MIDDLE SCHOOL MATHEMATICS TEACHERS' REACTIONS TO STATE MANDATED REFORM: SELF-EFFICACY AND CLASSROOM PRACTICE

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CHAPTER I

THE RESEARCH PROBLEM

Introduction

During the late 1960s, Donald Eichhorn and William Alexander (as cited in Williamson, 1996) begin writing about the call for a new school environment to serve the needs of youth, those that had not been fulfilled by the establishment of junior high schools. Interest continued and, as a result, two specific agendas were written to identify elements of a suitable middle level program, two of which were *This We Believe* and *An Agenda for Excellence at the Middle Level* (Johnston, Arth, Lounsbury, & Toepfer, 1985). In addition, the Carnegie Council on Adolescent Development issued a status report in 1989, *Turning Points: Preparing American Youth for the 21st Century*. This report recommended changes that could transform middle level education. Proposed changes focused on a reconsideration of the physical and developmental issues related to adolescents, along with a better understanding of effective practices for teaching students with regards to the diverse cognitive development of middle level students (Williamson, 1996).

Specific recommendations from these professional organizations have common themes and fall into three general categories: organization of instruction and relationships between instructors and students, curricular changes that are challenging and prepare students for lifetime learning, and instructional practices that are cooperative in nature and responsive to student needs (Carnegie Council on Adolescent Development, 1989; Cawelti, 1988; Williamson, 1996). Research by Valentine, Clark, Irvin, Keefe, & Melton (1993), Alexander and McEwin (1989), and Epstein & Mac Iver (1990), show that many of the recommendations such as interdisciplinary teaming programs, advisory programs and flexible instructional periods have been successfully employed in middle level schools. However, while more schools are implementing programs in response to the developmental needs of middle level students, "the challenge educators face is the preparation of teachers to work successfully in such 'developmentally responsive' schools" (Williamson, 1996, p. 386).

The knowledge and expertise necessary for working with middle level students are quite different from those required of educators teaching at others levels. Johnston and Markle (1986) described middle level teacher competencies as both behavioral and competency based: accepting, optimistic, and flexible with a demonstrated knowledge of subject matter, instructional practices, and diagnostic abilities. In addressing the preparation of middle level teachers, McEwin and Thomason (1989) identified two important teacher-held competencies: (1) knowledge of the developmental nature of early adolescents, and (2) subject matter and instructional expertise. Many educators assumed that the number of specific middle school teacher preparation programs would increase to meet the needs of the growing number of middle schools, but this has not been the case (Williamson, 1996).

The need for middle level teacher preparation programs continues to be the most serious challenge facing middle level education. Colleges and universities who have traditionally organized teacher preparation into elementary and secondary programs have been challenged to implement middle-level preparation programs (Williamson, 1986). The lack of professionally prepared middle-level teachers stems from the shortage of preparation programs at both the undergraduate and graduate levels in higher education (NCATE, 1991). Although the number of states reporting specialized middle level teacher licensure/certification has grown from 2 states in 1968 to 33 states in 1992, many states require no special preparation for middle level teachers (National Middle School Association, 2002).

The shortage of programs that adequately prepare and meet mandated certification requirements for middle-level teachers results in teachers whose preparation has been at either the elementary or secondary level undermining the specialized preparation needed to assure the successful education for young adolescents (National Middle School Association, 2001; Williamson, 1996). Adding to that problem is the number of new initiatives mandated by state departments of education, designed to increase the accountability of teachers and improve the quality of education suggested by research such as *A Nation at Risk* (National Commission on Excellence, 1983), *The Third International Mathematics and Science Study* (U. S. Department of Education, 1999), and *Before It's Too Late* (National Commission on Mathematics and Science Teaching for the 21st Century, 2000). These initiatives require teachers to demonstrate competence in areas where they have no expertise. Therefore, it is crucial that endeavors are made to enhance the preparation of those teachers who will serve in such a critical role (Williamson, 1996).

Statement of the Problem

The Oklahoma Legislature has recently mandated (HB2728) new certification measures for seventh and eighth grade middle school mathematics teachers. Those teachers who are either elementary trained, or have secondary training other than mathematics, must complete endorsement training or take the mathematics middle-level certification test by September 2003. Requirements for either endorsement or certification are as follows:

- Those who teach middle level mathematics courses for high school credit must take the certification test.
- All teachers who obtained a middle school mathematics endorsement after September 1999 must take the certification test.
- Teachers endorsed before September 1999 may participate in a professional development institute administered through the Oklahoma Commission for Teacher Preparation.
- Secondary trained teachers with an endorsement other than mathematics must take either the certification test or the professional development institute.
- Secondary trained teachers of mathematics are not affected by the mandate.
- Teachers are not affected by the legislation if they teach sixth grade only.

The middle level certification test requires knowledge of algebra I and II, geometry, trigonometry, calculus, and discrete mathematics. The test is one that has been previously required of secondary trained mathematics teachers. The passing score for the certification test is 80%.

The professional development institute focuses on methodologies as specified in the *Professional Standards for Teaching Mathematics* (NCTM, 1991). The professional development institute consists of 30 clock hours, is competency based, emphasizes effective learning practices and collaborative efforts among participants, and requires participants to prepare a portfolio that can be utilized in the classroom. The institute utilizes a curriculum, *Connected Mathematics*, developed by the Connected Mathematics Project (1997). The development of this curriculum was funded by the National Science Foundation and is aligned with the National Council of Teachers of Mathematics *Principals and Standards for School Mathematics* (NCTM, 2000). This curriculum is one of five programs given exemplary status by the U.S. Department of Education's Mathematics and Science Education Expert Panel (1999).

The intended effect of this legislation is to increase the content and pedagogical backgrounds of Oklahoma middle school mathematics teachers. Professional development as a resource in improving and upgrading teacher content is normally monitored by research to ascertain the effects of the professional development for both teachers and in terms of student achievement. Those studies, however, have been related to voluntary reform efforts. No research was found that addresses the effects of reform initiatives such as were mandated by the Oklahoma Legislature.

Purpose of the Study

The purpose of this study was to investigate the effects of state-mandated reform on the self-efficacy, outcome expectancy, and classroom practice of middle school teachers. The study included 3 groups of middle level teachers: (1) elementary certified who chose to take the state mandated certification test, (2) elementary certified who chose participation in the professional development institute for endorsement, and (3) secondary trained teachers certified to teach mathematics. Since the legislation requiring middle school mathematics teachers to either take the middle level certification test or attend professional development for new endorsement did not include secondary trained mathematics teachers, the assumption was that the legislation believed there to be differences in the content knowledge and classroom practice of secondary and elementary trained mathematics teachers. For this reason, secondary trained teachers were included in the study so that any differences between the groups might be observed.

Additionally, the research was designed in an attempt to describe teachers' decision process related to the mandate and their personal feelings in regard to the mandate. Mixed methodologies were utilized to study teacher choice in certification or endorsement, how the choice was made, differences in efficacy and classroom practice for those teachers, and how the teachers feel they have been personally affected by the mandate. Specifically, the questions addressed in the study are:

1. Does self-efficacy and outcome expectancy differ for the three (elementary certified choosing the certification test, elementary certified choosing

endorsement through professional development, and secondary certified mathematics teachers) groups of teachers?

2. Is there a difference in classroom practice (as measured by integration of NCTM Standards) and confidence in teaching for the three (elementary trained choosing the certification test, elementary trained choosing endorsement through professional development, and secondary trained mathematics teachers) groups of teachers?

3. In what ways do teachers feel personally affected by the state mandate?

These questions were explored using a mixed methodology. While data on teacher self-efficacy, confidence in teaching and classroom practice was gathered for statistical analysis, observations and interviews were also conducted to broaden the picture of this complex issue. According to Creswell (1998), the qualitative addition serves to present more than the final product of one who passes judgment on participants. The qualitative aspect of the research provides an avenue for participants' views, shows multiple perspectives, and provides a more detailed image of the issue.

Three instruments were employed to measure efficacy and examine classroom practice. The Mathematics Teacher Efficacy Beliefs Instrument (MTEBI) is an instrument adapted from the Science Teacher Efficacy Beliefs Instrument (Enochs, Smith & Huinker, 2000). The MTEBI consists of 21 items with two subscales for Personal Mathematics Teaching Efficacy (PMTE), and Mathematics Teaching Outcome Expectancy (MTOE). The Classroom Observation Instrument was developed through the Mathematics Assessment Process for the Middle Grades (Pechman, 1991), and utilized in a modified form in this study. The questionnaire used in the study was designed by the researcher to gain demographic data related to teachers' classroom practice, and included open-ended questions. In addition, interviews and classroom observations were conducted to help the researcher better interpret the questions under study.

Significance of the Study

A teacher's sense of self-efficacy has been reported as the single most powerful indicator of student performance and teacher change (Trentham, Silvern, & Brogdon, 1985). This research has the potential of adding to the knowledge base of variables contributing to teacher change in the context of state mandates. Furthermore, as Oklahoma schools and schools across the nation attempt to initiate reform in the face of educational studies such as TIMSS and growing teacher shortages in mathematics, results of this study may help increase understanding of how teachers' self-efficacy and classroom practice are affected by reform in a specific context. In particular, this reform has the potential of affecting the number of Oklahoma teachers available to teach mathematics at the middle school level for high school credit.

Most "reforms have not significantly improved the quality of education in the United States," according to Ashton and Webb (1986, p. 160). Furthermore, because those failings are often traced to deficiencies of teachers either in content knowledge, or pedagogical skills, very often failures lead to a focus on modifying teacher attitudes without attention to the social context in which the teachers' function, thereby suppressing a significant variable. This study focused on an examination of the variable "forced reform," and its effect on teacher beliefs and classroom practice.

Definition of Terms

Best Practice – Classroom instruction associated with the "Principles and Standards for School Mathematics" (National Council of Teachers of Mathematics, 2000), these include the incorporation of manipulative materials, cooperative group work, class discussion, writing about mathematics, integration of technology, problem centered approach to learning, questioning and making conjectures, the teacher being a facilitator of learning, and assessment as an integral part of instruction

Outcome Expectancy – Teachers' expectation that certain behaviors will produce specific outcomes. (Tschannen-Moran et al., 1998)

Teachers' Personal Sense of Self-Efficacy – Teachers' belief that they have the ability and skills to "execute the actions necessary to accomplish a specific task at a desired level" (Tschannen-Moran, Woolfolk, Hoy, & Hoy, 1998, p. 210)

Teachers' Sense of Self-Efficacy – Often referred to as general teacher efficacy, "teachers' expectations that teaching can influence student learning . . . the extent to which they believe that teaching can have an effect on student performance, despite external obstacles such as family background and student ability" (Ashton & Webb, 1986, p. 4).

Assumptions

Teachers involved in the study expressed emotional stress, tension, and anger due to the state mandate. The researcher assumed then, that these sentiments may be reflected in the teachers' efficacy measures and thus be altered from any measure that could have been made before the legislative mandate. A second assumption is that, despite some of the anger expressed in the questionnaires and interviews, teachers responded honestly and openly to the instruments. Additionally, the Mathematics Teacher Efficacy Beliefs Instrument was developed for use with preservice mathematics teachers. This study uses the same instrument with the assumption that inservice teacher self-efficacy can be measured in the same way.

Limitations

The sample chosen for this study represents a unique group of teachers, most of whom are under new state mandates for certification and endorsement. Any implications from the study therefore, will be limited to Oklahoma teachers. In addition, while random sampling of school districts across Oklahoma was performed, several school districts declined permission to survey teachers due to the sensitive nature of the study. It is assumed then, that the sensitive nature of the study may also have affected the number of participant responses to the survey; both in instrument return rates and volunteer rates for observations and interviews.

External validity was also a concern in this study due to the inability to generalize outside the population from which the sample was taken. Although efforts were made to limit this threat by random selection of a large population, all inferences should be limited to Oklahoma teachers affected by the legislation. A serious threat to the construct validity of this instrument was the fact that teachers may have responded defensively to the instrument. Teachers who believed that the legislation questioned their competence may have responded because they wanted to defend their competence (Creswell, 2002). In order to address validity concerns, schools were randomly selected and all teachers of those districts were asked to participate, including secondary trained teachers who were not affected by the legislation.

Overview

Chapter I of this study began with a brief introduction describing the origin and theoretical foundation of middle schools and ends with a description of the progress made since that time. Following the introduction is the problem statement, purpose of the study along with research questions, significance of the study, and finally, assumptions and limitations. Chapter II will introduce the problem and continue with a discussion of the relevant literature. The Chapter III describes the participants in the study, instruments, and the design and procedures to be used in the study. Results of both quantitative and qualitative analysis will be presented in Chapter IV, and Chapter V will present conclusions along with recommendations for future study.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

In order to examine teacher self-efficacy, professional development and its relationship to efficacy, and classroom practice several areas of research are relevant. First, because the legislation is specific to elementary trained middle school mathematics teachers, it will be necessary to examine the development of the middle school along with reform efforts and details of the mathematics taught at the middle school. Also, in considering teachers' classroom practice and confidence in teaching, it is necessary to research best practice in mathematics instruction and the mathematics preparation of elementary trained teachers. Finally, to study teachers' self-efficacy and how it may be affected by reform, the review will need to include literature related to both self-efficacy and professional development. Therefore, the literature review will include the following topics:

1. History and reform of the middle school;
2. Mathematics in the Middle School;
3. Best Practice in the mathematics classroom.
4. Mathematics background and preparation of elementary certified teachers;

5. Factors influencing and effects of teacher self-efficacy and outcome expectancy;
6. Factors influencing and effects of professional development.

