Spring 2005

Differences in teacher qualifications and the relationship to middle school student achievement in mathematics

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DIFFERENCES IN TEACHER QUALIFICATIONS AND THE RELATIONSHIP TO MIDDLE SCHOOL STUDENT ACHIEVEMENT IN MATHEMATICS

By

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A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Education in Curriculum and Instruction

COLLEGE OF EDUCATION
LOUISIANA TECH UNIVERSITY

May 2005

LOUISIANA TECH UNIVERSITY

THE GRADUATE SCHOOL

May 21, 2005
Date

We hereby recommend that the dissertation prepared under our supervision by Carrie R. Ferguson entitled Differences in Teacher Qualifications and the Relationship to Middle School Student Achievement in Mathematics be accepted in partial fulfillment of the requirements for the Degree of Doctor of Education in Curriculum and Instruction

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GS Form 13
(5/03)

ABSTRACT

The purpose of the study was to compare mathematics teacher preparation and experience to the achievement of middle school students (grades 6-8) on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS). Using a theoretical framework, the research examined the extent to which the teacher qualification variables were related to the student achievement. Measures of teacher qualifications included four independent variables: (a) number of mathematics content hours, (b) level of teaching certification, (c) number of years teaching experience, and (d) number of years teaching middle school/junior high mathematics. Participants in this causal-comparative study included 97 teachers and 6,391 students from the middle schools in Spring Independent and Spring Branch Independent School Districts near Houston, Texas. The researcher obtained the archival test scores from spring 2004 of the respective districts and determined a mean student score for each teacher. The responses to teacher surveys were analyzed using linear regression of the independent variables and showed a 0.04 level of significance between teacher qualifications and student performance on the TAKS. The researcher also examined the ANOVA results which indicated that only the number of years teaching middle school mathematics had a significant relationship to student achievement with a statistical significance ($p = .03$).

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Date May 21, 2005

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This dissertation is dedicated to my loving family:

my husband, my children, and my parents who have been

so supportive, patient, and encouraging throughout this endeavor.

A special thanks to:

Dr. Randall Parker, Major Professor
Dr. Otis LoVette
Dr. David Gullatt
Dr. Andolyn Harrison
Dr. Cathy Stockton
Dr. Bob Cage

Principals and Teachers of
Spring ISD and Spring Branch ISD
Jennifer Cobb
Amanda Salinas

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CHAPTER 1

INTRODUCTION

"In a constantly changing world that is demanding increasingly complex skills from its workforce, children are literally being left behind," said President George Bush (2001, ii) in the No Child Left Behind Act (NCLB). This legislation sought to improve the efforts already being made to accomplish high standards for all students. School districts were held publicly accountable for their performance and forced to report the academic results of all student subgroups (Haycock, 2002). Public schooling in America was facing the most sweeping and controversial era of educational reform in decades (Campshire, 2003).

The responsibility for student achievement and performance is being more closely assessed through the accountability systems that measure the adults, not just the children (Reeves, 2004). Due to the increased standards, schools must show evidence of student proficiency in the areas of mathematics, reading, and science in addition to creating more rigorous curricula (Camphire, 2003; Voke, 2002). Educators are making adjustments and paradigm shifts to ensure that all students have an equal opportunity to pass the state and national standardized tests. Districts and individual schools are held accountable to ensure that all student subgroups reach the identified state standards within the designated time frame (Jerald & Haycock, 2002).

Although parents support testing if it improves instruction, they neither want schools to suffer consequences, nor have the curriculum adjusted to the tests (Learning

First Alliance, 2003). In their guide for principals, the Learning First Alliance stated that discipline problems, increased class sizes, and better teacher quality were also important to parents. Legislators and state department officials have raised performance standards to a higher level, as public opinion has been influenced by the results of standardized testing. Students are responsible for basic facts plus the application of knowledge and critical thinking skills (Learning First Alliance, 2003). Teachers are required to present a more demanding curriculum and to set higher expectations of work for their students (Allen, 2002). Are teachers qualified to make these necessary changes to their teaching and to the ever-changing curriculum standards?

Ontario's Education Minister, Janet Ecker (1999), stated that governments must require teachers to have sufficient skills and knowledge in order to maintain teacher certifications and to provide the highest level of education to the students. However, when faced with teacher shortages, states are tempted to reduce requirements for teacher certifications and credentialing, and districts are forced to assign teachers to subjects out of their teaching fields (Voke, 2002). The hiring of non-certified teachers was found to be even more prevalent in low-performing schools where poor and minority students were twice as likely to be taught by teachers with no experience or by teachers not certified in the subject area (Jerald & Haycock, 2002).

Statement of the Problem

Specifically, Texas teachers of mathematics, English, language arts, science, and social studies are being held accountable for the performance of students on the standardized TAKS (Texas Assessment of Knowledge and Skills) (Texas Education Agency, 2004). According to NCLB (No Child Left Behind), which was signed into

federal law in January 2002, all states must administer standardized mathematics tests to all students in grades 3-8 by the 2005-2006 school year (Camphire, 2003). The Texas Legislature passed Senate Bill 103 in 1999 which required a statewide testing program (Texas Education Agency, 2003). Texas public school students are tested in mathematics (grades 10 and 11), reading (grades 3 through 9), writing (grades 4 and 7), English/language arts (grades 10 and 11), science (grades 5, 10, and 11), and social studies (grades 8, 10, and 11).

According to the Student Success Initiative (SSI), student performance on the TAKS impacts the grade advancement of students for (a) reading (grade 3) as of 2002-2003, (b) reading and mathematics (grade 5) beginning in 2004-2005, and (c) reading and mathematics (grade 8) beginning in 2007-2008 (TEA, 2003). The Student Success Initiative was legislation passed to ensure grade advancement requirements for students. The goal of SSI was to make certain that all students be educated and receive needed help in order to be successful in mathematics and reading. Since the 1999 bill, the legislature has mandated a science test at grade 8 to be implemented no later than 2006-2007. Students must pass the 11^{th}-grade exit-level TAKS in all areas--English, mathematics, science, and social studies--to graduate from high school and to show readiness to enroll in higher education programs.

Are teachers prepared with the knowledge and skills to ensure the success of their students on these high stakes tests? Is there any relationship between factors of teacher preparation and experience and the academic achievement of their students? Haycock (2002) stated that teacher quality has an enormous impact on the achievement of students. What teacher qualifications, if any, can predict student achievement in mathematics?

Some teacher qualifications include certification, experience, academic preparation, and performance on licensure tests (Haycock, 2002). Since there is no one specific definition for teacher quality, the measures of teacher qualifications for this study included the following four factors: (a) number of mathematics content hours, (b) level of teaching certification, (c) number of years teaching experience, and (d) number of years teaching middle school/junior high mathematics.

