had opened their eyes, she instructed them to reflect on their images in a five-minute writing session. Finally, she led a discussion about the guided imagery experiences and discussed ways to make mathematical assessment experiences positive for children.

Guided Imagery Number 4 (Problem Solving)

The facilitator asked participants to relax and close their eyes. After a pause, the facilitator said, “Let your imagination take you back to your early experiences with mathematics. Think about experiences learning to solve verbal problems for the basic skills. What did the teacher do? How did you feel? What happened during that experience? What did you or other participants do or say? How did that make you feel? If positive, how could you make it happen for your students? Imagine yourself doing that very clearly for your students. See your students’ responses as eager learners who are happy and performing well on solving verbal problems. See them struggling, making frowns but yet still persisting because you have taught them that they are mathematicians who accept those qualities as part of doing math. They know that math discoveries were not mere insight to geniuses but required a lot of thought and time to become clear. See yourself as a dynamite teacher who presents fun and challenging problems for kids. You take pride in the questions they ask and the responses they provide to you and each other. See your kids leave the classroom with smiles on their faces still talking about the interesting problems they just experienced.”

The facilitator then offered an option for negative imagery. “If negative, what could have happened to change it to a positive experience? How could you make it happen for your students? Imagine yourself doing that very clearly for your students. See your students’ responses as eager learners who are happy and performing well.”

After five minutes, the facilitator asked participants to open their eyes and come back to the present. She instructed them to reflect on their images in a five-minute writing session. Then she led a discussion about the experiences and discussed ways to make mathematical learning experiences positive for children

Appendix E

Consent Form

1. Title of Research Study: Confluent Interventions in Teacher Education
2. Project Director: Lisa Melancon Sullivan; UNO Department of Curriculum and Instruction, 2000 Lakeshore Drive, New Orleans, LA 70148; 280-6533; lsullivan@olhcc.edu.

   Faculty Advisor: Dr. Yvelyne Germain-McCarthy; UNO Department of Curriculum and Instruction; 280-6533; ygermain@uno.edu.
3. Purpose of the Research: This research project examines ways to enhance teacher candidates' confidence in teaching mathematics, thus making them better math teachers.
4. Procedures for this Research: During this semester, participants in this study will give permission for researchers to use their PPST PRAXIS scores in mathematics, their Mathematics Teaching Efficacy Beliefs Instrument pre-and posttest scores, and their mathematics content knowledge and pedagogical skills performance assessment scores.
5. Potential Risks or Discomforts: Discomfort may be associated with sharing negative experiences you have had with mathematics teaching and learning. If you wish to discuss these or any other discomforts you may experience, you may call the Project Director listed in #2 of this form.
6. Potential Benefits to You or Others: Potential benefits resulting from this research include the continued improvement of teacher education programs particularly in the area of mathematics.
7. Alternative Procedures: Your participation is entirely voluntary and you may withdraw consent and terminate participation at any time without consequence.
8. Protection of Confidentiality: Confidentiality of all data collected will be preserved. As

scores are obtained, they will be locked in a filing cabinet in the Faculty Advisor's office. Only the Project Director will have access to the data that is collected. Also, you will use a number on these tests instead of your names. In written reports, only mean scores of the group will be reported. Finally, your classmates will not know whether your scores were included because your agreement to participate will be kept confidential.

9. Signatures: I have been fully informed of the above-described procedure with its possible benefits and risks and I have given permission of participation in this study.

______________________	______________________	__________
Signature of Subject	Name of Subject (Print)	Date
______________________	______________________	__________
Signature of Person Obtaining Consent	Name of Person Obtaining Consent (Print)	Date

Appendix F

Permission to Access

PRAXIS I Scores

I, ____, give Lisa Sullivan permission to access my PRAXIS I score in mathematics. My score will be used solely for the purpose of Lisa Sullivan's dissertation research on mathematics teaching efficacy and the effects of guided imagery.

____ ____________________________

(Signature) (Date)

Appendix G

University Committee for the Protection
of Human Subjects in Research

University of New Orleans

Campus Correspondence

Lisa Sullivan
Yvelyne Germain-McCarthy
Curriculum and Instruction

12/8/2004

RE: Confluent interventions in a mathematics methods course

IRB#: 03dec04

The IRB has deemed that the proposed research project is now in compliance with current University of New Orleans and Federal regulations.

Be advised that approval is only valid for one year from the approval date. Any changes to the procedures or protocols must be reviewed and approved by the IRB prior to implementation. Use the IRB# listed on the first page of this letter in all future correspondence regarding this proposal.