History and Reform of the Middle School

Since the development of the middle school movement, there have been many changes in both grade structure and organization of middle schools. Middle level education has continued to grow and shift focus as research on adolescence grows. Williamson (1996) emphasized the need for exceptional educators who understand and can respond appropriately to adolescents who are in an explosive period in their development as individuals. The emphasis on specially prepared educators was stressed in the 1989 Carnegie Council on Adolescent Development report, *Turning Points: Preparing American Youth for the 21st Century*. This report recommended the following changes that could be implemented to transform middle level education:

- Organize schools into smaller cohorts of students so adult and student interactions are based on respectful relationships essential for academic development and personal growth.
- Educate students within a program that supports literacy, the sciences, and critical-thinking skills that challenge students to become healthy, ethically responsible, and tolerant citizens.
- Shift the emphasis from homogenous to heterogeneous classes; use flexible instruction, provide sufficient resources, and realize the value of peer tutoring and cooperative learning to ensure success for all students.

- Give teachers and administrators the power to make decisions to structure the curriculum to meet the needs of middle grade students.
- Employ teachers who are specifically qualified and have demonstrated an ability and competence to teach middle grade students.
- Enhance academic performance by promoting good physical health for students.
- Actively support family involvement in school governance and all aspects pertaining to the academic success of students.
- Promote and support meaningful partnerships between schools and communities so that students' success is a mutual responsibility.

While progress continues, in a study by Scales (1992), teachers identified areas still needing improvement including a more in-depth understanding of content. Initiatives such as in-service training, workshops and seminars to provide middle school teachers with needed content expertise have been the focus of much research. Particular attention has been devoted to issues such as teacher empowerment, the role of technology, cultivation of teaching dispositions, and methods of instruction (Leutzinger, 1998). There are few studies however, that address the effects of new mandates on middle school teachers' self-efficacy towards mathematics and their teaching of mathematics.

Mathematics in the Middle School

Middle school mathematics education has been highlighted as a concern in mathematics education beginning as far back as the publication of *A Nation at Risk*

(National Commission on Excellence in Education, 1983). More recently, the congressional report, *Before It's Too Late* (National Commission on Mathematics and Science Teaching for the 21st Century, 2000), cited statistics from the *Third International Mathematics and Science Study* (U.S. Department of Education, 1999), to stress that while U.S. students in the fourth grade were among the top nations in mathematics, they were near last by high school leaving the middle grades as a prime focus. In particular, the report identified the core of the problem to be classroom instruction, and students being taught by unqualified and underqualified teachers at many schools. Among suggestions made in this report is the need to increase the number and quality of mathematics teachers, and initiate a system to improve the quality of mathematics instruction. Sunley (National Science Foundation, 2000), specified in her NSF report that results from the *Third International Mathematics and Science Study Repeat* (U.S. Department of Education, 2000) confirmed a need for stronger mathematics preparation of teachers who teach in middle schools where curricula is weak and teachers often unprepared.

For this reason, enhancing middle grades mathematics is a primary focus in many reform efforts. At the middle school level, curriculum and instruction tend to center around an authoritarian model and is generally textbook driven (Madsen & Baker, 1993). In particular, current curriculum fails to build the foundation necessary for the study of algebra leading to failure when students are forced into a symbolic environment in later grades (Phillips & Lappan, 1998). Most current reform efforts strive to address changes in both teacher beliefs and classroom practice by promoting the *Professional Standards for*

Teaching Mathematics (NCTM, 1991) as a tool to impact the way mathematics instruction is implemented (Madsen & Baker, 1993).

In addition to the need to enhance teacher preparation programs, the congressional report, *Before It's Too Late* (National Commission on Mathematics and Science Teaching for the 21st Century, 2000), emphasized the need for continual professional development for teachers. The report defines professional development as an ongoing, continuous collaborative process planned to help teachers extend their content knowledge, improve teaching skills, promote awareness and contributions to new knowledge to the profession, and strengthen their ability to assess student learning. The influence of these reports can be seen in the recent increase of research and professional development funding for middle schools.

NCTM *Standards* and Best Practice In the Mathematics Classroom

While "best practice" is a common phrase used in many reform efforts, many are based on the framework established by the *Professional Standards for Teaching Mathematics* (National Council of Teachers of Mathematics, 1991). The six standards presented by the organization include the following:

- Worthwhile mathematical tasks;
- The teacher's role in discourse;
- The student's role in discourse;
- Tools for enhancing discourse;
- The learning environment;

- The analysis of teaching and learning.

Recommendations by the Carnegie Council on Adolescent Development (1989) reflect the same needs as those cited by the NCTM:

- Guide individual, cooperative group, and whole-class activities;
- Use technology in ways that promote learning;
- Help students make connections between previous and developing knowledge;
- Select motivating tasks that deepen students' understanding of mathematics and its application;
- Develop in all students the ability to communicate using mathematics, to make connections between mathematical ideas and other disciplines, to reason mathematically in a variety of problem solving situations, and to live and work productively in a multicultural society. (p. 46)

According to Pechman (1991), the effects of implementing these standards for effective mathematics instruction can be observed in the mathematics classroom. Specifically, students will be engaged in a learning environment designed to encourage inquiry and analysis. More distinct indicators of best practice include changes in physical facilities, classroom climate, student voice and involvement, instruction and activities, classroom communication, time allocations, student assessment, and teacher attitude and initiative (Zemelman, Harvey, & Hyde, 1998.) While these indicators encompass all aspects of the classroom experience, all are student centered. The purpose is to create a classroom whose main focus is student achievement and success, modes of communication and activities that promote that success, and a physical environment depicting and encouraging student success. To achieve this goal of best practice, teachers need to build a classroom structure that supports more student-directed activity, and make teacher-guided activities both less prevalent and more successful (Zemelman, et al, 1998).

Mathematics Background and Preparation of Elementary Certified Teachers

Any type of reform in the middle school must take into account the background and training of the middle school mathematics teacher. Despite years of encouragement for middle level preparation programs, most middle schools are still staffed by teachers trained for either elementary schools or secondary schools (Alexander & McEwin, 1989; Epstein & Mac Iver, 1990; Valentine et al., 1993). Past research has found that the mathematical background and preparation of elementary teachers provides a dismal picture of mathematics education when those same teachers are placed in the middle schools. This is primarily due to the neglect of research in innovative mathematics preparation for middle school teachers, the inadequacies of elementary preparation programs, the college professors who teach those courses unwillingly, and students who enter the program with weak mathematics backgrounds and high levels of mathematical anxiety. The elementary teacher's mathematical preparation is in fact, the "weakest link in our nation's entire system of mathematics education" according to Hungerford (1994).

According to a study by Rech, Hartzell and Stephens (1993), elementary education majors not only had inferior backgrounds in almost all areas of mathematics compared to the general college population, but also had less positive attitudes towards mathematics. To compound the problem, while the recommended curriculum stated in the

Standards for Teacher Preparation (NCTM, 1991), for teacher preparation in grades 5-8 is 15 semester hours of mathematics, many states including Oklahoma require fewer courses. Similarly, in her study of elementary mathematics teachers in the U.S. and China, Liping Ma (1994) found no group of U.S. teachers that possessed what she called a "profound understanding of fundamental mathematics" (p. 120). She found that while U.S. teachers were concerned with "doing" mathematics, Chinese teachers were concerned with developing a deeper understanding of the mathematics. Finally, Ma emphasized that in order to improve students' mathematics education, it is imperative to improve their teachers' mathematics understanding and knowledge.

Sowder, Philipp, Armstrong, & Schappelle (1998) also found that middle school teachers' knowledge of mathematics was shallow and existed only on a symbolic level. The teachers' ability to teach only at a superficial level stems from the lack of opportunity to explore content in their own mathematics preparation. Furthermore, this problem is reinforced by the lack of opportunities in professional development for teachers to develop a deeper understanding of mathematics.

Insufficient preparation leads teachers to feel inadequate and incompetent with regard to mathematics thus causing the teachers to assume that their negative experiences are a reflection of the essentially useless content of mathematics. Those negative experiences are then transferred to ideas related to the teacher's role, who can learn mathematics, and what it takes to learn mathematics (Ball, 1996). Furthermore, since the elementary teacher plays a key role in developing a student's appreciation of mathematics, elementary teachers with insufficient content knowledge and little interest in mathematics are likely to pass those poor attitudes on to their students (Hungerford, 1994).

Factors Influencing and Effects of Teacher Self-Efficacy and Outcome Expectancy

Teachers' mathematical abilities and attitudes are critical elements of the classroom environment (Hungerford, 1994). Since teachers' attitudes can positively contribute to student leaning and understanding, they are the most important basis for teachers' feelings of efficacy (Ball, 1996). Efficacy in general, as explored by Bandura (1977), is a measure of the effort people are willing to expend and how persistent they will be in attempting to overcome obstacles and adverse experiences. He argued that behavior is influenced by each individual's beliefs pertaining to types of expectations, outcome expectation and efficacy expectation. In respect to teacher efficacy, researchers (Ashton & Webb, 1986; Gibson & Dembo, 1984; Woolfolk & Hoy, 1990) have labeled the two beliefs in various ways including personal efficacy, general efficacy, teaching efficacy, and personal teaching efficacy. In relation to any measurement however, the distinction is critical since the belief that certain actions can produce certain outcomes is affected by whether one believes they have the abilities necessary to perform and affect those outcomes (Bandura, 1977). Personal efficacy is in reference to an individual, and is a self-attribution that is situation specific (Smith III, 1996).

In reference to Bandura's (1977) distinction between outcome and efficacy expectations, efforts to construct a subject specific efficacy beliefs instrument in science education by Riggs & Enochs (1990), focused on the areas labeled as (1) Personal

Science Teaching Efficacy and (2) Science Teaching Outcome Expectancy. Likewise, the Mathematics Teaching Efficacy Belief Instrument adapted from the science instrument uses much the same labels: (1) Personal Mathematics Teaching Efficacy (PMTE) and (2) Mathematics Teaching Outcome Expectancy (MTOE). Specifically, the PMTE refers to a mathematics teacher's belief in his or her own ability to teach effectively, and MTOE refers to the belief that effective teaching can positively affect student outcomes (Enochs, Smith, & Huinker, 2000).

There are also certain attributes that have been found to be predictors of teacher efficacy including self-perceptions of teaching competence (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998), experience, and higher levels of education (Hoy & Woolfolk, 1993). Raudenbush, Rowen, & Cheong (1992) found that teachers of honors or academic track classes had higher efficacy measures than those that taught non-tracked or higher level classes particularly in mathematics and science. DeMoulin (1993) found interrelationships among motivation, confidence, and stress in determining self-efficacy. He also found that shifts in those variables coincided with the degree to which self-efficacy impacts teacher performance effectiveness.

A teachers' sense of personal efficacy is considered as a strong influence in their classroom practice and instructional decisions (Fennema & Franke, 1992; Lubinski & Vacc, 1994; Pajares, 1992). In particular, according to Thompson (1984), observed consistencies between the teachers' perceived perceptions of mathematics and the method in which they normally presented the content, clearly indicate that the teachers' ideas, beliefs, and preferences about mathematics substantially impact their instructional practice. In addition, Gibson and Dembo (1984) found that teacher efficacy might have some bearing on patterns of classroom activities related to higher achievement levels for students.

Teacher efficacy is also critical to teacher expectations, classroom practice, and student achievement. Even teachers, who believe that their activities in the classroom can produce certain student-related outcomes, or outcome expectancy, may not be induced to perform those activities if they lack confidence in their ability to perform the activities at what they perceive to be an effective level (Coladarci, 1992). Research has continued to find evidence.that teacher efficacy and outcome expectancy is related to student achievement (Ashton & Webb, 1986; Dembo & Gibson, 1985; Gibson & Dembo, 1984), and that students are likely to be influenced by their teachers' beliefs about teaching and learning mathematics (Crater & Norwood, 1997). In other words, teachers with low levels of self-efficacy transfer to their students feelings of inadequacy and anxiety towards mathematics. Teachers with high levels of self-efficacy, however, create within their students the belief that they can learn mathematics.

Additionally, teachers' sense of efficacy is related to the effort they put into teaching, the goals they set for themselves and students, and how receptive they are to new ideas and willingness to experiment with different methods of instruction (Guskey, 1988; Stein & Wang, 1988). Specific to teachers with a high sense of efficacy is a stronger commitment to (Coladarci, 1992) and enthusiasm for teaching (Guskey, 1984), a tendency to be more organized and less likely to refer students for special education (Allinder, 1994), and a willingness to work longer with students having difficulties (Gibson & Dembo, 1984). Finally, teachers with higher self-efficacy are more likely to be receptive to formal change and staff development programs (Coladarci, 1992; Guskey, 1988; Tschannen-Moran, Woolfolk, Hoy, & Hoy, 1998), but since new standards and expectations challenge existing teacher beliefs and lower their confidence, training should provide needed support through this period of change (Guskey, 1986).

Factors Influencing and Effects of Professional Development

Characteristics of quality professional development needed to effect change, according to Koency and Swanson (2000), include a mixture of shared experiences that assimilate pedagogical skills, assessment tools, and content knowledge. The researchers add that an important part of professional development often missing is the focus on content knowledge for mathematics teachers. Furthermore, improvements in student performance must follow a change in the quality of teaching in the mathematics classroom. Finally, improvements in mathematics teaching must originate in quality educational programs and be sustained and enhanced by professional development.

Part of the challenge of structuring professional development stems from the difficulty of changing the conditions under which teachers practice. Recent research indicates that teachers are better able to meet new challenges to improve their practice when they have opportunities to work and learn together, and keep abreast of new research and development in mathematics instruction. Changing the conditions under which teachers practice through professional development in this way can improve teachers' confidence and competence in their practice (NCTM, 2000).