Kaplan and Owings (2001) used similar factors of teacher quality and concluded that student achievement was increased through improved classroom instruction of quality teachers. Emerick, Hirsch, and Berry (2004) concurred that the essential component to increasing student achievement was to improve the quality of the classroom teacher. However, they suggested that teacher quality can not be attributed to teacher knowledge alone, but also, the instructional practices and experience of the teachers.

Although teacher knowledge has been considered to be one of the most important factors to teacher quality, Brewer (2003) acknowledged that a teacher must be able to communicate that knowledge to the students. Teacher knowledge can be measured in various ways including number of content hours, college major or minor, and content or certification exams. Regardless, teachers' knowledge of the subject taught is critical to the success of the students (Goldhaber & Brewer, 1996). Similarly, the level of certification is often related to the teacher knowledge and was found to be significant to student achievement when the teacher had majored or minored in the subject area taught (Wenglinsky, 2000). Teachers who were certified in mathematics produced greater

student results in general mathematics than those teachers that were not certified (Hawk, Coble, and Swanson, 1985).

In addition to teacher preparation, Fetler (1999) noted that teacher experience had a significant impact on student achievement in the area of mathematics. In a study conducted by Klecker (2002), the teachers' years of experience not only affected the students' mathematics achievements, but also the motivation of students towards mathematics. By examining teacher qualifications and their relationship to student achievement, educators can begin to improve teacher requirements, preparation, and staff development in order to create the teaching quality needed for today's classrooms. The implementation of the NCLB legislation has impacted how school districts are defined, recognized, and scrutinized (Jerald & Haycock, 2002).

Research Questions

The purpose of this study was to compare mathematics teacher preparation and experience to the achievement of middle school students (grades 6-8) on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS). Five specific research questions were presented as follows:

1. To what degree do the factors of teacher qualifications predict middle school student achievement on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS)?
2. Do middle school students who have teachers with varying content hours of mathematics score significantly higher on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) across the sampled school districts?

3. Do middle school students who have teachers with varying certifications score significantly higher on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) across the sampled school districts?
4. Do middle school students who have teachers with varying years of teaching experience score significantly higher on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) across the sampled school districts?
5. Do middle school students who have teachers with varying years of middle school mathematics teaching experience score significantly higher on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) across the sampled school districts?

This study focused on the middle school mathematics students and their teachers in two metropolitan districts in Houston, Texas: Spring Independent and Spring Branch Independent School Districts. The Spring ISD had five middle schools with approximately 5,400 students in grades 6-8; whereas, Spring Branch ISD had nine middle schools with 6,923 students.

This study examined the TAKS achievement levels of these middle grade students in relation to the preparation and experience levels of their respective teachers to determine if there were any significant relationships that might predict the academic performance of middle school students on the mathematics portion of the TAKS.

Theoretical Model

The theoretical model for this study is presented in Figure 1. As can be seen in the model, the independent variables of (a) number of mathematics content hours, (b) level of

certification, (c) years of teaching experience, and (d) years of teaching middle school mathematics lead to an impact or a relationship to student achievement at the middle school level.

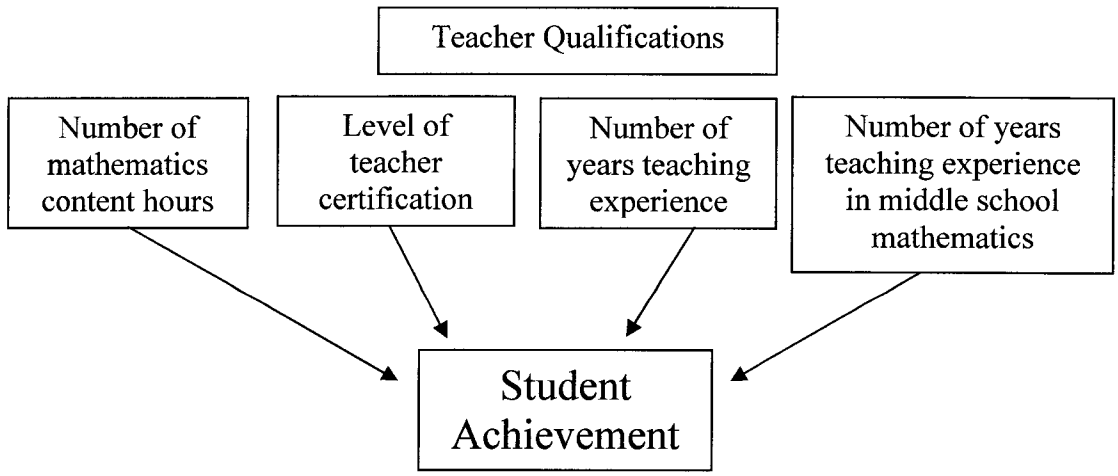

Figure 1: Teacher Qualifications and Student Achievement

Definition of Terms

In order to prevent ambiguity, a list of terms and definitions related to this study are included. The following is a list of these terms and their definitions:

Achievement levels: The academic levels of the middle grade students in this study were assessed using the results of the mathematics section of the TAKS test that was administered in the spring of 2004.

Certification levels: The state certification of the teachers included (a) elementary education (K-8 or 1-8), (b) middle school/junior high certification, (c) secondary mathematics, (d) temporary or emergency certification, and (e) alternative certifications.

Middle schools: Only campuses with grade configuration of 6th, 7th, and 8th grades were identified as middle schools for this study.

Number of mathematics content hours: These hours included the number of undergraduate and graduate mathematics credit hours completed by the teacher but not including mathematics methods courses. For the purpose of this study, the subject knowledge of the teacher is defined as the number of mathematics content hours.

Teaching experience: The number of years that the teacher had spent teaching will be divided into two categories: (a) total number of years in teaching and (b) number of years in teaching mathematics. The amount of experience included full-time or part-time assignments, but excluded substitute and/or student teaching. Some middle school/junior high teachers were likely to teach more than one subject per day; therefore, even one period of mathematics was considered as a year of mathematics teaching experience.

Texas Assessment of Knowledge and Skills: This criterion-referenced test was first administered in the spring of 2003 for baseline data, as it replaced the TAAS (Texas Assessment of Academic Skills). The TAKS measures student mastery of the Texas Essential Knowledge and Skills (TEKS) which are defined as the essential concepts and skills for each grade level (Texas Education Agency, 2003).

CHAPTER 2

REVIEW OF LITERATURE

Researchers have conducted various studies to determine the factors that impact student achievement. The discussion in this chapter will focus on the research regarding teacher quality and teacher certification as they relate to student performance. Teacher quality will address the teacher's subject knowledge and years of experience. The areas of teacher certification will include alternative certification and middle school certification. The use of standardized testing and recommendations for improving middle school mathematics will also be examined.