If an adverse, unforeseen event occurs (e.g., physical, social, or emotional harm), you are required to inform the IRB as soon as possible after the event.

Best of luck with your project!
Sincerely,

Laura Scaramella, Ph.D.
Chair, University Committee for the Protection of Human Subjects in Research

Appendix H
Qualitative Data and Guided Imagery

No significant treatment effects were revealed by quantitative data, but qualitative data suggests that meaningful thinking took place. During the guided imagery sessions, subjects were required to complete written reflections. These were included in course requirements and collected by the course instructor. Examination of written reflections, although not part of the methods of the current study, provides evidence that something worthwhile was happening.

Two major themes emerged from the analysis of written reflections: unpleasant experiences with mathematics with a desire to make mathematics learning better for students and satisfying experiences with mathematics with a desire to replicate these experiences for students. Some examples of each of the themes are included in the discussions that follow. Pseudonyms have been used for the candidates' names.

Unfortunately most of the reflections sorted into the category of unpleasant experiences with mathematics. For example, after describing devastating feelings associated with receiving an "F" in math on her fifth-grade report card, Karla described how she plans to make her students' experiences better. She wrote,

> I pictured myself in my classroom, helping my students learn about fractions and decimals, and they were enjoying it. I could not see the exact activities, but they were actively participating and answering and asking questions, and I am truly enjoying watching them understand what I didn't at their age.

In another written reflection, Karla described her experiences with mathematics assessment as follows.

> I saw myself always being nervous about taking math tests. I always thought I was prepared, but every time I got the test in front of me, I would lose what I thought I knew. I also saw

> myself trying different methods of assessment with my students. I want my students to feel comfortable with the math, so when it is time to be assessed, they aren't lost and still looking for answers.

Likewise, Allison describes her frustration with mathematics assessment.

> I remember lots of paper-and-pencil tests. I always dreaded all of the calculations. I hated having to do any math in my head. I pictured by classroom being more about active involvement. I see students in small groups working on problems as I walk around making observations. I see students writing in journals and discussing their thoughts. I also see me doing interviews one on one with students as they demonstrate their knowledge of the concept.

Finally, although she did not give details about her own experiences with mathematics assessment, Amberly expressed her feelings about how she wants her students' experiences to be better than hers.

> I would like to assess my students differently. I imagine myself giving them a real-world problem that requires them to think, and then I would watch them work using a rubric to assess, not only the product, but also the process they went through in solving the problem. I imagine them being excited about the lesson and continuing to talk about it on the playground.

After describing her struggle with division, Leah was able to identify the turning moment in her feelings about mathematics. She wrote, "This is when I began to see math in a negative light. It was not fun; it was intimidating. In my class, I want my students to lose the intimidation towards me, the teacher, as well as the subject."

Like Leah, Mallory describes a terrible experience with division in 6th grade.

> I was challenged in math class when we did division. I was beyond lost and the teacher just told me to try harder and I would get it. Well, I tried harder but the concept wouldn't click in my mind. That year, I didn't learn division.

Mallory continues that reflection by describing how she wishes to make things different for her own students. She wrote, "In my class, if the students don't understand, I would stop my lesson and explain the concept over and begin again."

Found throughout the reflections were many comments regarding plans for making mathematics learning a fun and meaningful experience. For example, Allison wrote, "I thought about my experiences and what I didn't like, at first. Then, I thought about how I wanted it to be. I began to picture my classroom buzzing excitedly about a math problem." Similarly, Abby expressed her feelings as follows. "I'm willing to do whatever it takes to get my kids interested and liking math. If I have to sing or dance them into it, I will!"

Sadly, very few written reflections included descriptions of positive experiences candidates had with mathematics. The few that did are discussed below.

After describing an activity in which she bought toys with play money from an in-class store in her first-grade classroom, Amberly described how much fun that was for her. "I've always remembered that as being a fun experience, and an experience that I would like to recreate for students."

Additionally, Mallory described her Algebra II teacher as one who "made the class so much fun." She continued to explain why she liked the teacher so much. "We were allowed to go to the board. She explained the material on our level and had manipulatives," she wrote.