Professional development should recognize teachers' anxiety about mathematics, and address ways of overcoming that anxiety through extended in-service programs that include time to reflect on their explorations, and opportunities to verbalize their changing values about mathematical knowledge and teaching mathematics (Irwin & Britt, 1994). Guskey (1986) however, suggests teachers' beliefs and attitudes are changed only after they witness changes in student achievement. He contends that teachers who gained evidence of improved student outcomes expressed more optimistic attitudes with respect to teaching and greater personal accountability for their students' learning – very much like a sense of self-efficacy.

Summary

Teachers' prior beliefs and experiences interact in the process of learning and affect what they learn. More importantly, the contexts in which teachers' work is thought to affect, hamper, and restrain teachers' efforts (Ball, 1996). The process of professional development that can support teacher learning, self-efficacy and classroom practice is a complex issue based and dependent on a multitude of variables. Enochs & Huinker (2000) argue that limiting the preparation of mathematics teachers to content and pedagogy is insufficient. Additionally, "They must acquire richer knowledge of subject matter, pedagogy, and subject-specific pedagogy; and they must come to hold new beliefs in these domains" (Borko & Putnam, 1995, p. 60).

The most currently acknowledged framework related to effective teaching is the *Professional Standards for Teaching Mathematics* (NCTM, 1991). These *Standards* reflect the principle that successful mathematics teaching necessitates an insight into what students know, what they need to learn, and the need to challenge and support that learning. The *Standards* also represent new methodologies and approaches to teaching that necessitates change for many teachers, change that is inevitably dependent on and affected by teachers' self-efficacy.

CHAPTER III

THE RESEARCH DESIGN

Introduction

This investigation utilized a mixed-methods model to investigate the problem. A quantitative and qualitative study was designed to examine differences in teachers' self-efficacy and classroom practice for three groups of teachers. This chapter addresses the characteristics of the sample and subjects, instrumentation, and the study design and procedure. The study focused on the following research questions:

1. Does self-efficacy and outcome expectancy differ for the three (elementary certified choosing the certification test, elementary certified choosing endorsement through professional development, and secondary certified mathematics teachers) groups of teachers?
2. Is there a difference in classroom practice (as measured by integration of NCTM *Standards*) and confidence in teaching for the three (certification, endorsement, and secondary) groups of teachers?
3. In what ways do teachers feel personally affected by the state mandate?

Subjects

Subjects involved in this investigation were seventh- and eighth-grade middle school mathematics teachers from 11 Oklahoma school districts, including two of the largest districts in Oklahoma with student populations of over 40,000. Letters, directed to school superintendents, requesting permission to survey teachers were mailed to 45 school districts randomly chosen from all Oklahoma school districts. From those 45, 11 school districts granted permission for the study with the request for research results at the conclusion of the study. There were two school districts that declined permission due to the sensitive nature of the study.

Most school districts requested that contact be made with each individual school principal or dean of instruction. Packets were then mailed to the principal or dean of instruction for distribution to every 7th and 8th grade mathematics teacher. Each packet contained the Mathematics Teacher Efficacy Beliefs Instrument (MTEBI), a researcher-designed questionnaire, a self-addressed stamped envelope for return to the researcher along with a letter to the teachers requesting their participation in the study. Two school districts preferred to copy the instruments, and arrange the distribution and return of the instruments themselves. One school district provided the researcher with a list of teachers, and packets were mailed directly to those teachers.

Because two schools copied the packets and distributed the instruments themselves, the exact number of packets distributed to teachers is unknown, although an approximate number is 170, a response rate of 36%. Of the 61 instruments returned, five were incomplete and not included in the study. The remaining 56 participants included

11 males and 45 females, 26 elementary certified and 30 secondary certified teachers. Since only 20 of the 56 instruments were from the two largest districts, they are not considered to unduly influence the results of the study. The mean age of participants was 41.5 (SD = 9.879, N = 56). The participants described themselves as white with no ethnicity specified (75%), African American (16%), American Indian (7%), Asian (3.5%), while 3.5% preferred not to respond to ethnicity. The average experience in years for all participants was 12.4 (SD=9.182, N=56).

Observations and interviews were conducted with two teachers from each group, all of which were female. Both teachers in the first group, elementary trained choosing endorsement over certification, were near retirement having taught more than 20 years. Jennifer had a Bachelors degree with a standard certificate in elementary education. Her background in mathematics consisted of two courses in mathematics for elementary teachers, two methods courses, and courses in college algebra and geometry. Debbie had a Masters degree in education with a standard certificate in elementary education. She had taken two courses in math for elementary teachers, three courses in teaching methods, but no coursework in college algebra or higher-level mathematics. Both Jennifer and Debbie plan to retire within 2-3 years. Neither teacher has attended the professional development institute due to availability, but both planned to attend within the coming year.

The second group of teachers, elementary trained choosing the new certification, were newer to the profession than the first group. Neither teacher had taken the certification test, but both were planning to do so within the next month. Kelly had taught nine years and planned to continue teaching at least five more years. She has a Bachelor degree with a standard certificate in elementary education. Kelly had taken one course in math for elementary teachers, three courses in teaching methods and at least 15 credit hours beyond college algebra. Joan has taught 14 years and plans to continue teaching 14 additional years. She has a Bachelors degree with a standard certificate in elementary education. In addition, she holds a principal certificate and one in special education. Joan had only one course in math for elementary teachers, but did have coursework including college algebra, geometry, and calculus. Neither teacher has plans to retire in the near future.

The third group consisted of Erin and Susan, secondary trained teachers unaffected by the new legislation. Erin has been teaching three years, but plans to continue only ten more years. Her original certification was alternative, but she has since completed a Masters degree in secondary education with an emphasis in mathematics. Erin has 42 hours past college algebra, but only one course in methodologies. Susan is also alternatively certified. Her degree is in Mathematics and Statistics with 42 hours past college algebra, however, in addition she had three courses in teaching methodologies. Susan plans to teach at least 20 more years.

Only nine participants indicated their willingness through the questionnaire to participate in classroom observations and the interview. All nine were contacted to arrange interviews and observations but only six responded. Of those six, two from each group participated in observations and interviews. Demographic data for all participants is listed separately for each group in Table 1.

TABLE 1

DEMOGRAPHICS OF MIDDLE SCHOOL MATHEMATICS TEACHER PARTICIPANTS (N = 56)

Category	Endorsement	Certification	Secondary
Age			
Mean	42.1	37.5	42.7
Standard Deviation	7.9	10.2	9.8
Gender			
Male	0	0	11
Female	15	11	19
Ethnicity			
White	12	10	18
African American	2	2	5
American Indian	0	0	4
Asian	0	0	2
Not Reported	1	0	1
Teaching Experience (years)			
Mean	15.7	7.8	12.3
Standard Deviation	8.3	5.8	10.2
Math Hours College Algebra +			
Mean	3.0	1.8	18.3
Standard Deviation	2.9	1.9	12.3
Teaching Subject of Choice			
Yes	12	15	26
No	2	0	1
Teacher Groups			
Elementary Certified Seeking Endorsement		15 (26.8%)	
Elementary Certified Seeking New Certification		11 (19.6%)	
Secondary Certified		30 (53.6%)	

Of the 26 elementary certified participants, 11 were seeking endorsement by taking the state certification test, while 15 were seeking endorsement by attending the profession development institute. All participants were assured their participation in the study would remain confidential, and their return of the instruments served as an indication of their consent to participate. Participants who were willing to participate through classroom observations and interviews were asked to indicate their willingness by signing the questionnaire and providing contact information. Only nine of the 56 participants volunteered for observations and interviews. When later contacted however, three teachers failed to respond leaving six participants, two for each of the three groups of teachers. Subjects who participated in interviews and observations signed the required consent form. All subjects participating in the classroom observations and interviews were female.

Instrumentation

This study employed three instruments to collect data: the Mathematics Teaching Efficacy Beliefs Instrument (Huinker & Madison, 1997), a researcher-designed questionnaire, and the Mathematics Classroom Observation instrument (Pechman, 1991). In addition, qualitative data were gathered during participant interviews. After receiving approval from each school district, instrument packets were either mailed or hand delivered to individual schools for distribution in November, December, and January of 2002. Most instruments were returned before the end of December, however eight were received as late as February 10, 2002. All interviews and classroom observation were conducted the last two weeks of January. Data analysis began in late February 2002 with quantitative data first, followed by an analysis of the qualitative data.

Mathematics Teaching Efficacy Beliefs Instrument. The Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) is an instrument modified from the Science Teaching Efficacy Beliefs Instrument (Riggs & Enochs, 1990), by Huinker and Madison (1997) in researching preservice mathematics teacher efficacy. The instrument uses a Likert-type scale consisting of 21 items, 13 items on the Personal Mathematics Teaching Efficacy (PMTE) subscale, and 8 items on the Mathematics Teaching Outcome Expectancy (MTOE) subscale. Scores for the PMTE range from 13 to 65, and 8 to 40 on the MTOE. There are five response categories for each item: strongly agree, agree, uncertain, disagree, and strongly disagree. Eight items on the PMTE are negatively worded and were recoded before analysis. A copy of the instrument is included in Appendix A.

Reliability analyses, conducted by Enochs, Smith, and Huinker (2000), produced an alpha coefficient of 0.88 for the PMTE (personal self-efficacy) and 0.75 for the MTOE (outcome expectancy). A reliability analysis, using SPSS 10.0 (1999), in this study produced an alpha coefficient of .83 for the PMTE, .81 for the MTOE, and .73 for the complete MTEBI. Results of the reliability analysis, along with analyses for each individual group, are shown in Table 2.

Enochs et al. (2000) also evaluated factorial validity of the instrument by conducting a confirmatory factor analysis using a structural modeling program. That analysis showed a reasonably good model fit and indicated that the two scales, PMTE and MTOE, were independent.

TABLE 2

INSTRUMENT RELIABILITY ANALYSES:
ALPHA CRONBACH

		Coefficient Alpha
Mathematics Teacher Efficacy Beliefs Instrument		0.73
MTEBI All Participants	N = 56	
PMTE		0.83
MTOE		0.81
MTEBI Elementary Endorsement Group	N = 15	0.74
PMTE		0.86
MTOE		0.81
MTEBI Elementary Certification Group	N = 11	0.76
PMTE		0.92
MTOE		0.88
MTEBI Secondary Group	N = 30	0.72
PMTE		0.77
MTOE		0.77
Questionnaire Items		
Lecture Time and Standards (2 items)	N = 56	0.83
Classroom Practice (20 items)	N = 56	0.86
Confidence in Teaching Topics (10 items)	N = 56	0.89

(Fennema & Franke, 1992; Gibson & Dembo, 1984; Lubinski & Vacc, 1994; Pajares, 1992). For this reason, it was determined that classroom observations would be included in the study in an effort understand how those classroom practices and instructional decisions were related to teachers' self- efficacy in this specific context. Although the questionnaire completed by participants included a section regarding aspects of their classroom practice, it was determined by the researcher that classroom observations would yield more detailed images of teachers' classroom practices and competencies since self-efficacy is a reflection of self-perception of competence rather than a genuine level of competence, and individuals commonly miscalculate their own abilities (Tschannen-Moran, et al., 1998). Furthermore, teachers judge their self-efficacy in lieu of self-perceptions of teaching competence based on what they understand to be teaching task. What a teacher deems to be good teaching will influence how they judge themselves regarding self-efficacy and competence (Tschannen-Moran, et al.). For example, while the questionnaire asks participants to indicate how often their students use calculators in the classroom, responses were limited to regularity as in not at all, occasionally, or at least once a week. Observations however, allowed the opportunity to view the context in which calculators were used, whether calculators were used for computing purposes only, problem solving, or in exploration of new mathematical ideas.

Observations, performed by the researcher, were arranged at each teacher's convenience. All chose to have the observation prior to their planning period and interview. Observations were made during either one 2-hour block period, or two 50-minute class periods. Classroom observation data were obtained using an instrument developed by Pechman (1991) through the Mathematics Assessment Process for the

Middle Grades (MAP). The Mathematics Classroom Observation instrument is divided into three sections. The first section is designed to help describe the physical characteristics of the classroom. Items include seating arrangements for students, student work on display, and instructional materials and representations of mathematics in the classroom. The second section pertains to instructional processes. These items are meant to help describe interactions between and among students and the teacher. Examples of these interactions are student engagement and attentiveness, student participation in discussion and explanation, the components of the observed lesson, and verbal interactions between the teacher and students.

The last section contains general information related to the context in which students work, whether students work individually or in groups, and whether they use manipulatives to investigate problems. There are also several items in each section that pertain to the enthusiasm and competence of the teacher. Finally, the instrument contains a page for additional notes, comments, and extensions to aid in describing the observation. The researcher used this section extensively to record information for later analysis.

This instrument was structured according to the National Council of Teachers of Mathematics *Curriculum and Evaluation Standards for School Mathematics* (1989) and incorporates components of best practice. For this reason, the MAP instrument was considered to be the most appropriate instrument for this study. Although the instrument uses a likert-type scale and could be analyzed quantitatively, it was used in this study only as a guide in classroom observation, thus a qualitative analysis. The classroom observation instrument is included in Appendix C.

Questionnaire. The questionnaire was designed by the researcher to gather demographic data and other information previously found in the literature to be related to teacher self-efficacy. These items included teachers' age, experience, type of degree, certification level, their decision regarding choice of certification or endorsement, confidence in teaching certain mathematics topics, and aspects of classroom practice. Demographic data for all participants is listed in Table 1. Specifically, the questionnaire included a section to determine teachers' level of confidence in teaching several mathematics topics, another to determine instructional practice in the classroom related to NCTM Standards, percentage of time spent lecturing, and at what level they incorporated the NCTM Standards in their classroom practice.