Teacher Quality

Since teacher quality has been found to be one of the biggest influencing factors on student performance, states are defining teacher quality, providing additional training, and implementing competency evaluations (Camphire, 2003; Haycock, 2002). In his 2002 annual report to Congress, former U. S. Secretary of Education Paige stated, "We know that a high-quality teacher is the single most significant factor on how well students achieve" (2002, p. 1). As part of the Abell Foundation of Maryland, Walsh (2001) examined 150 studies conducted during the last fifty years on teacher training and student outcomes. She concluded that many of the studies lacked sufficient evidence, used inadequate statistical measures, and relied heavily on anecdotal evidence. Walsh did find the studies showed that teacher quality was more important to student achievement than class size, spending, and instructional materials.

Kaplan and Owings (2001) made recommendations to principals for improving teacher quality and student achievement. They explained the difference between teacher quality and teaching quality. A teacher's qualifications contribute to the teacher quality through (a) college majors, (b) teacher preparation, (c) certification, (d) professional work experiences, (e) examination scores, (f) aptitude, and (g) demographics. However, the teaching quality is determined by what the teacher actually brings to the classroom to improve student learning. "Teaching quality includes creating a positive learning climate, selecting appropriate instructional goals and assessments, using the curriculum effectively, and employing varied instructional behaviors that help all students learn at higher levels" (Kaplan & Owings, 2001, p. 64). When teachers used hands-on learning and in-class teacher assignments, their students scored 72% higher in mathematics and 40% better in science compared to the classmates on the 1996 NAEP (Blair, 2000). Differences were also noted when teachers had been trained to work with students from various cultures or students with special needs. These factors of teacher quality, including teacher knowledge, assessment, and instructional methods, had a 70% higher impact on student achievement than class size (Wenglinsky, 2000).

The executive director for the Association for Supervision and Curriculum Development (ASCD), Carter (2003) stated, "Meeting the demands of high academic standards requires teachers who know their subjects, know how to teach their subjects, and know how to access their students' learning" (p.2). In addition, teachers must be given the opportunity to be lifelong learners by working collaboratively in order to improve student achievement (Darling-Hammond, 1998a).

No Child Left Behind has examined teacher quality by defining the requirements needed to be "highly qualified" teachers:

- Teacher must be fully certified by a state or national educational agency.
- Teacher must have bachelor's degree.
- Teacher must demonstrate competency in subject knowledge and teaching. (Bush, 2001)

By the end of 2005-2006 school year, these requirements must be in place, and all public school teachers must be "highly qualified" (Camphire, 2003). In order to demonstrate competency, teachers can either be fully certified in subject areas by completing college course work or by passing subject matter tests. According to the U.S. Department of Education, highly qualified teachers were identified by subject: (a) 47% of mathematics teachers, (b) 50% of English teachers, and (c) 55% of science teachers at the secondary level. Unfortunately, states are having to offer alternative methods to veteran teachers who have being teaching for many years, but do not have the adequate requirements to be highly qualified. (Laitsch, 2003). For example, teachers in Louisiana can complete ninety CLUs (Continuing Learning Units) or staff development hours in specific areas in order to fulfill the certification requirements (Louisiana State Department of Education, 2003). New teachers that are hired may be required to meet even higher expectations, especially if Title I funds are used (Camphire, 2003).

When asked about meeting the demands for teacher quality, Darling-Hammond (1998b) suggested ten strategies to address teacher quality in the United States. Her list included equalizing teacher salaries while creating teacher licensure programs across states and National Board Certification. Hammond stated that programs are needed to

recruit teachers and to expand services especially in areas of teacher shortages. Additional teachers could be produced by supporting community colleges and college pathways as they offer teacher training classes to paraprofessionals. The number one recommendation given by Darling-Hammond (1998b) was to simply "Just say no to hiring unqualified teachers" (p. 1).

In order to improve teacher quality, states are implementing programs to recruit and retain teachers (Camphire, 2003). Representative Boehner, Chairman House Committee on Education and the Workforce, explained that states and schools were being given $3 billion in resources to address NCLB's teacher quality issues. These funds can be used in recruiting, hiring, training, and retaining quality public school teachers (Laitsch, 2003). School administrators in Arkansas have paired new teachers with experienced teachers in a mentoring program. Similarly, master teachers in mathematics can receive $5000 in Texas to mentor their peers that teach at schools in need of assistance. Improved health insurance benefits are being offered to Oklahoma teacher applicants in an effort to recruit better teachers. Programs in New Mexico are trying to find shortcuts to standard certifications for teachers that currently have provisional certificates (Camphire, 2003).

Educators in Tennessee have proposed another way to measure teacher quality by using the test data of the teachers' students (Robelen, 2003). Under the NCLB's federal regulations, a state can create a "high, objective, uniform state standard of evaluation" known as HOUSSE. The officials in Tennessee must prove that by using the state's value-added data, the teachers have sufficient content knowledge. Although the teachers might not meet the federal requirements to be highly qualified, their students are

producing high test scores due to the teachers' expertise and experience in the same subject and grade level. Robelen pointed out that this alternative process would be voluntary by the teachers who would sign waivers in order for the student/teacher data to be used as part of their evaluation. Under the Tennessee Value-Added Assessment System, the student achievement data for each teacher would be analyzed over a period of three years and would be compared to the gains of other students in the district, state, and nation. Opponents of the plan questioned the amount of student growth needed in order to justify a teacher being given the highly qualified status (Robelen, 2003).

According to a NCLB survey, Texas' Department of Education does not appear to be on track in preparing a definition for highly qualified teachers or in assuring that highly qualified teachers are in every classroom. However, Texas' schools are providing adequate requirements for subject matter competency of teacher applicants (Education Commission of the States, 2003).

In addition to the NCLB definition of a highly qualified teacher, the National Research Councils' Mathematics Study Committee (2001) has defined quality teaching by identifying specific guidelines for mathematics. The five strands of proficiency are necessary for successful teaching and learning of mathematics:

1. Conceptual understanding of the core knowledge required in the practice of teaching.
2. Fluency in carrying out basic instructional routines.
3. Strategic competence in planning effective instruction and solving problems that arise during instruction.

4. Adaptive reasoning in justifying and explaining one's instructional practices and in reflecting on those practices so as to improve them.
5. Productive disposition toward mathematics, teaching, learning and the improvements of practice. (p. 8)

These proficiencies are directly related to the teacher's effectiveness when used consistently to help students learn mathematics. Versatility is also crucial when working with diverse students with wide ranges of mathematical content and ability levels (National Research Council..., 2001). Teachers with inadequate qualifications were more likely to be found in low socio-economic areas where qualified teachers were not willing to teach due to the diversities in the student demographics (Voke, 2002). According to Jerald and Haycock (2002), districts in Charlotte, North Carolina have created plans for low-performing schools to attract good teachers by offering financial incentives and smaller class sizes. Unqualified teachers in New York are not allowed to be hired at schools with lower performances. Fetler (1999) reported that the shortage of teachers is directly proportional to the lower high school student performances, especially in mathematics. He examined the teacher credentialing of mathematics teachers in California and found a definite increase in the number of teachers who were teaching on emergency permits or teaching out of their certification areas.