Although rich, meaningful reflection took place, as evidenced by the written reflections that followed the guided imagery sessions, candidates reported that they did not value the intervention as an important component of the course. This information was revealed when the instructor asked candidates to evaluate various course assignments and activities, indicating what should stay as is; what should be pitched; and what should be reduced or expanded. Guided imagery was listed on this course evaluation, and 12 out of 16 (75%) candidates who completed the evaluation indicated that they would “pitch” the guided imagery sessions. One specifically wrote, “Did not like it.” Only four candidates (25%) who answered the evaluation indicated that they would keep guided imagery as part of the course. One of those participants wrote, “Stay as is- relaxation tool that helped relieve stress and reduce anxiety.”

Because the majority of the participants indicated that they would remove guided imagery from the course, finding out reasons intrigued the researcher and course instructor. This may have been an indication that they did not like the sessions; therefore, they may not have completely acquired the benefits.

Suggestions for using guided imagery. Drake (1996) suggests that guided imagery be included in teacher education programs. Although significant treatment effects were not found in this study, qualitative findings suggest that there is merit in using guided imagery with preservice teacher candidates. Quantitative data suggests that there were no significant advantageous effects on efficacy, but there were no detrimental effects on cognition and pedagogy either. If teacher educators choose to use guided imagery, the following suggestions might be helpful.

Teacher educators should introduce guided imagery to a class by providing information to candidates about successful uses of the intervention. Birkeland (1987) completed a study in which teachers were encouraged to examine reasons to use guided imagery as a teaching tool. Findings of this research revealed that teachers felt more comfortable using guided imagery once they understood the cognitive importance of the strategy. Additionally, Schardt (2003) suggests that in order for guided imagery to be successfully integrated into the classroom, facilitators should educate participants about the history, risks, and benefits associated with guided imagery. Making teacher candidates feel comfortable with the intervention is important so that they will not see the time used for guided imagery as wasted.

The amount of time spent participating in guided imagery can also be a factor in its effectiveness. Gothelf (2003) and Schardt (2003) suggest that guided imagery may not be immediately effective; however, the use of the methodology is still supported. The more one participates in guided imagery, the more powerful the imagery becomes. Naparstek (as cited in Schardt) found that one's response to guided imagery intensifies the more it is used. This suggests that participants should engage in guided imagery exercises as much as possible. Schardt maintains that encouraging participants to practice guided imagery at home could be one way to increase time spent on the intervention, thus enhancing its effectiveness.

Another caution in using guided imagery as an intervention in teacher education is willingness to participate. Reluctance to participate in guided imagery interventions has been a problem in other studies. For example, of the 139 persons invited to participate in Schweer, Hart, Glick, and Mobily's (1999) study using guided imagery in helping families cope with critical illness, only 26 actually accepted, and only 10 subjects completed the study.

In this study, subjects participated in ten guided imagery sessions. Since guided imagery is considered a "learned skill," patience and persistence is necessary for successful participation (Schardt, 2003). Ten sessions may not have been enough time. Subjects in this study were also not encouraged to practice guided imagery outside of the classroom setting. Furthermore, although the researcher in this study explained the purpose of the study to subjects, she did not educate subjects about guided imagery and its uses, history, risks, and benefits. Finally, subjects had a choice about whether or not to participate in this research study, but they did not have a choice about whether to participate in the guided imagery intervention, as it was a part of the methods course in which they enrolled. Being involved in the guided imagery sessions, as well as writing reflections following each session, were considered class participation.

For the reasons explained above, teacher educators who choose to implement guided imagery should consider explaining its uses, history, risks, and benefits to participants prior to beginning the intervention. Teacher educators should also encourage participants to continue guided imagery exercises outside of class.

Vita

Lisa Melancon Sullivan was born in Marrero, Louisiana and educated in the Jefferson Parish Public School System. In 1991, she received her B.S. in secondary mathematics education from Our Lady of Holy Cross College in New Orleans. While teaching middle-school mathematics at Ellender Middle School in Jefferson Parish, Sullivan received her master's degree in teaching mathematics from Loyola University in New Orleans in 1994. She continued to teach middle-school mathematics and began to teach mathematics courses as an adjunct instructor at Our Lady of Holy Cross College. In 1997, Sullivan entered the doctoral program at the University of New Orleans and started a full-time faculty position in the Education Department at Our Lady of Holy Cross College.

Sullivan is currently an Assistant Professor of Education and the Director of the Professional Laboratory Experience Program at Our Lady of Holy Cross College where she plans to continue teaching and research in the area of curriculum and instruction. Preparing preservice teacher candidates to become effective classroom teachers, especially in the area of mathematics, is Sullivan's primary interest area. She is interested in continuing to provide preservice teacher candidates with the knowledge, skills, and dispositions necessary to be reflective stewards in the field of education.