Two likert-type scales were presented to assess teachers' perceived confidence and instructional practice. Teachers rated their confidence in teaching the following topics: fractions, decimals percents, ration/proportion, integers, probability, statistics, problem solving, algebra (full course), and geometry (full course). Each item ranged from 1=Not at all confident to 10=Very confident. Instructional practice was rated on the use of technology in the classroom along with manipulatives. These items ranged from 1=Not Available to 6=Daily use. Two other questions related to classroom practice included the level to which teachers believed they incorporated NCTM *Standards* in their classroom practice, and the amount of time spent lecturing. The question on *Standards* ranged from 1=Not at all to 10-completely, with additional space to mark "I am unfamiliar with the *Standards*." For the amount of time spent lecturing, participants were asked to respond on a scale of 10% to 100%.

Reliability analysis for those items yielded the following alpha coefficients: confidence in teaching = .89, classroom practice = .86, lecture time and standards incorporation = .83 (see Table 2). Validity issues were addressed in a number of ways. First, questions such as those related to confidence in teaching were separated into specific topics normally taught in middle school mathematics so that terms would be unambiguous and topics would not overlap. Second, teachers were given a likert-type scale from 1 to 10 on which to rate their confidence. Finally, multiple measures were taken through the use of the questionnaire, interviews, and observations to add credibility to any inferences drawn from the results.

The researcher-designed questionnaire also asked participants to respond to several questions. These questions were based, in part, on concerns and comments made to the researcher prior to the study by middle school teachers affected by the legislation. During several conversations, teachers expressed confusion about why Oklahoma legislators had taken this step and what they hoped to accomplish. Many teachers were angry and voiced the opinion that new testing and endorsement would have no effect on their competence as teachers of mathematics or on their classroom practices.

In light of that information, teachers were asked to indicate their choice of certification through testing or endorsement through approved professional development, whether they believed that choice would make them a better teacher of mathematics, and whether they believed they had the necessary training to effectively teach middle school mathematics. Additionally, teachers were asked whether they were teaching the grade and subject area of their choice, and whether they believed there should be a special teacher preparation program for middle school teachers. In comparing self-efficacy between the groups of teachers, it was also necessary to obtain information on their confidence in teaching mathematics and their classroom practice. Many researchers have found that a high level of efficacy has been linked to commitments to professional development and reform, including new and innovative approaches to teaching (Coladarci, 1992; Tschannen-Moran et al., 1998). Bandura (1997) theorized that people would be susceptible to question and doubt about their self-worth if they felt others did not value their abilities or their contributions to society. Research has also found that when people are required to perform a task for which they lack the skill, attempts to support and persuade them are more likely to intensify low self-efficacy (Gist & Mitchell, 1992). Thus, it was considered important to include questions on whether elementary certified teachers had chosen endorsement through professional development or certification through testing, whether they believed that this course of action would affect their competence, and how they felt personally affected by the legislation.

Space was also provided for any personal comments teachers elected to include. The questionnaire concluded with a request for interviews and classroom observations and provided space for contact information. Teachers were assured that their voluntary participation in interviews and classroom observations would be kept confidential. The names of all participants involved have been changed to maintain anonymity, and no districts have been identified. The questionnaire is located in Appendix B.

Interview. Prior to the study, the researcher had the opportunity to spend time with middle school mathematics teachers and came to realize that many of the teachers expressed emotional stress, anger, and confusion due to the legislation. Therefore, it was determined that the study would be incomplete without the voices of the teachers. The interview process provides an avenue toward individual perspectives and the opportunity for the researcher to ask for more detail on specific questions. So, in order to examine more closely the teachers' choices in regard to certification or endorsement, how the mandate may have changed their classroom practice, and how teachers' feel personally affected by the mandate, the following questions were addressed in personal interviews conducted by the researcher:

1. What led you to choose certification over endorsement? (endorsement over certification)
2. Do you believe your choice of certification/endorsement has affected you as a teacher of mathematics, or your beliefs about teaching mathematics? If so, how?
3. Do you believe your ability to teach mathematics effectively changed as a result of certification or endorsement? For example has there been a change in your content knowledge or your understanding of how children learn mathematics? If so, how?
4. Has your classroom practice changed as a result of certification or endorsement? For example, has there been a change in the methods you use to teach math? If so, how?
5. What are your personal feelings about the new mandate regarding certification and endorsement?

Interview questions for the group of secondary teachers were slightly modified from those structured for the elementary certified teachers. Since middle school teachers often form teams that work closely together, it was hoped that interviews of secondary certified teachers would yield yet another perspective related to the self-efficacy and classroom practice of elementary trained teachers. Interview questions for the secondary certified teacher group were as follows:

1. Are you aware of the new legislation regarding either certification or endorsement for elementary trained middle school mathematics teachers, and, if so, are you personally familiar with any teachers affected by the legislation?
2. What impressions have you received in regards to the attitudes of those teachers that are personally affected by the legislation?
3. Have you had the opportunity to observe classrooms or work closely with teachers affected by the legislation, and, if so, how would you describe any differences between your classroom practices and beliefs or attitudes about teaching?
4. What is your personal opinion of the new legislation? Do you believe it is necessary?

Research Design and Procedure

The 56 teachers responding to the questionnaire and MTEBI (Mathematics Teacher Efficacy Beliefs Instrument) were divided into three groups: (1) elementary trained who were certified or planning to certify under the new mandate (N=11), (2) elementary trained who were endorsed or planning to endorse under the new mandate (N=15), and (3) secondary trained teachers unaffected by the mandate (N=30). To answer research question 1 (Do personal self-efficacy and outcome expectancy differ for the three groups of teachers?) a one-way ANOVA, using SPSS 10.0 (1999), was used to compare group means between the three groups on self-efficacy and outcome expectancy, measures from the MTEBI. An ANOVA was also used to answer research question 2 (Is there a difference in classroom practice and confidence in teaching for the three groups of teachers) so that group means from the questionnaire related to confidence in teaching mathematics topics could be compared. One-way ANOVA's were conducted for confidence in teaching algebra, geometry, and statistics since those subjects are the only ones taught for high school credit, and for which the legislation requires certification instead of endorsement. All other topics are presented with group means.

Additionally, in an effort to provide a richer insight into the behaviors related to research question two, the differences in classroom practice and confidence for the groups of teachers, qualitative data from the questionnaires and interviews were analyzed. This qualitative analysis also provided the perspective necessary to examine individual cases in an attempt to answer research question 3, how teachers feel personally affected by the state mandate. According to Guba and Lincoln (1998), this qualitative perspective can help redress discrepancies and avoid ambiguities that occur when quantitative approaches fail to address contextual information and the meaning and purposes linking humans and human activities. This approach also helps address data that has no applicability to the individual case. The qualitative approach taken here parallels a constructivist paradigm in which trustworthiness and authenticity replace reliability and validity (Guba & Lincoln, 1998).

In collecting qualitative data two factors were of extreme importance. First, a research bias existed in that the researcher expected that secondary trained teachers and elementary trained teachers choosing certification would have higher self-efficacy and confidence scores than those of elementary trained teachers choosing endorsement. Additionally, the researcher supposed that secondary trained teachers would exhibit classroom practices more in line with NCTM *Standards* than those of elementary trained teachers.

The second factor under consideration was the researcher's bias that the legislation was warranted, and that elementary trained teachers were inadequately prepared to teach mathematics at the middle school level as has been found in previous research. In confronting these factors so that the research would be unprejudiced, the researcher attempted to approach both the data and individual teachers with an open mind. One particular concern was the necessity of establishing trust between the subject being interviewed and the researcher. In dealing with this concern, I tried to approach teachers in a neutral manner that acknowledged their awkward and disturbing situation, and my genuine empathy for them. As argued in the research, I could not "go native," but would remain the "other." I could however, attempt to represent the truth and authority of those represented by the study (Denzin & Lincoln, 1998).

To analyze the qualitative data, in relation to the three groups, teachers' interviews were taped. The interviews were then transcribed, cut, and pasted together for each interview question. The same was done for each question on the questionnaire. Descriptions relating to classroom observations were assimilated according to each section of the instrument. All documents were then read and reread until themes and sub-themes became apparent. These themes were color coded and revised at each of three additional readings until it was felt that the themes and sub-themes adequately represented the voices of the teachers (Creswell, 2002). Finally, pattern generalizations were developed in order to compare and contrast the data with literature from previous studies (Creswell, 1998).

Summary

This chapter discussed the methods and procedures used in the study to obtain data related to teacher reactions to state mandated reform. The study utilized a mixed methodology in data collection. Instruments included the Mathematics Teacher Efficacy Beliefs Instrument, a researcher-designed questionnaire, a classroom observation instrument, and interviews. Also included is a description of the subjects and details of how the data, both quantitative and qualitative, was analyzed. Results from the data collection are given in the next chapter.

CHAPTER IV

RESULTS

Introduction

The purpose of this study was to investigate the effects of a state-mandated reform on the self-efficacy, outcome expectancy, and classroom practice of three groups of middle school mathematics teachers. The study included elementary certified teachers who (1) chose to take the state mandated certification test, (2) those that chose participation in the professional development institute for endorsement, and (3) secondary certified mathematics teachers unaffected by the mandate since they met state requirements by passing the state advanced mathematics exam. Finally, the research attempted to understand teachers' decision process related to the mandate and their personal feelings in regard to the mandate. Mixed methodologies were utilized to study teacher choice in certification or endorsement, how the choice was made, differences in efficacy and classroom practice for those teachers, and how the teachers feel they have been personally affected by the mandate. The study focused on the following research questions:

1. Does self-efficacy and outcome expectancy differ for the three (elementary certified choosing the certification test, elementary certified choosing

endorsement through professional development, and secondary certified mathematics teachers) groups of teachers?

2. Is there a difference in classroom practice (as measured by integration of NCTM *Standards*) and confidence in teaching for the three (elementary certified choosing the certification test, elementary certified choosing endorsement through professional development, and secondary certified mathematics teachers) groups of teachers?

3. In what ways do teachers feel personally affected by the state mandate?

Research Questions

Research Question One

Do Personal Self-Efficacy and Outcome Expectancy Differ for the Three (elementary certified choosing the certification test, elementary certified choosing endorsement through professional development, and secondary certified mathematics teachers) Groups of Teachers?

The MTEBI (Mathematics Teacher Efficacy Beliefs Instrument) produced two scores for each participant, a personal self-efficacy score and an outcome expectancy score. Score means and standard deviations were calculated for all participants, and for each group (see Table 3). A one-way ANOVA was then performed to determine whether differences existed among the groups on these two dependent variables. Results from the

TABLE 3

MEANS AND STANDARD DEVIATIONS FOR THE MTEBI
(N = 56)

Category	Endorsement (N=15)	Certification (N=11)	Secondary (N=30)
PMTE	58.33 (5.2)	58.00 (5.6)	58.57 (4.6)
MTOE	25.30 (5.0)	28.36 (5.3)	25.58 (4.7)

Note: Standard deviations in parentheses.

ANOVA (see Table 4) showed no statistically significant differences among the three groups on either of the dependent measures.

TABLE 4

ANALYSIS OF VARIANCE FOR THE MTEBI
(N = 56)

Category	Source	*df*	*F*	*p*
PMTE	Between	2	.054	.947
	Within	53		
MTOE	Between	2	1.536	.225
	Within	53		

Note: á = .05.

Failure to find a statistically significant difference in personal self-efficacy is consistent with group means that suggested no differences. Outcome expectancy group means however, suggested that there might have been a difference between the means of the endorsement and secondary group (25.3 and 25.58 respectively) and the certification group (28.36).

Research Question Two

Is There a Difference in Classroom Practice (as measured by integration of NCTM Standards) and Confidence in Teaching for the Three (certification, endorsement, or secondary) Groups of Teachers?

Quantitative Data. In examining components related to the classroom practice, teachers were asked to rate their usage of a variety of methodologies recommended by NCTM and related to best practices. Variables measuring classroom practice included: use of computers (both teacher and student), use of calculators (both teacher and student), mathematical games, supplementary workbooks/resources, student projects, group work, and manipulatives: algebra related, base-10 blocks, Cuisenaire rods, dice, fraction bars/cubes/circles, geoboards, geometry construction, measurement instruments, pattern blocks, protractors, spinners, and 3-dimensional models.

A focus on the percentage of teachers from each group who incorporated these methods and manipulatives into their classroom practice at least once a week revealed a variety of differences in teaching methodologies among the groups of teachers (see Table 5). This data suggests that secondary trained teachers use the widest variety of teaching

TABLE 5

PERCENTAGE OF TEACHERS USING NCTM RELATED METHODOLOGIES AND MANIPULATIVES AT LEAST ONCE A WEEK

Category	Endorsement (N=15)	Certification (N=11)	Secondary (N=30)
Computer (teacher)	87	91	90
Computer (student)	13	36	23
Calculator (teacher)	60	82	57
Calculator (student)	27	45	33
Math Games	20	9	27
Supplementary resources	73	73	63
Student Projects	0	7	27
Group work	33	45	50
Algebra related	5	9	13
Base-10	0	0	3
Cuisenaire rods	0	0	3
Dice	0	9	10
Fraction bars/cubes/circles	0	9	0
Geoboards	0	0	0
Geometry construction	0	0	3
Measurement instruments	3	9	10
Pattern blocks	0	0	3
Protractors	0	9	7
Spinners	0	9	3
3-Dimensional Models	0	9	7

methodologies and manipulatives, since they indicated weekly use of 18 of the listed items versus nine for the endorsement group and 15 for the certification group. The data also implies that the secondary and certification groups use methodologies and manipulatives common to teaching algebra and geometry more often than did the endorsement group. Other areas that appear different for the groups were in student use of computers and calculators, student projects, and group work. The endorsement group indicated no weekly use of 11 of the 20 listed methodologies and manipulatives.