Subject Knowledge

Elementary education majors are generally required to take only six to twelve hours of mathematics including college algebra, college trigonometry, and statistics. Silver (1998) explained that as educational standards increase, the mathematical concepts being taught in the eighth grade are becoming much more difficult with pre-algebra skills

being introduced in the earlier grades. The mathematics curriculum in the United States is "a mile wide and an inch deep" as more areas are included at every grade level (Silver, 1998, p. 2). Lappan, former president of the National Council of Teachers of Mathematics, agreed that eighth grade mathematics is becoming sophisticated with the incorporation of rational numbers, algebra, geometry, measurement, and statistics (Mann, 2000).

Teachers should be learning all the time and should constantly be studying the material they teach (Sparks, 1998). Brewer (2003) stated that teachers must find a balance between their subject knowledge and the methods they use to present the information effectively to their students. The essential to good teaching is the balance between the "what of subject matter and the how of teaching" (Brewer, 2003, ¶ 3). A teacher's subject competence and a teacher's competence in communicating that subject were given as keys to teacher preparation programs.

Teachers having a teaching license and at least a college major in their subject area were greater predictors of student achievement than per-pupil spending, class size, or socioeconomic status (Archer, 2000; Darling-Hammond, 2000). Higher student performance scores were associated with teachers who were certified in mathematics and those who had bachelor's or masters' degrees in mathematics and science (Goldhaber & Brewer, 1996). These data were compiled from the National Educational Longitudinal Study (NELS) of 1988 that examined the impact of teacher degrees on student performance in mathematics, science, English, and history. Since the teacher and student data provided by the NELS were categorized into the four subject areas, Goldhaber and Brewer (1998) used a sample that included 18,609 public school students with 6,196 in

English, 5,113 in mathematics, 4,357 in science, and 2,943 in history. In order to exclude previous knowledge, the students were tested in one or more subjects of mathematics, science, reading/writing, and history at both the eighth and tenth grades. Family and school factors were held constant using the achievement models and the education production function methodology.

The researchers attempted to predict the students' achievement levels based on whether the teacher had a bachelor's or master's degree. The majority of the teachers in the study had at least a master's degree in some field. However, less than 25% of the teachers had more than a bachelor's degree in their specific subject area being taught. More English and history teachers had majors in their subject areas than those in mathematics and science. Goldhaber and Brewer's conclusions were different than expected with no significant evidence supporting the hypothesis that teachers with advanced degrees produced higher student results than teachers not having advanced degrees; thus, raising the question as to why teachers with advanced degrees are generally paid more. The results showed that tenth grade mathematics students of teachers with bachelor's and master's in mathematics scored only one tenth of a standard deviation higher than students taught by teachers with only a bachelor's degree, not in mathematics.

Other studies have also found a significant relationship between student achievement and teacher knowledge. When Wenglinsky (2000) conducted a similar study with 5,000 eighth graders on the NAEP (National Assessment of Educational Progress) in 1996, students exceeded their classmates by 40% on the mathematics and

science tests when they were taught by teachers who had majored or minored in the subject being taught.

However, in a study examining teacher shortages, Ingersoll (1997) found that almost one-third of all high school mathematics teachers had neither a major nor a minor in mathematics or a related discipline; whereas, 25% of high school English teachers had neither a major nor minor in English or related field. Haycock (2002) stated that high poverty schools were more apt to have students being taught by teachers with less subject knowledge and without even a minor in the content area. In math and science classes with 90% or larger minority populations, fewer than half of the teachers were qualified using state standards for certification.

Cohen and Hill (1997) conducted a study in California and surveyed 1,000 teachers in grades second through fifth. The students' performances were compared with the professional development experiences of their teachers. According to Richardson (1998), "High quality professional development for teachers translates to higher scores for students on mathematics assessment" (p. 1). According to the study of Goldhaber and Brewer (1998), the subject-specific training determined the improved student performance especially in the areas of mathematics and science rather than teachers' ability, knowledge, or college degree. Therefore, they concluded that professional development of secondary teachers should target the specific subject area taught by the teachers rather than general content (Goldhaber & Brewer, 1998). Professional development is frequently unproductive because of the broad activities that lack substance and are unrelated to the actual curriculum (Jerald & Haycock, 2002).

In Ontario, Canada, regularly testing of teachers began in June 2000 and was intended to measure the teacher's subject knowledge and skills (Schofield, 1999). In a letter to the Ontario College of Teachers, Ecker listed the following parameters for the teacher testing:

- regular assessment of teachers' knowledge and skills
- methodologies which include both written and other assessment techniques
- a link to re-certification
- remediation for those who fail assessments
- de-certification as a consequence if remediation is unsuccessful. (1999, ¶ 3)

The extreme testing was due to the increased public demands for school accountability. The Canadian Teachers' Federation had voted in July for voluntary professional development rather than the mandated testing of teachers (Schofield, 1999). The Ontario College of Teachers provided feedback regarding the teacher testing and suggested that the testing be used to measure teacher competence (College advice on teacher..., 2000). In a consultation paper, the college argued the relationship between good teaching and a written test (Robertson, 2000).

> A consensus on what defines teacher competence is elusive, if not impossible, to reach. There is more to teaching than a knowledge base. There is the ability to convey knowledge, to create environments where students can learn, and support learners in the process of learning. (Consultation Paper, 2000, p.41)

Since January 1, 2003, all applicants for membership in the Ontario College of Teachers must complete the Ontario Teacher Qualifying Test (Ontario College of Teachers, 2004). Teachers trained outside of Ontario are given a one-year interim

certificate, in which time; they must complete the qualifying test as well. However, Darling-Hammond (2000) believed that the teacher qualities of dedication, caring, perseverance, sensitivity, and integrity could not be measured by a standardized test alone.

In 1985, the governor of Arkansas, Clinton forced the state's 37,000 teachers to take competency tests with over 3% failing; therefore, the testing was dropped (Schofield, 1999). Teachers at higher grade levels were required to obtain certification for Arkansas in more than one subject area. Professional growth plans have also been implemented so that teachers document their goals and development. Another form of testing for teachers has been the mandatory skills tests like the National Teacher Examination and the Praxis. Of the new teachers in Massachusetts who took the three part state examination in June, 1999, 43% failed. Therefore, Governor Cellucci suggested that colleges not be accredited if more than 20% of their graduates failed the certification exams. Texas, Florida, and New York have adopted similar regulations (Schofield, 1999).