Teachers were also asked to indicate the percentage of class time spent lecturing and the level at which they incorporated the NCTM *Standards* into their classroom. The endorsement group had a mean lecture time of 28.3% (SD = 1.6), while the certification and secondary groups had mean lecture times of 39.5% (SD = 2.3) and 34.0% (SD = 1.5) respectively. The level at which teachers believed they incorporated NCTM *Standards* into their classroom practice was rated on a likert-type scale of 1-10. The endorsement group had the lowest mean rating of 5.67 (SD = 4.9), while the certification group had a mean rating of 6.05 (SD = 3.5) and the secondary group 6.77 (SD = 3.7). Approximately 27% of all elementary trained teachers and 20% of secondary trained teachers responded that they were unfamiliar with NCTM *Standards*.

In examining components of confidence in teaching mathematics topics, means and standard deviations were calculated for each group of teachers for all topics (see Table 6). These means suggested little difference among the groups with the exception of confidence in teaching algebra, geometry, and statistics. For this reason, and because these topics are the primary focus on the certification test, further investigation was

TABLE 6

MEANS AND STANDARD DEVIATIONS FOR CONFIDENCE IN TEACHING

Category	Endorsement (N=15)	Certification (N=11)	Secondary (N=30)
Fractions	9.87 (.52)	9.64 (.67)	9.70 (.62)
Decimals	9.53 (.52)	9.73 (.65)	9.80 (1.02)
Percent	9.60 (1.55)	9.45 (.82)	9.73 (.58)
Ratio/Proportion	9.53 (1.55)	9.64 (.67)	9.77 (.50)
Integers	9.60 (1.55)	9.64 (.92)	9.70 (.60)
Probability	8.73 (2.05)	9.27 (1.19)	9.33 (1.16)
Statistics	7.47 (3.00)	8.91 (1.22)	8.97 (1.25)
Problem Solving	8.67 (2.44)	9.45 (.52)	9.57 (.73)
Algebra	7.13 (3.07)	8.91 (1.38)	9.30 (.92)
Geometry	5.60 (3.60)	7.73 (2.33)	8.40 (1.69)

Note: Standard deviations in parentheses.

warranted. One-way ANOVA's (see Table 7) were then performed for confidence in algebra, geometry, and statistics to determine whether differences existed among the groups with Bonferroni (alpha = .005) follow-ups focusing on differences. Results from the ANOVA's revealed that secondary trained teachers had statistically significant higher means for confidence in teaching algebra ($p = .001$) and geometry ($p = .002$) than did the endorsement group.

TABLE 7

ANOVA FOR CONFIDENCE IN TEACHING
(N = 56)

Category	Source	*df*	*F*	*P*
Statistics	Between	2	3.459	.039
	Within	53		
Algebra	Between	2	7.258	.002*
	Within	53		
Geometry	Between	2	6.563	.003*
	Within	53		

Note: * $p < .005$.

Qualitative Data. In addition to the questionnaire, classroom observations were also conducted in order to gain a more in-depth perspective of teachers' classroom practice and confidence in teaching mathematics. Using an instrument developed in the Mathematics Assessment Process for the Middle Grades (Pechman, 1991), classroom observations focused on the physical characteristics of the classroom, teacher processes, and general information related to student involvement. Dates and times for all observations and interviews had been prearranged at the convenience of the teacher, and all took place during morning classes.

The physical characteristics of elementary trained teachers' classrooms were very similar. All had traditional seating arrangements; students sat in rows of individual desks. None of the classrooms displayed applications of mathematics, natural or artistic uses of mathematics, or student displays and/or projects representing the use of mathematics. One classroom had posters that displayed the basic operations of fractions and decimals. All others were attractively decorated, but failed to identify the classroom as a mathematics classroom. No manipulatives were noticeable in any of the classrooms.

Both classrooms of secondary trained teachers had posters that illustrated mathematic applications and natural uses such as patterns, symmetry, relationships, and graphic representations. One classroom was arranged using round tables while the other had single desks clustered into groups of three. Visible throughout each secondary teachers' classroom were a variety of instructional models and manipulatives. One classroom had stacks of boxes in various shapes and sizes on a shelf against the wall. Beside the boxes were a stack of measuring tapes and rulers, algebra tiles, and another box filled with geoboards. The second classroom had student-made 3-dimensional objects hanging from the ceiling. Adjoining this classroom was a large storage room filled with hands-on manipulatives such as algebra tiles, geoboards, mathematics games, and a box filled with dice and spinners.

The instructional processes observed in the elementary trained teachers' classrooms were also very much alike. All were traditionally structured with a short review of previous skills followed by worksheets and a homework assignment from the textbook. Students in these classrooms were not actively engaged in discussion, explanations, illustrations, or projects. Physical representations and manipulative materials were neither used by students, nor modeled by teachers.

Three of the four teachers and their students failed to use correct mathematical language in appropriate ways. In demonstrating a method for solving proportions, the words "ratio and equality" were never used. Instead, the teacher referred only to algorithmic procedure. "Times top number and bottom number and left to right." Another teacher's review of fraction division never used the terms, "numerator," or "denominator." Her instruction was: "flip the second number over, then times top numbers and bottom numbers."

Assessment, in the form of a written exam, was seen in only one of the classrooms. The assessment consisted of a textbook instrument meant to assess procedural knowledge of operations using fractions. After distributing the test, the teacher monitored the students, giving assistance when needed. Three students were observed making use of a calculator while taking the test. Four students were still trying to complete the test when the teacher began introducing the next lesson.

The classroom practice of the secondary certified teachers was marked by student involvement and activity. Assessment took place in both classrooms. One teacher gave an exam utilizing both a textbook reproduced test together with a hands-on demonstration of knowledge using algebra tiles. Throughout the hands-on demonstration, the teacher moved about the room questioning students. After the assessment, students were asked to share unique answers and demonstrate techniques. During the lesson that followed, students collaborated with each other and were active participants in guiding the instructional process.

The second teacher gave a short review on solving proportions in which students were active participants. The assessment that followed began with a cookie recipe being written on the board. Students were then told to convert the measurements using proportions, so that the recipe would yield one cookie per student. Students, working in groups, then used their measurements to make the cookies in class with the teacher questioning each student regarding their part of the project. This teacher used both students' written work and their participation in the project as an assessment tool. The secondary certified teachers also consistently encouraged alternate methods in problem solving, and were visibly enthusiastic in their teaching. No secondary certified teachers were observed using incorrect or inappropriate mathematical language.

Research Question Three

In What Ways Do Teachers Feel Personally Affected by the State Mandate?

In an effort to understand how teachers feel they have been personally affected by the legislation, qualitative data were gathered through the use of open-ended questions on the questionnaire and in personal interviews. The following question was asked on the questionnaire and in personal interviews: "How do you feel about the new legislation regarding endorsement and certification for middle school mathematics teachers?" Even before reading questionnaire answers, it was apparent that most elementary-trained teachers affected by the legislation were angry. With the exception of only four teachers, responses looked as if they were written with a great deal of physical pressure making deep indentions in the questionnaire. Many words were underlined, sometimes twice, to emphasize meaning. Comments such as the following often included repeated exclamation marks. From the questionnaire, one teacher wrote, "Unfair – After 28 years of teaching and attending colleges in math every 5 years – I resent the new certification!!" Jennifer, a teacher with 20 years of experience commented much the same during the interview: "I just don't understand! I'm a good teacher with years of experience and good reviews and evaluations. It's more than demanding I take a test; it's saying I'm not qualified. That's not fair!"

These comments capture the first of four main themes expressed in comments by elementary trained teachers, both in the questionnaire and in personal interviews. Teachers made repeated references to their experience and mathematics background as evidence to their competence and to the futility of the legislation. The experience and mathematics backgrounds for teachers making such comments, however, varied greatly. While the teacher quoted above had 28 years of experience teaching, another teacher with far fewer had the same attitude: "I question why, after teaching 5 years, they have decided that I am no longer qualified." Another teacher wrote: "It is ridiculous!!! After teaching middle school math for 8 years, now I have to pass the test to teach it?"

Conversely, many teachers admitted that while they lacked the mathematics background to pass the test, they knew "enough" to teach middle school. Two teachers commented that they chose endorsement because they did not have a strong mathematics background and believed they would fail the test. One such teacher wrote, "I've never even had college algebra, how am I supposed to pass the test? I'll do the endorsement because it's easier, my students can't do algebra anyway." This particular teacher had taught nine years and had not had prior coursework consisting of college algebra or higher-level mathematics. Several teachers indicated that they believed college coursework would be necessary before they would be capable of passing the test. One such teacher with 16 years of experience and no background in college algebra or above wrote: "I don't have time to go back to college to take algebra, geometry, and calculus AND I don't need it!"

The second theme found throughout both questionnaires and teacher interviews was an opinion that the legislation should include a "grandfather" clause so that only new teachers were affected by the legislation. Teachers with at least 15 years experience made the majority of these comments. A teacher of 22 years responded: "I feel that all present teachers should be grandfathered in just like all other subjects – no one else has been told to retest!" Similarly, in the interview Debbie with 28 years experience stated, "I was hoping that they would 'grandfather-clause' us old people that's been teaching for 20 years but unfortunately they didn't." Another teacher related her experience and success at teaching as a reason for the grandfather clause. She wrote: "I think for a person like me that has taught 24 years and been very successful at helping students at all levels that I should be grandfathered in. You can check any of my students scores before and after me and see why!"

Even teachers with few years of experience expressed the need for a grandfather clause. One teacher with only three years of experience wrote: "I've already taught for three years. We should be grandfathered in and testing started with new teachers."

Another teacher with only five years of experience saw success as a valid reason for the grandfather clause: "I've been well prepared and am a good teacher. There should be a grandfather clause for those already teaching."

This particular theme was also echoed by a few of the secondary certified teachers. One such teacher commented, "I feel that not every middle school teacher needs to be tested. There is no other core being retested to see if they are capable of teaching their core subject. I feel there should be a grandfather clause." The issue of mathematics being the only core affected by the legislation represents the third theme, and a major objection among elementary trained teachers.

This third theme that emerged from listening to teacher voices was an outcry about the unfairness of the legislation. Not only did teachers resent having their competence questioned, but they also expressed indignation at being singled out by the legislation as the only middle school teachers having to prove their competence. One such comment made on the questionnaire was, "Why are we the only teachers having to retest? What about science teachers and English teachers, they have the same preparation we do." Another teacher wrote, "Why the focus on math? We all have the same training, but only we math teachers are being attacked." Debbie, a teacher of 28 years, made this comment during the interview: "What about other teachers? Why just math teachers? I only have a few years left to teach, I won't stay longer."

That statement frames the fourth and most apparent theme in both questionnaires and interviews. Teachers, both secondary and elementary trained, continuously voiced a concern for the loss of teachers due to the legislation, and many stated their resolve to quit teaching rather than take the test. Their anger and frustration is obvious, as voiced in this statement of a secondary trained teacher: "I felt that we lost a lot of good, experienced teachers because of it, why make a bad situation worse?"

Comments from another teacher of 15 years summed up what many other angry teachers threatened,

> No wonder so many teachers leave Oklahoma. We're 50th in the national ranking in pay but expected to be first in training and performance. If I am required to take and pay for one more "test" by the state of Oklahoma to keep my job they can have it. I'll go to Arkansas or Texas.

Jennifer voiced a similar conviction during her interview: "Those of us that are close to retirement or have other certification will stop teaching math. The legislation will leave the state of Oklahoma very shorthanded."

While comments from elementary certified teachers are filled with anger and resentment, only four of the secondary teachers voiced the same concerns. The majority of secondary trained teachers, however, agreed with the need for teacher testing. Erin, a secondary teacher, commented during the interview that all elementary certified teachers needed a deeper understanding of mathematics and that endorsement should not be an option because "the PDI doesn't cover mathematics in depth. If teachers don't have a thorough knowledge of algebra, then neither will their students." Susan, another secondary teacher stated during the interview, "Teachers have to know more than the subject that they're teaching. The math taught in the elementary education program is very minimal. They need more and higher levels of math."

Most secondary certified teachers made similar comments in their responses to the questionnaire. One such teacher of 20 years commented on his experience working with elementary trained teachers and said, "The legislation is too long in coming. I feel that it was needed to hold teachers accountable for content knowledge." Another such teacher voiced her concern based on team teaching efforts with elementary certified teachers. She said, "My experience working with elementary trained teachers has shown they are not prepared to teach middle school. They should be certified because this forces the teachers to take higher levels of math classes in order to get certified." Finally, another teacher adds to this idea, "They should be held accountable. Most I've worked with have only a procedural knowledge of mathematics, and don't have the ability to prepare students for higher levels of math."

Like the secondary certified teachers, there were three elementary certified teachers who made positive comments about the legislation. One teacher commented that the legislative requirement would "force us to keep up in some of our weak areas," while another said that "expanding our math backgrounds (a necessity for taking the test) cannot help but make us better teachers, better for our students." These were the only comments by any affected elementary certified teacher that referenced the legislation in terms of student achievement. Finally, while these themes encapsulate the key viewpoints expressed by teachers, it should be noted that the dominant emotion overwhelmingly apparent in most responses was one of anger. Teacher responses were saturated with anger to the point of almost being visible.

Extended Results

In addition to the stated research questions, teachers were also asked to respond to several other questions. It was determined by the researcher that answers to these questions could help expand and broaden the research questions. Many of these answers were shadowed with the same anger and resentment as responses to the research questions.

Question One

Are you teaching the grade level and subject area of your choice? If no, why not.

Only four teachers responded negatively to this question. Two of the teachers were elementary trained. Both responded that they would prefer teaching 6^{th} grade or below, but that they had been placed against their wishes in different positions by their school districts. The second two teachers were alternatively certified. One teacher has a degree in Health and Wellness. She stated, "my true passion is health education, but it is rarely offered as a class." The other alternatively certified teacher holds an accounting degree. He was assigned to teach 7^{th} and 8^{th} grade math and pre-algebra, but would rather teach 6^{th} grade math.

Question Two

What led you to choose certification over endorsement, or endorsement over certification?

Only four of the 15 teachers choosing certification over endorsement stated a reason for their choice. One teacher said that she chose to take the certification test because she was from a small school district. She stated, "I don't have time to do the professional development, besides, if I don't certify our students won't be able to take algebra for high school credit." One teacher commented that she had already taken the test before she realized she had a choice, and the last two teachers referenced pressure from their school districts to certify rather than attend the professional development institute.

Endorsement through the professional development institute was chosen by 11 of the 26 elementary trained teachers. The most common reasons given for choosing endorsement dealt with time issues in preparing for the certification test and the teachers' lack of content background. Responses varied from "I chose endorsement because I didn't think I could pass the test" to "I chose the endorsement because there were many concepts on the test that I felt I needed to review and simply don't have the extended time to do so." Most, however, stated a firm conviction that they would not tolerate the insult to their competence. One teacher stated, "I will not take a test to prove what I have successfully taught for 20 years." Yet another teacher commented, "If they believe me to be incompetent I'll quit teaching, but I will not take the certification test!" Still another teacher wrote of choosing the endorsement route only after having taken the certification test twice and failed to pass. " I tried to pass the test twice, 76% and 78% were my scores. I had no choice but to take the professional development institute," she related in her comments.

Question Three

Do you believe there should be a special teacher preparation program for middle school teachers? If so, what types of courses would you deem necessary in regards to both content and pedagogy?

Teachers were also asked on the questionnaire to comment on the type of preparation they felt necessary for middle school mathematics teachers. Secondary certified teachers' comments centered around two themes: (1) the need for content knowledge and (2) the need for knowledge of instructional methodologies. Several secondary teachers commented on the need for teachers to have mathematics backgrounds that included college algebra and geometry as well as probability and statistics. Four secondary teachers echoed the comment of one teacher who stated, "Teachers should have mathematics as a minor or area of concentration."

Elementary certified teachers, however, felt either that no special preparation was necessary or that the preparation needed be specialized to adolescent psychology and classroom management. One teacher commented, "Teachers need more specific psychology courses or classroom management would be helpful, especially to beginning teachers." Another teacher emphasized the need for "special emphasis on the physical and emotional needs of middle school students." Most elementary certified teachers however, felt no additional special preparation was needed to teach middle school mathematics. One teacher commented that "classroom experience is the best teacher and resources and staff will assist in problems." Another teacher stated, "Courses can never prepare an effective teacher – [the] teacher's individuality and his/her mind set dictates her effectiveness. Trials and errors will shape what preparation is needed." Finally, one teacher commented that the only prerequisite for teaching any subject was that "you should like that age student."

Summary of Data Analysis

The purpose of this study was to investigate the effects of state-mandated reform on the self-efficacy, outcome expectancy, and classroom practice of three groups of middle school teachers. The study included teachers with elementary education backgrounds who (1) chose to take the state mandated certification test, (2) those that chose participation in the professional development institute, and (3) secondary certified mathematics teachers. Another purpose of the research was to attempt to understand teachers' decision process related to the mandate and their personal feelings in regard to the mandate. Both quantitative and qualitative data were examined to answer the research questions.

No statistically significant difference was found among the groups of teachers when considering self-efficacy and outcome expectancy. There were, however, differences found in classroom practice among the groups of teachers suggested by both quantitative and qualitative data. Secondary certified teachers had statistically significant higher means than did the endorsement group for confidence in teaching algebra and geometry. In addition, an examination of teachers' use of several types of classroom methodologies and manipulatives suggested differences among the groups in several areas. Secondary certified teachers appeared to use a larger variety of methods and manipulatives in weekly instruction. The data also suggests slight differences among the groups in the percentage of time spent lecturing, and in the integration of NCTM *Standards*. All groups contained several teachers who reported being unfamiliar with NCTM *Standards*.

The qualitative examination of classroom practice through classroom observations provided a more in-depth view of the teachers' practice. Observations of secondary teachers' classroom practice showed a variety of manipulatives in use and classroom discussions driven by student questions and discoveries. These classrooms were arranged for and supported a collaborative working atmosphere, and assessment took place in various forms. Secondary teachers appeared knowledgeable about their subject area, and both teachers used and expected appropriate mathematical language from their students.

The classroom practice of elementary certified teachers, as seen in classroom observations, was traditional in nature. Students' desks were arranged in rows and no collaborative efforts among students were observed. Teachers appeared textbook and worksheet reliant, and no manipulatives were seen either being modeled by teachers or used by students with the exception of calculators that were used during an exam. In addition, observations revealed elementary certified teachers and their students using inappropriate mathematical language.

In addition to classroom observations, teachers were asked to respond to questions regarding their personal feelings toward the legislation on both the questionnaire and in interviews. Comments made on the questionnaire and during one-on-one personal interviews underscore the anger and indignation most elementary certified teachers feel toward the new legislation. Their anger is visually apparent in written responses that were abundant with deep depressions in the paper, exclamation marks, and underlining for words such as "unfair" and "ridiculous." Many believed their success in teaching and years of experience should have exempted them from the legislation through a "grandfather" clause. There were also many teachers who commented on the potential loss of a number of classroom teachers due to the legislation.

Secondary certified teachers, for the most part, commented on the positive side of the legislation in regards to accountability for teachers and what is best for students. Most felt that the affected teachers needed a broader and deeper mathematics background. Several of the secondary teachers, however, also voiced a concern about the potential loss of teachers due to the legislation. They commented on the consequences, related to student interests, of losing many experienced teachers.

These results are discussed further in Chapter V. Additionally, conclusions are drawn, and implications of the findings and recommendations for further research are suggested based on the conclusions of the study.

CHAPTER V

CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS

Introduction

A high level of personal self-efficacy is considered to be a key predictor of middle school teachers who successfully participate in types of reform (Coladarci, 1992). Variables found to influence teachers' personal self-efficacy include teachers' mathematics ability and attitudes (Ball, 1996), self-perceptions of teaching competence, and experience (Tschannen-Moran, Woolfolk, Hoy, & Hoy, 1998). Additionally, interrelationships among motivation, confidence, and stress have also been found to be determining factors of personal self-efficacy (DeMoulin, 1993). Finally, teachers with higher levels of personal self-efficacy are more likely to be receptive to formal change and staff development (Coladarci, 1992; Guskey, 1988; Tschannen-Moran, et al., 1998), although new standards and expectations are likely to lower teachers' confidence levels (Guskey, 1986).

These theories suggest that teachers' personal self-efficacy, classroom practice, and confidence in teaching might be influential variables in relation to how teachers reacted to the new legislation. In particular, one hypothesis was that teachers choosing the certification test would have higher levels of personal self-efficacy, outcome expectancy, and confidence in their teaching than those choosing the professional development. A second hypothesis was that, passed on the above theory, teachers under the stress of new legislation would have lower or unstable personal self-efficacy measures. Within this framework, the study focused on the following research questions:

1. Do personal self-efficacy and outcome expectancy differ for the three (elementary certified choosing the certification test, elementary certified choosing endorsement through professional development, and secondary certified mathematics teachers) groups of teachers?
2. Is there a difference in classroom practice (as measured by integration of NCTM *Standards*) and confidence in teaching for the three (certification, endorsement or secondary) groups of teachers?
3. In what ways do teachers feel personally affected by the state mandate?

Summary and Conclusions

Research Question One Summary and Conclusion

The first research question sought to examine differences in teachers' personal self-efficacy and outcome expectancy among three groups of teachers: teachers with elementary education backgrounds who (1) chose to take the state mandated certification test, (2) those that chose endorsement through the professional development institute, and (3) secondary certified mathematics teachers unaffected by the legislation. Results of the ANOVA's (see Table 4 in Chapter IV) showed no statistically significant difference for either of the dependent variables personal self-efficacy and outcome expectancy.

Since prior studies have found that teachers' personal self-efficacy is often negatively affected by the stress of reform, these results suggest a conclusion not supported by previous research. There are, however, several factors that when considered together support rather than refute previous research results. Assuming the results are accurate and there is no actual difference in personal self-efficacy among the groups of teachers, it could be that these results do not support prior research because previous research was focused on voluntary participation in different types of reform efforts such as new instructional methods and assessment practices. No research was found that included the variable "forced reform," a variable that could add a new dimension to the relationship between efficacy and reform efforts. This new variable could be one that does not fit the model or relationship between teacher efficacy and reactions to reform efforts. Rather than refuting previous research on self-efficacy, it stresses the complexity of the issue.

A second consideration is, that while accurate, the results of this study do not support prior research due to the instrument utilized and its ability to measure personal self-efficacy. Recent research has found that self-efficacy is linked to specific classroom activities, and that teachers' beliefs are based on their perceived ability to perform those activities (Brouwers & Tomic, 2001). A support for this theory exists in the traditional classroom practice of the elementary certified teachers whose confidence and efficacy is supported by their reliance on a controlled classroom environment and their dependence on their textbook. Additionally, since outcome expectation directly impacts self-efficacy, teachers' personal self-efficacy may be protected from instability by high levels of outcome expectancy (McKinney, Sexton, & Meyerson, 1999).

Finally, a third consideration is that the results indicating no difference among teacher groups in personal self-efficacy and outcome expectancy may not at all be contrary to past research that found measures of self-efficacy tend to oscillate in times of reform. Since there were no self-efficacy or outcome expectancy measures taken before the legislation, it could be that the measures taken in this study had already changed, and were indeed in a state of fluctuation. This conclusion seems highly more likely due to other supporting evidence found in the study.

The first support for this conclusion is the qualitative data gathered for just this reason – to help explain and provide a clearer picture of this complex issue. Listening to the voice and perspective of an individual teacher changes the focus from the group to how each individual is affected by the legislation and what that means in terms of personal self-efficacy, classroom practice, and confidence in teaching. For instance, Victoria is an elementary certified teacher of 16 years and has a mathematics background of 18 hours in college algebra and higher-level coursework. Her self-efficacy measure was a score of 64, the highest of the group that chose to take the certification test. She rated her confidence in teaching as follows: statistics = 10, algebra = 10, and geometry = 10. In Victoria's case, high confidence ratings are aligned with her high efficacy rating as has been found in previous research. In response to the questionnaire, Victoria responded that she was strong in mathematics and knew she could pass the test.

Now consider Madison, a teacher of 13 years, who has chosen to attend the professional development institute instead of taking the certification test. Madison's mathematics background consists of only college algebra. Her self-efficacy rating was also 64, but her confidence ratings are much lower in comparison. She rated her confidence as follows: statistics = 6, algebra = 6, and geometry = 2. With lower confidence ratings and less hours in mathematics as preparation, Madison still has a self-efficacy rating equal to that of Victoria's. Madison's response to the question regarding choice of certification or endorsement indicated that she chose endorsement because she knew she would not be able to pass the test.

Another example is Spencer who has chosen the certification route and has nine years of experience. Her mathematics background includes 18 hours of College Algebra and higher-level coursework. Spencer's self-efficacy rating is a 51, which is the lowest of her group. She rated her confidence as follows: statistics = 10, algebra = 7, and geometry = 7. These ratings were also the lowest in her group. Here, again, a low self-efficacy rating is aligned with low confidence ratings. Spencer's comment on the questionnaire was that she felt well prepared to take the certification test because of her background in mathematics.

Jennifer, a teacher of 12 years, has chosen the endorsement route. Her mathematics background is 6 hours of College Algebra and beyond. Jennifer's self-efficacy rating is 50, the lowest of her group. Her confidence ratings, however, reflect a score of 10 for each mathematics topic. In this case, a low self-efficacy is not matched with low confidence ratings.

In both cases, teachers in the certification group had self-efficacy and confidence ratings that were parallel. The endorsement group's ratings of self-efficacy and confidence, however, did not correspond in the same manner. These seemingly conflicting findings may suggest compatibility to results in previous research that revealed fluctuations in teachers' personal self-efficacy within the stress of reform efforts.

According to Maddux and Lewis (1995), self-efficacy beliefs need not be accurate to be adaptive. Positive and optimistic distortion is not only the norm, but it is also healthy and beneficial in supporting an individual during an adjustment period.

A final view is that while it may have been expected that the endorsement group would have had lower self-efficacies than those of the certification group, that lack of difference may be due to what Prochaska, DiClemente, and Norcross (1992) described as the Precontemplation stage in the stages of change associated with self-efficacy. Individuals in this stage see no need for change and have no intention of changing. It is probable that because the elementary certified teachers believed that had the appropriate training and saw no need for the mandate they were unwilling participants in the reform effort and angered by the mandate.

Research Question Two Summary and Conclusions

To examine possible differences in classroom practice between the three groups of teachers, two sources were utilized. First, a self-rating of instructional methodologies was obtained from the teachers through the questionnaire. Teachers' ratings on a variety of instructional methods and uses of manipulatives suggested differences among the groups of teachers in both the variety and frequency of use. Specifically, secondary certified teachers indicated the greatest diversity in teaching methods, especially in tools commonly used to teach algebra and geometry. That difference is consistent with the finding that secondary teachers have statistically higher levels of confidence in teaching those topics. Finally, these findings are also consistent with data gathered through classroom observations which showed elementary certified teachers to be textbook reliant and severely limited in their use of methods and materials. In contrast, observations of secondary certified teachers' classroom instruction supported their self-ratings of instructional methodologies and manipulative use. So, while methodology self-ratings and observations were comparable for secondary certified teachers, they revealed marked differences for both groups of elementary certified teachers.