"As teachers increase their conceptual knowledge and become more fluid in connecting their knowledge to lesson presentation, their students' mathematical competence should also improve" (Leinhardt & Smith, 1985, pp. 269-270). Even in the area of physical education, a study revealed that teachers who were experts on a particular skill or concept were able to better identify and correct students' learning problems (Schempp, Manross, Tan, & Fincher, 1998). Ten physical education teachers were interviewed four times to determine their subject matter expertise and its impact on their pedagogical content knowledge. In other words, did being an expert at soccer make them better equipped to teach their students? Teachers were given a subject knowledge

expertise rating scale to determine their expertise in 25 physical education content areas. After using a constant comparative technique to assess the data, the researchers found that student motivation and implementing appropriate activities were still pedagogical problems of the teachers regardless of the individual teacher's own expertise in the particular area of physical education (Schempp et al., 1998). Limitations of this study were noted as the small sample size of only 10 teachers and their recruitment/selection based on proximity to the investigators. The researchers recommended that subject matter knowledge in physical education should be presented in a developmental process rather than bound to skills being taught at specific grade levels.

Leinhardt and Smith (1995) agreed that teachers should possess an expertise level of knowledge in the subjects that they plan to teach to students. Their study examined the subject matter knowledge of eight 4th-grade mathematics teachers to determine how they used the knowledge to actually organize and teach the content of fractions to their students. Methods during this three-year study included interview, card-sorting tasks, and transcriptions of videotaped lessons, while a semantic net was implemented to organize the concepts and their relationships. Leinhardt and Smith (1993) concluded that the subject expertise of the teachers made a substantial difference in the degree the procedural information was presented and the level at which the conceptual facts were delivered by the teachers.

Some teachers have had little experience with some of the complex mathematics that they are now required to teach their students (Silver, 1998). Unlike their elementary counterparts, secondary mathematics teachers need more specialized subject matter knowledge (Fetler, 1999). Differences in student achievement were higher especially for

those students whose secondary mathematics and science teachers had strong content knowledge (Goldhaber & Brewer, 1998). When teachers encouraged students to think critically and to write about the mathematics content and processes, the students' scores were 39% higher (Kaplan & Owings, 2001).

Unfortunately, well-intentioned mathematics and science teachers who are proficient in classroom management and discipline are teaching students in subject areas where the teachers have inadequate knowledge of the material (Appel, 1999). A retired superintendent, Appel (1999), suggested a core curriculum for all teachers that was similar to a high school curriculum including four years of mathematics, three years of science, four year of English, four years of foreign language, four years of history/geography, one year of art, and one year of music. Two reasons for this liberal education would be to improve the broad knowledge base for elementary teachers and to provide background information for secondary teachers who are teaching outside their content areas.

Teacher Experience

In addition to subject knowledge, researchers have found that teacher experience is also a factor for improving student achievement. Klecker (2002) stated that teachers must perform at high levels beginning in their first year on the job-- unlike most other professions. In an *ex post facto* designed study, Chidolue (1996) examined the relationships between the characteristics and classroom environments of eleven biology teachers and the 375 students' achievement and attitudes in Nigeria. The researcher found a significant positive relationship between the factors of teacher experience and teacher locality with the students' attitudes and their achievement levels in biology. In the

research discussed previously regarding advanced degrees, Goldhaber and Brewer (1998) found that higher student test scores were not the result of teachers with more teaching experience, but the teacher's specific content knowledge.

Wilkins (2002) used a comparative analysis to determine the relationship between student achievement and the four variables of (a) per-pupil expenditure, (b) class size, (c) teacher advanced training, and (d) teacher experience. None of the variables showed significant findings in their impact on student achievement. The researcher reported that neither teacher experience nor teacher advanced training presented a direct relationship to the achievement of students sampled in West Virginia.

While a member of the California Commission on Teacher Credentialing, Fetler (1999) conducted a study on high school staff characteristics and mathematics test results at 795 high schools in California. After recognizing the shortage of teachers in California, the researcher began to study the characteristics and qualifications of secondary mathematics teachers in relation to the achievement levels of their students. Approximately 1.3 million students in second through eleventh grades were given the Stanford Achievement Test Series in the spring of 1998. The teacher data were obtained using the 1998 Professional Assignment Information Form (PAIF) in order to attain the instructional assignments of the teachers. The educational levels of the teachers were also coded and ranged from doctorate to those with no degree. Years of experience was noted and defined as years of educational service at any location, but did exclude student teaching.

Teacher data showed that more than 10% of the mathematics teachers had emergency permits. Over half of the teachers in the study reported ten or more years of

teaching experience. The students' test scores were first disaggregated using pairwise correlations and a significance level, $p < .001$. Later, the variables were dissected independently using a multiple regression analysis. The researcher concluded that teacher experience and preparation had a significantly positive impact on student achievement after controlling for poverty and other student demographics. Fetler (1999) admitted that the correlational data may have underrepresented the relationships between the variables due to the fact that the mathematics teachers were only a small part of all teachers at the schools. The researcher offered suggestions to improve teacher qualifications including staff development and recruitment incentives, but emphasized that the ideal solution would be to require more mathematics classes in high school and in undergraduate courses.

In another study related to mathematics achievement and teaching experience, Klecker (2002) analyzed the mathematics results from the National Assessment for Educational Progress (NAEP) in 2000 for students in grades 4, 8, and 12 nationally and grades 4 and 8 on a state-by-state assessment. The national sample included over 43,000 students; whereas, the state by state sampling assessed nearly 100,000 fourth and eighth graders. The researcher measured significance with an alpha level of .01, and used the NAEP Data Tool to report (a) statistically significant differences between groups, (b) the mathematical difference between the means, and (c) the calculated p value. However, the results showed that the differences between the means of teachers with varying experiences were not significant. Klecker (2000, p. 15) stated, "Although statistical significance ($p < .01$) was found between the groups on the eighth grade tests, the effect size of these differences were interpreted as 'less than small,' that is, less than .2 standard

deviations or 'small,' that is, in the .34 to .37 range." Limitations of this study were the lack of variance in the data itself and the use of a secondary correlational analysis.

Herman (2000) went a step further and examined the impact of teacher experience on the teachers' beliefs about their ability to positively influence their students' learning. Using a mediation model, Herman hypothesized that teacher efficacy was the mediating factor that enabled teacher experience to affect student motivation, and ultimately student achievement. The Learner Centered Battery was given to 272 teachers in six states as a self-assessment instrument used to help teachers enhance their teaching. After examining the results, the researcher found that teaching experience including number of years was largely unrelated to the students' achievement and their motivation to learn.