The second method used to measure differences in classroom practice was a teacher self-rating of confidence in teaching a variety of mathematics topics. In this case, statistically significant differences were revealed in teachers' confidence in teaching mathematics topics particularly in teaching algebra, and geometry. Secondary teachers showed higher confidence in teaching each of those topics than did elementary certified teachers choosing endorsement. This result seems logical since secondary teachers traditionally have more in-depth mathematics backgrounds.

Ironically, those same results were not reflected between elementary certified teachers choosing endorsement and those choosing certification. One might have expected a difference here since many who chose endorsement commented on their fear of not being able to pass the certification test. Once again, these contradictions may be attributed to both a distortion in confidence and the lack of need for change as seen by the endorsement group.

Research Question Three Summary and Conclusions

Based on the results of the study, one could conclude that most teachers affected by this legislation, whether choosing endorsement or certification, were confused, insulted, and angry over having been stripped of their endorsements and forced, once again, to prove their competency. This reactionary stance again reaffirms previously cited references to the discomfort and stress teachers feel in types of reform efforts.

Teachers' responses on the questionnaire and in interviews centered around 4 main themes. Most teachers defended their competence by referring to their experience and mathematics background. This defense was used by teachers having as few as 4 years and as many as 24 years of experience. Those teachers having very little mathematics background to a great deal of college mathematics used the same defense.

The second theme that emerged from the questionnaire and from interviews was the need for a "grandfather" clause for all existing teachers. Again, teachers promoted this issue regardless of their experience. There were even several secondary certified teachers who promoted a grandfather clause. This theme was shadowed by the idea that Oklahoma schools could loose teachers because of the mandate. Many teachers, again, regardless of their experience, were adamant about not taking the test, but instead were planning either to leave the profession or move to another state.

The third and strongest theme to emerge from teachers' responses was the way in which they interpreted the mandate as an unjust attack on current middle school mathematics teachers. Teachers repeatedly questioned why the legislation has singled them out as the only middle school content group who has to again prove their competence. The teachers' emotions were clearly evident on this issue given that many chose to emphasize their anger and confusion through their written responses which contained question marks, exclamation marks, as well as underlined words and phrases. The response of one teacher summed up all themes including the last – that of teachers willing to leave the profession rather than comply with the legislation:

> I am insulted that I have to take another test to prove my competency – it's unfair! No other teachers are required to do this. Why are math teachers being singled out by the legislation? Why is this necessary? I have already proven my competence by testing and years of experience. I may quit teaching, but I will not take another test!!

The threat of leaving the profession or moving out of state to teach was the fourth theme to emerge from teacher responses. While it was not the strongest theme, every group including secondary certified teachers voiced a concern over the potential loss of teachers due to the legislation. This potential loss of teachers could have very real and serious consequences for Oklahoma education.

Final Conclusions and Discussion

How did middle school mathematics teachers react to the new legislative mandate? As one might envision, teachers reacted with anger and confusion at having been stripped of their credentials. This reaction could be predicted for any professional group in the same circumstances. One cannot help but feel empathy for these teachers, but it is extremely important to attempt to understand more than their emotional responses. Should the state implement like changes in other disciplines using the same methods, what we have learned from these mathematics teachers could be a used to help prepare other teachers, and perhaps lessen negative responses from teachers. The findings of this study must be aggregated into a unified whole rather than provide a litany of emotional response from the involved teachers. The study results must be more than emotional accounts or statistical findings. We need to understand how teachers' personal self-efficacy, outcome expectancy, classroom practice, and confidence are related to that emotion and what can be done to support teachers involved in reform effort by way of professional development.

Though no significant differences were found in teachers' personal self-efficacy and outcome expectancy it is easy to justify the earlier assumption that change has either already occurred and that teachers' personal self-efficacy and outcome expectancy are in a state of flux as supported by the literature, or that a distortion of self-efficacy exists. However, since previous literature supports the decline of self-efficacy during reform efforts, we might conclude that the elementary certified teachers had pre-reform efficacy measures higher than those of secondary certified teachers. This supposition is also supported by findings from the classroom observations.

Classroom observations revealed elementary certified teachers to be lecture and textbook reliant, with no focus on progressive methods such as collaborative group work, hands-on instruction, or authentic assessment. Many have argued that teachers in the 'telling mode' who use textbooks to narrow procedures and practices maintain a type of control leading them to feel effective (Thompson, 1984). Because this procedural approach restricts the possibility of encountering student questions and problems that are beyond the teachers' abilities or make them feel less in control, teachers are able to accentuate their strengths while reducing their weaknesses (Borko, et al., 1992). Smith (1996) provides a realistic summation of the effects of this type of instruction mode on teacher efficacy:

> To sum up, teachers of mathematics, like all teachers, need to believe that their teaching actions have significant causal impact on their students' learning.

> Telling, irrespective of its pedagogical strengths and weaknesses, provides a clear model for teachers of mathematics to develop a sense of efficacy. Though good telling cannot guarantee that students will learn, it narrows the scope of the content to manageable proportions, clearly defines what the central acts of teaching are and what counts as evidence of student learning, and provides structure for daily classroom life. Teachers can feel efficacious when their students accomplish the reasonable tasks of remembering facts and computing with the standard procedures. (p. 391)

Since the elementary certified teachers in this study fit that model, we might expect that they would have had high levels of self-efficacy, perhaps higher than secondary certified teachers before the enactment of the mandate.

Likewise, while outcome expectancy showed no statistically significant difference among the groups, it is probable that like self-efficacy, outcome expectancy has already undergone change. It is not difficult to reason that teachers, who once felt that their actions in the classroom would produce specific outcomes, might now, due to their emotional state and the legislation, believe that outside influences have more control. Teachers may now exempt themselves from responsibility in student achievement by associating students' lack of success to factors outside the school (Guskey, 1981; Trentham, Silvery, & Brogdon, 1985). This view is emphasized by the comments of Jennifer during her interview:

> People feel that the reason why these children score so low in math is because of the teachers. They think we aren't equipped with the right skills to teach them. They never once think about could it possibly be the children and it might

possibly be the fact that it could depend on socioeconomic conditions, it could depend on maturity, it could depend on society, the family, but no it must be the math teachers.

Finally, while it was hoped that investigating personal self-efficacy, outcome expectancy, confidence, and methodologies might provide insight into how elementary certified teacher made their choice between endorsement and certification, that choice might have had more elementary roots. The demographic data provided by teachers revealed two interesting facts. The data suggests that teachers who chose the endorsement route had been teaching longer (15.7 years opposed to 7.8 years), and they were older (42.1 versus 37.5). It may well be that the influential factors in the choice of certification or endorsement were age and experience. Taken simply, the data suggests that teachers closer to retirement were less willing to undergo new certification mandates. Teachers whose responses indicated they would stop teaching before taking the test support this assumption. A second interesting fact revealed through the questionnaire is that 52 of the 56 teachers involved in the study are teaching the subject and grade of their choice, a finding contrary to the literature. Additionally, most reported that they believed they had received appropriate training to prepare them for teaching at the middle school level. Regardless of the fact that most research, including that of the National Middle School Association, believe secondary and elementary training to be unsuitable for a middle school teacher, the teachers in this study were almost all (96%) content with their placement.

In summary, these findings link each of the research questions together with the emotions of teachers. The emotional response to the mandate to meet new certification requirements affect teachers' efficacy, confidence, classroom practice, and choice of certification or endorsement. Teachers' emotional reactions help explain the inconsistencies between these findings and the literature on teacher self-efficacy. Results that should be aligned with previous research have been altered and reshaped by the forced reform movement and the emotional reactions it has generated.

Implications

What the results of this study suggests in terms of the Oklahoma teacher population is serious considering that a large number of Oklahoma teachers, 32%, are due for retirement in the next five years. A report commissioned by the Oklahoma State Regents for Higher Education (2002) concluded that 308 middle school and 736 high school mathematics teachers would need to be hired in the next five years to meet projected shortages. At the same time, the report confirms that there are no shortages in the production of teachers, only obstacles in hiring and retaining teachers. Those obstacles, which include low salaries, demanding work environments, and job opportunities in other professions, are the results of issues unrelated to teacher production.

The results of this study suggest another obstacle to hiring and retaining teachers lies in more rigorous certification testing. Moreover, if the new legislation is a trend to be continued in other disciplines, teacher shortages could escalate since shortages are also projected in science, art, music, special education and other areas. This research does not argue against previous research findings that elementary certified middle school mathematics teachers have inadequate mathematics backgrounds. What this research does question is the method used by the legislation to enhance teacher quality. The results, if teacher loss is one, are ones that Oklahoma can ill afford. Furthermore, while the legislation requires all new elementary certified mathematics teachers to take the middle level certification test in order to teach at the middle school level, no new middle school preparation programs have been initiated at the university level to prepare teachers.

Final Remarks and Recommendations

As cited throughout this research, most of the literature is in agreement that not only can efficacy be measured reliably, but also that efficacy can be influenced and predicted by a number of variables. One of the most cited factors to negatively influence efficacy is the uncertainty accompanied by reform. However, since the previous studies have been based exclusively on teachers' voluntary participation in reform efforts while this reform was mandated, the results should be viewed alongside, not against previous study results.

The new variable "forced reform" adds a new dimension to the literature on teacher efficacy. It is this researcher's opinion that differences in results between this research and previous studies are due primarily to this new variable - forced reform. In voluntary efforts, indecision and confusion play an influential role in how participants react to reform. Anger and resistance, however, mark this reform effort and focus attention on the question of how the reform could have been achieved without those negative aspects.

The first goal should be the development of a specific middle-level mathematics program in higher education to prepare teachers to be competent and confident middle school teachers. The results of this study have emphasized this need, which has long been argued by the National Middle School Association, but implemented by very few states. Aside from the current teachers affected by the legislative mandate, all new middle school mathematics teachers must pass the certification test, in most cases, without the benefit of adequate preparation. Without adequate teacher preparation programs, Oklahoma will face either a shortage of mathematics teachers in the middle schools or the need for more reform.

An ideal program to prepare teachers for middle school mathematics should include coursework in college algebra, geometry, trigonometry, probability, and statistics. These content courses should be taught using methodologies that integrate a variety of concrete models. This integration of content and methodology would allow future teachers to develop the in-depth understanding they need to help students develop a broad based knowledge of mathematics on which to build upon and make mathematical connections. These courses should also incorporate methods of assessment along with strategies for collaborative learning. Finally, the middle school program should include courses specific to the psychology of early adolescence.

At the same time, the needs of current teachers must be met. So, the second goal should be the process of making continuous professional development a natural part of a teacher's professional life. Professional development must play a part in helping teachers recognize the need for improvement and encourage that process. Teachers should have the opportunity to read, discuss, and reflect on new programs and research related to student learning, content needs, and new methodologies so that they come to understand, accept, and even anticipate the need for continual growth and professional development.

This should be a program encouraged and supported by school districts and the state department of education working together. Had this type of professional development been in place, the changes mandated by the Oklahoma Legislation could have easily been integrated into the program in a logical fashion.

That ideal system, however, does not exist in Oklahoma. Therefore, when the Oklahoma Legislature negated the credentials of teachers who had completed the required education and testing procedures required by Oklahoma when they began teaching, teachers were furious, as would be a doctor, attorney, or other credentialed professional. The most valuable and significant question arising from this study is how the desired improvement in teacher quality could have been accomplished within the present system, but without the volatile reactions observed in this study.

It is the researcher's opinion that the legislature, working through the Oklahoma Department of Education and the Oklahoma Commission for Teacher Preparation, should have first developed a plan for communicating to affected teachers the "need" for change so that teachers would have been more receptive to the mandate. Then, those teaching algebra or geometry for high school credit should have been given the opportunity, at the state's expense, to enroll in college coursework or programs specifically designed to prepare the teachers for the certification test. All other middle school mathematics teachers would be required to participate in a professional development institute with a focus on upgrading content and pedagogy. Additionally, and most importantly, this should have been required for teachers of every discipline to emphasize the importance of professional growth. While there would still have been a number of teachers disgruntled by the reform effort, most teachers respond positively when approached with the 'need' for change. Furthermore, positive responses, just like self-efficacy, affect professionals collaboratively.

What this study illustrates, a point emphasized by all the literature, is that teacher efficacy is complex, and affected or unaffected by many factors, and obviously situational. Future research recommendations include longitudinal case studies of teacher efficacy so that efficacy may be examined across various conditions including acts of reform both voluntary and forced, and any resulting effects in terms of student achievement. More research is also needed to examine in what ways the efficacy of elementary and secondary teachers develops and differs in specific situations. Most importantly, this research with both its similarities and contradictions to the literature, bears witness to the complexities of teachers' personal self-efficacy.

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APPENDIXES

APPENDIX A

MATHEMATICS TEACHER EFFICACY

BELIEFS INSTRUMENT

Mathematics Teaching Efficacy Beliefs Instrument

Date: ____________________ ID#: ____________________

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. 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 middle school mathematics.	SA	A	UN	D	SD
12. The teacher is generally responsible for the achievement of students in mathematics.	SA	A	UN	D	SD

Continued on reverse side

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

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 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 D SD concept, I will usually be at a loss as to how to help the student understand it better.		SA	A	UN	
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

Thank you!

APPENDIX B

TEACHER QUESTIONNAIRE

Middle School Mathematics Teacher Survey

Date: ____________________ ID#: ________________

PERSONAL

Age: ______ Gender: ____ M or ____ F Ethnic Background: ________________

Are you bilingual? ____ No ____ Yes, Languages: ________________________________

TEACHING EXPERIENCE

Number of years teaching experience: _______

Number of years teaching experience at the middle school level: ____

Number of years teaching mathematics: ____

Number of years you plan to continue teaching: ____

Math subjects currently teaching: ____

Subject areas previously taught: ____

Education – Degrees held – date received: ____

Certification: ____ Standard ____Alternative _____Out of state

Certification Area: ____ Elementary ____ Secondary ____ Middle School (check all that apply)

College Level Mathematics Taken: Math for Elementary Teachers ___ How many courses? ___

Teaching Methods ___ How many courses? ___ College Algebra ___ College Geometry ___

Calculus ___ Others: ____

Please use the given scale to rate your **Confidence** in teaching the following topics. Circle your choice.