Similar findings were noted by Darling-Hammond (2000) who made the distinction that years of teaching experience was related to teacher quality and increased student achievement only if the years of experience was less than three years of classroom practice. Rosenholtz (1986) concurred that the benefits from years of experience tended to taper off after about five years of teaching experience and suggested that experienced teachers tended to stop growing professionally and became tired in their teaching positions.

Teacher Certification

When classrooms have qualified and certified teachers, their students' achievement is higher (Matson, 1999). Darling-Hammond (2000) collected survey data from all 50 states which showed that teacher preparation and certification were the strongest determining factors in accounting for 40-60% of the total variance for improving student performance in reading and mathematics even after controlling for

poverty and language status. She found that most teacher education programs required students to obtain hours in general education, professional education, and the cognate or teaching areas, along with field or clinical experiences.

Recently, the number of undergraduate hours has been increased at some colleges and universities in hopes of better preparing pre-service teachers. In Louisiana, middle school teachers can have either elementary or secondary certification in the subject area taught. However, in Texas, middle school mathematics teachers could have middle school certification (grades 4-8) or high school certification (grades 8-12). Teachers seeking certification after 2002 for middle school mathematics must also pass the Texas Examinations of Educator Standards (TExES) certification exam for high school mathematics as compared to just the middle school mathematics content exam (Texas State Board for Educator Certification, 2004). Should middle school mathematics teachers be required to have secondary mathematics certification or should there by a unique middle school certification for mathematics, science, and English? Several years ago, the Louisiana State Board of Education had approved a middle school certification for teachers, and there are now national teacher examinations for middle school teachers (Louisiana State Dept of Education, 2003). However, school administrators often employ elementary certified teachers who can teach in more than one subject area (Valentine & Mogar, 1992). What impact would higher requirements have upon rural areas where a shortage for mathematics teachers already exists? (Useem et al., 1999)

Hawk et al. (1985) conducted a study that compared 36 mathematics teachers, of which 18 were mathematics certified and 18 were certified in another field. Teacher differences were measured by (a) student achievement, (b) teacher knowledge of subject,

and (c) teacher professional skills as observed in the classroom. The Stanford Achievement Test (general mathematics) and the Stanford Test of Academic Skills (algebra) measured the student achievement in mathematics. Teacher knowledge was measured using the Descriptive Tests of Mathematics Skills (DTMS). Finally, trained observers used the Carolina Teacher Performance Assessment System (CTPAS) on two occasions to identify the level of teacher instruction.

The results of the study showed that when students were taught by teachers certified in mathematics, the student achievement was greater in general mathematics. Also, certified mathematics teachers had better levels of instruction which suggested "teachers who are more knowledgeable in mathematics are more successful in presenting material to students" (Hawk et al., 1985, p. 15). The 826 students were given a pretest using the Stanford Achievement Test (general mathematics) and the Stanford Test of Academic Skills (algebra). After five months of instruction, the same Stanford tests were given to the students as a posttest. However, there were no significant differences according to a chi-square analysis ($t = 4.23$, $p < .001$) of teacher data including the following sub-groups: (a) years of experience, (b) years of experience teaching mathematics, and (c) degree held by teachers; bachelors or advanced. The researchers concluded that neither years of teaching nor degree level impacted the achievement of students, but the students of mathematics certified teachers had significantly higher achievement levels in mathematics than those students who had been taught by non-certified teachers according to the ANOVA (F ratio of 13.98, $p < .001$ for general mathematics and F ratio of 7.96, $p < .01$ for algebra).

Researchers at the University of Texas explained that students performed better when their teachers had experience in the subject area. The grades of all middle schools students taking Algebra I were higher when more than 68% of the teachers were certified (Matson, 1999). In a comparison of elementary students' scores, Fuller (1999) showed that students of all ethnic backgrounds scored significantly higher on the Texas Assessment of Academic Skills when the majority of their teachers had completed undergraduate programs, completed state licensures, and passed teacher certification examinations.

Alternative Certification

Alternative certification programs were first implemented to relieve teacher shortages in mathematics, science, and elementary education, but then moved into the areas of early childhood, bilingual education, the arts, special education, library science, and inner-city schools (Edelen-Smith & Sileo, 1996; Feistritzer, 1994). According to Feistritzer (1994), colleges of education have begun to develop alternative certification programs in order to meet the teacher shortages. The United States will need to recruit 200,000 teachers annually in order to have 3.5 million teachers needed to service the 54 million students by the year 2005 (Berry, 2002). Alternative certification has been defined as "a state-adopted process by which an individual may acquire a regular teaching certificate through a nontraditional certification program and which allows the individual to assume full classroom responsibility prior to completion of the preparation program" (Roth & Lutz, 1986, p. 22).

From 1983 to 1996, more than 50,000 teachers participated in alternative certification programs in the United States and obtained the educational coursework in a

reduced length of time to receive the training and certifications needed (Voke, 2002). Feistrizer (2001) found that forty-five states already have or were in the process of developing alternative programs with 16% of teachers in Texas, 22% in New Jersey, and 8% in California entering the classroom with alternative certifications.

What impact does alternative certification have on the NCLB's highly qualified teacher requirements? Laitsch (2003) reported that the American Board for the Certification of Teacher Excellence (ABCTE) and the Department of Education have worked together to help states identify highly qualified teachers using standardized tests rather than relying on their educational background or teacher preparation. This type of certification has been questioned by educators who measure teacher quality by educational and classroom experiences rather than just standardized testing.

Teacher certification requirements vary by state with the usual route being a four-year baccalaureate degree from teacher education programs. The requirements for alternative certification also vary between the specific departments or institutions (Jelmberg, 1996). However, more and more states are granting alternative certifications to deal with teacher shortages and to provide opportunities for career changes (Darling-Hammond, 2000; Feistritzer, 2001; Littleton & Holcomb, 1994). Due to the increased pressures for competency-based education, states have attempted to improve their teacher licensing programs and have increased the standards for certification (Steffenson, 1994).

Another reason for providing alternative certifications is the alarming teacher turnover rate which estimates that of those with teaching certificates, 25% either never begin teaching or leave teaching after only a couple of years (Adams & Dial, 1993). Using a regression model, Adams and Dial found that the teacher's certification was

significant in explaining teacher retention. With a sample of 2,327 of white, black, and Hispanic-American first year teachers, the researchers examined the factors of sex, ethnicity, education, and certification route with their relationship to teacher retention.

However, Hawley (1990) emphasized that "when conventionally certified teachers cannot be found, it is better to have formal programs for recruiting, preparing, and supporting prospective teachers than it is to use emergency licensing procedures to fill teaching vacancies" (p. 4). Neumann (1994) explained that the difference between being emergency and alternatively certified is that emergency-certified teachers are generally not required to pass subject matter competency tests. Finding qualified mathematics teachers could be difficult over the next few years as more students are taking algebra courses earlier, and mathematics majors are forced to choose between $25,000 teaching jobs or $50,000 positions in the computer industry (Matson, 1999). In addition, Matson found that national and state agencies have provided teacher training in mathematics including monetary incentives and have considered certifying those who have the necessary subject knowledge but lack the educational and pedagogical training.

Alternative certification programs should be collaborative programs between the school districts, the schools, teachers, and universities. The selective process should seek applicants who seek professional growth and experiences while receiving strong support from everyone involved (Littleton & Holcomb, 1994; Wise, 1994). Qualified people with the essential subject knowledge can teach in the classrooms while working on their appropriate certification (Matson, 1999).

In a response to the teacher shortages in secondary mathematics and science, Denton and Morris (1991) studied the recruitment and selection of teacher candidates for

a five-year alternative certification program. This graduate level program encompassed 36 semester hours on a series of instructional skills including (a) selecting content, (b) specifying performance objectives, (c) developing instructional strategies, (d) diagnosing prerequisites of learners, and (e) evaluating the effectiveness of instruction. Students in the program completed their master's degree in education while obtaining requirements for certification. Local school districts and universities collaborated and were responsible for the placement of all the interns into full-time positions at the end of the program.

Alternative certified teachers are usually considered better than average in content knowledge, which may be a result of entering the education field after working in other professions (Bradshaw & Hawk, 1996). In a study of the characteristics of new teachers in New Jersey, traditionally prepared teachers in mathematics and science had higher grade point averages than those teachers who completed alternative certification programs (Natriello, Sumwalt, Hansen & Frisch, 1990). Unfortunately, these alternatively certified teachers reported to have entered teaching, not because of their interest in children and learning, but due to the lack of jobs in their related fields.

In addition, Berry (2002) stated, "Alternative entrants are not necessarily the most academically abled; they are less likely to remain in teaching; and by virtue of their limited training, they do not possess the knowledge and skills needed to reach all students" (p. 22). Teachers who received less training such as alternative routes had more difficulty with (a) curriculum development, (b) pedagogical knowledge, (c) different learning styles and levels, (d) classroom management, and (e) student motivation (Darling-Hammond, 1990; Miller, McKenna, & McKenna, 1998). With the continued legislation in support of charter schools, the number of alternatively certified

teachers will increase; therefore, school-based support and supervision be need to be improved (Franklin & Crone, 1992).

"Most research indicated that students taught by fully prepared teachers learn more than students taught by teachers who are not fully prepared" (Darling-Hammond, 1990, p. 135). In addition to subject matter knowledge, teacher preparation training must include child development, learning theory, curriculum development, and teaching methods. Obviously, the teacher preparation itself and the subject matter are important in determining the effectiveness of the alternatively certified teacher, especially in the areas of secondary science and mathematics. Therefore, the alternative certification programs should focus on the content mastery for secondary teachers and the pedagogical skills for elementary and special education teachers (Sindelar & Marks, 1993). Conversely, in a study of 70 middle grade teachers, Miller et al. (1998, p. 174) made the conclusion that after three years, "there appeared to be no observable teaching behavior differences, student output differences, or attitudinal differences" between those who had received alternative and traditional certifications.

Bradshaw and Hawk reported differences in the attitudes of traditionally and alternatively prepared teachers with alternative teachers being more apt to do the following:

- mention the importance of education and life long learning
- accept responsibility for their instructional effectiveness
- hold high expectations for low income and minority students
- recommend the program, and profession, to a friend

- report lower job satisfaction, and perceive teaching as a less rewarding and more complex than traditionally prepared teachers. (1996, p. 5)

Many of the individuals who are seeking alternative certification have been shown to be enthusiastic and educated and wanting to make a difference in the education system and its real-world applications (Feistritzer, 1994; Guyton, Fox, & Sisk, 1991). Sindelar and Marks (1993) added that alternative certification programs were also attracting individuals from diverse and ethnic backgrounds into a profession generally occupied by white females. In another comparison between teachers with varying certifications after one year, those with regular certifications were more positive about teaching, and alternative certified teachers found the teaching profession less rewarding and more complex (Guyton et al., 1991).

Middle School Certification

A report issued by the U.S. Department of Education following the administration of the Third International Mathematics and Science Study (TIMSS) focused on "...a pervasive and intolerable mediocrity in mathematics teaching and learning in the middle grades and beyond" (Silver, 1998, p. 1). According to the National Middle School Association, ten to fourteen year olds attended middle schools in 1995 with various configurations including Grades 5-8 (1,223 schools, 11%), Grades 6-8 (6,155 schools, 55%), Grades 7-8 (2,412 schools, 22%) and Grades 7-9 (1,425 schools, 13%) (Middle Schools..., 1999).

Schmidt, executive director of the U.S. National Research Center for TIMSS, gave several reasons for America's scores including low expectations for student achievement, insufficient professional development, and repetitive mathematics curricula

(Mann, 2000). Students in the United States in grades 7, 8, and 12 scored much lower in mathematics compared to students from other countries. Although American 8th graders ranked average in areas of algebra, fractions, data representation and analysis, and probability, these students were below average in geometry, measurement, and proportionality (Silver, 1998).

Data from five case studies related to teachers' knowledge of mathematics showed that middle grade teachers struggled with the necessary mathematics content including rational numbers, multiplicative operator, multiplicative reasoning, quantitative reasoning, and proportional reasoning (Wilkins, 1999). Examples of the teachers' frustrations, shortcomings, and failure in teaching the multiplicative concepts were attributed to the teachers' experience and background.

According to Lappan, former president of the National Council of Teachers of Mathematics, most states do not require middle school certification in content areas; hence, mathematics teachers in grades 5-8 do not possess adequate knowledge about geometry or statistics (Mann, 2000). However, North Carolina, Georgia, and Ohio have created programs for the middle school teacher to be better prepared and have specific teacher licensures for middle grades (Jackson & Davis, 2000). Intermediate teachers need to receive special training especially in the subject matter they plan to teach (Armstrong, 1977). "Teachers in grades 5-8 often have the same mathematics background as teacher is grades K-4, yet they are expected to teach more complex content" (Silver, 1998, p. 13).

Researchers have suggested that middle school teachers have additional training in content knowledge and adolescent development (Jackson & Davis, 2000; Silver, 1998). "Increasing middle grades teachers' knowledge and skills before and during their

tenure in the classroom is critical to the success of middle grades education" (Jackson & Davis, 2000, p. 94). The National Middle School Association has proposed middle school licensure requirements that would force teachers to obtain content knowledge in at least two subject areas (Middle Schools: Something..., 1999). When middle school teachers received preparation in two or more content areas, they were more likely to use interdisciplinary activities that spanned various subjects (Jackson & Davis, 2000).