1 = **Not at all** confident 10 = **Very** confident

Fractions	1	2	3	4	5	6	7	8	9	10
Decimals	1	2	3	4	5	6	7	8	9	10
Percents	1	2	3	4	5	6	7	8	9	10
Ratio/Proportion	1	2	3	4	5	6	7	8	9	10
Integers	1	2	3	4	5	6	7	8	9	10
Probability	1	2	3	4	5	6	7	8	9	10
Statistics	1	2	3	4	5	6	7	8	9	10
Problem Solving	1	2	3	4	5	6	7	8	9	10
Algebra (full course)	1	2	3	4	5	6	7	8	9	10
Geometry (full course)	1	2	3	4	5	6	7	8	9	10

Please use the given scale to rate (circle) your **frequency of use** for the following list.

	Not Available	Not used	Rarely	Occasionally	Once/week	Daily
Computers (your use)	1	2	3	4	5	6
Computers (student use	1	2	3	4	5	6
Calculators (your use)	1	2	3	4	5	6
Calculators (student use)	1	2	3	4	5	6
Mathematical games	1	2	3	4	5	6
Supplementary workbooks/resources	1	2	3	4	5	6
Student projects	1	2	3	4	5	6
Group work/collaboration	1	2	3	4	5	6
Manipulatives:						
Algebra related	1	2	3	4	5	6
Base-ten blocks	1	2	3	4	5	6
Cuisenaire rods	1	2	3	4	5	6
Dice	1	2	3	4	5	6
Fraction bars/cubes/circles	1	2	3	4	5	6
Geoboards	1	2	3	4	5	6
Geometry construction	1	2	3	4	5	6
Measurement instruments	1	2	3	4	5	6
Pattern blocks	1	2	3	4	5	6
Protractors	1	2	3	4	5	6
Spinners	1	2	3	4	5	6
3 –dimensional models	1	2	3	4	5	6
Others (list)	1	2	3	4	5	6
________________	1	2	3	4	5	6
________________	1	2	3	4	5	6

Please respond to the following questions.

1. Are you teaching the grade level and subject area of your choice? If no, why not.

____

2. If given a choice of teaching assignment, what grade level and subject would you choose?

____

3. How do you feel about the new legislation regarding endorsement and certification for middle school mathematics teachers?

____

____

4. Do you believe there should be a special teacher preparation program for middle school teachers? If so, what types of courses would you deem necessary in regards to both content and pedagogy?

____

____

If your certification is **Secondary** (high School) Mathematics, please skip to #8 and continue. Thank you.

5. Have you taken the Middle School Mathematics (Middle Level) Certification Test? ___ No ___Yes
If yes, how did you prepare for this test (self study, Professional Development…)? ________________

Did you ____Pass or ____ Fail

6. If you attended professional development, what aspects of the training were most beneficial?

7. Regarding the new endorsement or certification requirements for math, which did you choose, and what factors lead to that decision?

8. Do you believe the endorsement training or certification test will make you a better teacher? If so, in what way? If not, why?

9. Do you believe you have had the necessary training to be an effective mathematics teacher at the middle school level? Why or why not?

10. At what level do you incorporate the National Council of Teachers of Mathematics *Standards* into your classroom?

Not at all 1 2 3 4 5 6 7 8 9 10 **Completely**

_____ I am unfamiliar with the *Standards*

11. What best represents the amount of class time you spend lecturing?

__ 10% ___ 20% __30% __40% __50% __60% __ 70% __ 80% __ 90% __ 100%

Please use the following space for any comments you might like to make.

I very much appreciate your time and effort to help in this study. I would also like very much to further discuss your views on the above questions. If you would agree to a short **voluntary** interview and classroom observations (2) sometime in the Fall of 2001 or Spring of 2002, please indicate by signing below. Thank you again for your participation.

Sincerely, You have my permission to contact me for an interview.

Gwen D. Fholer

Signature Name (please print)

Phone and/or email

APPENDIX C

MAP: CLASSROOM OBSERVATION INSTRUMENT

MATHEMATICS CLASSROOM OBSERVATION

Observer______________________________

Instructions

*To ease the recording of your observations, the checklist on the following pages has been divided into three sections. The first section includes **physical characteristics of the classroom**. They should be noted while you are in the classroom. The second group of items includes **instructional processes** that should be marked as they are observed. The third group includes general items that need not be marked until after leaving the room. Mark each item once, regardless of how many times you observe it.*

SECTION I: Physical Characteristics of the Classroom

The following items describe characteristics of the classroom environment. They should be noted while you are in the classroom.

IDEALS	PHYSICAL CHARACTERISTICS OF THE CLASSROOM *Mark If Observed*	1	2	3	4	5	6	7	8	9	10	TOTAL
[D-5]	1. The seating arrangement in the classroom can best be described as:											
	a. Seating arranged in rows	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
	b. Seating arranged in semi-circles	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
	c. Seating arranged in clusters	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
[D-5]	2. Adequate numbers of textbooks and instructional materials are available for students to do their classwork.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
[E-4]	3. Student work is displayed on bulletin boards.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
[F-2]	4. On display are imaginative applications of mathematics such as patterns, numerical and spatial relationships, algebraic models, graphics, etc.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
[F-3]	5. The natural or artistic uses of mathematics (e.g., symmetry, balance, pattern in nature, graphic representations, shape and space manipulations, and constructions) are displayed in the classroom.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
[A-9]	6. Student displays and/or projects demonstrate the modern use of mathematics in many nations, including third-world countries.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
[I-8]	7. Instructional materials represent various racial and ethnic groups doing mathematics and/or related work.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

SECTION II: Instructional Processes

The following items describe interactions between students and teachers and among students. They should be marked as they occur, while you are observing the lesson. Regardless of how often they occur, mark them only one time per observation period.

IDEALS	INSTRUCTIONAL PROCESSES *Mark if Observed*	1	2	3	4	5	6	7	8	9	10	TOTAL
[B-1]	**8.** Most students' facial expressions and/or body postures reflect their active involvement, attentiveness, and/or interest in mathematics.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[B-1]	**9.** Students are actively engaged in doing mathematics. Mark all that apply:											
	a. Building and discussing models	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	b. Measuring or estimating	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	c. Working with manipulatives	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	d. Gathering and interpreting data	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	e. Making or reading graphs	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	f. Playing mathematical games	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	g. Debating	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	h. Explaining or demonstrating	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	i. Drawing diagrams	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	j. Writing about results	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	k. Using calculators	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	l. Using computers	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[B-4]	**10.** The students illustrate discussions and explanations using (mark those that apply):											
	a. Chalkboard or chartpaper	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	b. Overhead projector	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	c. Physical models or manipulative materials	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	d. Computer monitor	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	e. Written descriptions or journal entries	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[B-4]	**11.** Students' assignments use real-life mathematical applications or models, as well as numbers and algorithms.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[B-6]	**12.** Which of the following components of the teacher's lesson were observed? Please mark all that apply:											
	a. Review of previously introduced ideas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	b. Concept development	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	c. Skill development	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	d. Routine application problems	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	e. Non-routine problem solving	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	f. Homework assignment, explanation, or review	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[B-7]	**13.** Mathematics assignments include projects and/or problems that extend beyond the immediate classroom.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	14. Teacher's talk includes questions like the following (mark those that apply):											
[C-1]	a. Are there other valid solutions to this problem? What might be a different approach or strategy?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____

IDEALS	INSTRUCTIONAL PROCESSES *Mark if Observed*	1	2	3	4	5	6	7	8	9	10	TOTAL
[C-4]	b. Have we made an error here? Can you find my mistake?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[C-5]	c. What do you think? Why do you think that? How did you arrive at your answer? How can you prove to us that you are correct?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[C-2]	15. Teachers use estimation and/or hypothesis testing as tools.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[C-4]	16. Teachers help students take accurate notes, pose questions, organize materials, and in other ways improve their analytical skills.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[C-5]	17. In their discussions, students and teachers use correct mathematical language in appropriate ways.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[C-6]	18. Students give oral or written evidence of mathematical experiments, discoveries, processes, and/or strategies.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
[C-7]	19. Teachers give clear, concise explanations, adjusted to meet the needs of students who are confused or have questions.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[C-7]	20. Teachers listen thoughtfully to students and provide sufficient time for students to ask and to respond to questions.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[D-1]	21. Girls and minority students are full and equal participants in class.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[D-2]	22. Student groups reflect:											
	a. Racial/ethnic diversity	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
	b. Gender diversity	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[D-3]	23. Teachers accommodate students' special needs, abilities, and disabilities.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[D-5]	24. The classroom environment encourages participation by *all* students.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[E-4]	25. Teachers praise and reward all students, regardless of achievement levels, for their use of unique and inventive problem-solving methods.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[E-6]	26. Teachers respond to students' incorrect answers in a sensitive, constructive manner and, when appropriate, in private.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[F-5]	27. Teachers' comments link the assigned topics and students' past and future mathematics learning.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[F-1]	28. Teachers relate students' mathematical experiences to assignments in other classes and/or to students' lives outside of school.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[F-2]	29. Computational work is practiced in applied contexts, through games or by solving problems that relate to students' everyday lives.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____

IDEALS	INSTRUCTIONAL PROCESSES *Mark If Observed*	1	2	3	4	5	6	7	8	9	10	TOTAL
[F-5]	30. Teachers refer positively to careers that use mathematics and/or they encourage *all* students, regardless of gender or ethnic group, to consider entering these fields.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[G-1]	31. Teachers are visibly enthusiastic and positive about the material they are teaching.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____

Section III: General Items

The items in this section should be reviewed immediately after the classroom observation and marked if they were observed.

IDEALS	GENERAL INFORMATION *Mark If Observed*	1	2	3	4	5	6	7	8	9	10	TOTAL
[A-8]	32. Students demonstrate an understanding of the practical applications of mathematical terms, concepts, and/or algorithms.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[B-2]	33. Students use manipulatives to make the problems they are working on more concrete.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[B-3]	34. Students work individually on activities and/or assignments.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[B-3]	35. Students work cooperatively in small and/or large groups.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[B-5]	36. Students use computers for generating both mathematical problems and solutions (i.e., not just for drill and practice).	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[B-5]	37. Students use calculators for analyzing problems and finding solutions (i.e., not just for routine calculation).	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[C-3]	38. Students test out their intuitive mathematical rules or procedures.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[C-3]	39. Students invent problems, discover solutions, or engage in mathematical games.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[C-6]	40. Students discuss each others' logic and/or problem-solving methods and mathematical strategies.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[E-3]	41. Students help develop classroom expectations, rules, and procedures.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[G-1]	42. Teachers demonstrate understanding of the mathematical concepts they are teaching.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____
[H-5]	43. Parents and/or community representatives are visible partners, working with students in mathematics activities and programs.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	____

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Notes

Please add any comments or extensions of your observations that enhance your understanding of the activity and processes observed. Indicate the date and observation number, but do not record the name of the teacher observed.

APPENDIX D

INSTITUTIONAL REVIEW BOARD

APPROVAL FORM

Oklahoma State University
Institutional Review Board

Protocol Expires: 10/24/02

Date: Thursday, October 25, 2001 IRB Application No ED0236

Proposal Title: MIDDLE SCHOOL MATHEMATICS TEACHERS' REACTIONS TO STATE MANDATED REFORM: SELF-EFFICACY AND CLASSROOM PRACTICE

Principal
Investigator(s):

Gwen Fholer
6519 NW 11th
Oklahoma City, OK 73127

Dr. Patricia Lamphere-Jordan
247 Willard
Stillwater, OK 74078

Reviewed and
Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

Dear PI :

Your IRB application referenced above has been approved for one calendar year. Please make note of the expiration date indicated above. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved projects are subject to monitoring by the IRB. If you have questions about the IRB procedures or need any assistance from the Board, please contact Sharon Bacher, the Executive Secretary to the IRB, in 203 Whitehurst (phone: 405-744-5700, sbacher@okstate.edu).

Sincerely,

Carol Olson

Carol Olson, Chair
Institutional Review Board

VITA 2

Gwendolyn Darlene Fholer

Candidate for the Degree of

Doctor of Education

Thesis: MIDDLE SCHOOL MATHEMATICS TEACHERS' REACTIONS TO STATE MANDATED REFORM: SELF-EFFICACY AND CLASSROOM PRACTICE

Major Field: Curriculum and Instruction

Biographical:

Personal: Born in Tulsa, Oklahoma on December 15, 1956, the daughter of Franklin Leon and Frankie Charlene Davis.

Education: Graduated from Catoosa High School, Catoosa, Oklahoma in May 1975; received Bachelor of Science degree in Mathematics from Tulsa University, Tulsa, Oklahoma in July 1988; received a Master of Education in Secondary Mathematics from University of Central Oklahoma, Edmond, Oklahoma in August 1999. Completed the requirements for the Doctor of Education degree with a major in Curriculum and Instruction at Oklahoma State University in August 2002.

Experience: Raised in Tulsa, Oklahoma; taught mathematics in both Broken Arrow and Catoosa Public Schools. Employed as a Master Teacher in Residence at the University of Central Oklahoma as part of the Oklahoma Teacher Education Collaborative from 1997 to 2002.

Professional Memberships: National Council of Teachers of Mathematics, Oklahoma Council of Teachers of Mathematics (Board Member), Kappa Delta Pi.