In a study that examined middle schools (grades 5-9) in eight states, Scales (1993) received 439 questionnaire responses (28%) from teachers about their preparation and suggestions for improving the pre-service programs. The researcher gave excuses for the lower response rate; however, the sample did include teachers from a variety of areas including 25% urban, 35% suburban, and 40% rural teachers. Of these, most of the teacher respondents had teaching experience in a middle school (34%) or junior high school (28%) based on grade-level configurations of the buildings. Although 83% of the teachers had not received special middle school teaching preparations, over half of the teachers had ten or more years of experience in the middle grades.

Eighty-six questionnaire responses (57%) were returned from deans and directors for colleges of education who were also surveyed regarding their perceived effectiveness of middle school teacher preparations. Scales formulated eleven specific issues or activities related to middle school grades and asked the teachers to evaluate how well their educational programs prepared them. The deans were asked to appraise how well they believed their respective programs prepared its teachers. Unfortunately, a limitation to the study was that the teachers were not from the same institutions as the deans

surveyed. Table 1 shows the specific middle school issues and how they were rated by the teachers and the deans (Scales, 1993, p. 380).

Table 1: Middle School Teacher Education Programs

Percent of Teachers and Deans Saying Their Teacher Education Programs Prepared Them or Their Students for:		
Middle School Issues or Activities	Teachers %	Deans %
Using varying instructional techniques	74	95
Understanding early adolescent development	72	94
Motivating students	65	96
Student assessment alternatives	58	74
Involving community resources	53	67
Involving parents and/or family	50	64
Cooperative learning/grouping	47	94
Interdisciplinary curriculum and/or teaming	46	73
Teacher-based guidance	46	69
Teacher's role in site-based management	36	62
Cultural and/or language diversity	35	82

Nevertheless, there was a large discrepancy between the teachers and deans when asked about the preparation concerning cooperative learning and cultural and language diversity. Surprisingly, 40% of the teachers in this study did not believe that middle school teachers should be trained differently, but 68% of the teachers and 89% of the deans did think that the knowledge base differs for middle school teachers as compared to elementary and secondary teachers. The teacher respondents stated that this knowledge

base should include aspects relating to adolescent development (93%) including social and self-concept issues (91%). Teachers needed preparation in order to provide different teaching and assessment strategies that are applicable to middle school students including cooperative learning, authentic assessments, and portfolios (Scales, 1993).

As part of this study, 323 teachers also gave recommendations for middle school teacher preparation by increasing the field experiences and student teaching across more middle school grades. Scales (1993) stated, "They also recommended the development of a greater variety of teaching and assessment techniques (40%), more emphasis on social relationships and self-awareness (33%), classroom management (29%), and development of deeper academic subject content (29%)" (p. 381).

As part of *Turning Points 2000: Educating Adolescents in the 21st Century*, the following prerequisites were given for middle grade teachers:

- A strong conceptual grasp of their academic disciplines and skills in developing and using assessments to guide instructional decisions.
- Instructional knowledge and skills grounded in how people learn best.
- An understanding of how effective interdisciplinary teams work and how they can best contribute to effective teams.
- Substantial comprehension of young adolescents' developmental characteristics and needs.
- Willingness and the preparation to participate actively in the school's governance system.
- Knowledge and skills to support a safe and healthy school environment.

- Capacity to engage parents and community members in support of students and the school. (Jackson & Davis, 2000, p. 96)

Valentine and Mogar (1992) supported the need for different preparation programs in their discussion of middle level certifications. Some form of middle school certification program existed in 36 states with over one-third of the states requiring middle school certification in order to teach in the middle grades. By 1999, middle grades teacher licensure or a middle grades endorsement was available in 42 states although most credentialing was voluntary and with little or no specialized training (Useem, Barends, & Lindermayer, 1999). However, the researchers did state the effects of the middle level certification programs may take time since this phenomenon is just beginning to emerge. "Middle level educators must focus on the mission of required standards in every state, for every teacher of every child" (Valentine et al., 1992, p. 42). Gaskill, director of the Michigan Schools in the Middle Program, explained that middle school teachers can not ignore the developmental needs and issues of their students in order to force higher standards, scores, and more testing (Middle Schools..., 1999). A disadvantage of the middle school certification was noted as the restricting of teachers to a smaller window of job opportunities in addition to the hardship of employers to find teacher applicants at the middle school level (Jackson & Davis, 2000; Scales, 1993).

Recommendations for Improving Middle School Mathematics

Based on the TIMSS report, Silver made the following suggestions for improving progress in the mathematics programs of the United States:

1. There needs to be a serious national commitment to improved mathematics learning by all students.

2. The mathematics curriculum and instructional practices utilized in the middle grades need to be enhanced.
3. A substantial investment needs to be made in teacher professional development in order to support a more ambitious curriculum and more intellectually challenging mathematics instruction, which will in turn lead to greater student achievement. (1998, p. 7)

Lappan agreed that "high expectations coupled with a developmental understanding of middle schoolers, professional development, coherent curriculums, parent support, and effective teaching" must be part of the improvement process in mathematics (as cited in Mann, 2000, p. 2). The concepts of algebra and algebraic thinking are now being introduced way before high school in a time when algebra is for all students, not just those going to college (Blair, 2003). The reasoning skills and problem solving of algebra are essential in the today's workplace and technological society according to Moses, founder of the Algebra Project. Professional development is needed to get teachers to think differently about algebraic concepts.

Standardized Testing

As stated previously by Camphire (2003), the NCLB addressed standardized testing for all students and required that states adhere to the following deadlines:

- Administer mathematics tests to students in grades 3-8 by the 2005-2006 school year.
- Administer reading/language arts and mathematics to students in grades 3-8 and at least once to students in grades 9-12 by the 2005-2006 school year.

- Administer science tests to students at least once in each of the grade spans of 3-5, 6-9, and 10-12.
- Provide documentation of proficiency of all students on these mathematics and science tests by the 2013-2014 school year.
- Demonstrate adequate yearly progress toward the achievement goals.

In attempting to meet these accountability systems, many states are being forced to create standards and assessment measures in a hasty manner rather than using educational or psychometric procedures. The total costs for all states to establish the required NCLB tests could reach $5.3 billion in a time when many are experiencing financial cutbacks (Laitsch, 2003).

According to Popham (2000), there are three purposes of standardized tests: (a) to access the extent to which students have developed a foundation core knowledge and essential skills which are the norm for a particular grade level, (b) to provide teachers with an external evaluation of students' level of learning, and (c) to inform teachers as they make important decisions related to the instructional programs within their classrooms. Testing mandates are driving instructional reforms in almost every state; for example, forty-three states have now designed new curriculum documents based upon the National Curriculum Standards (Steinburg, 1996; Wood, 1992). Mandated high stakes testing programs at different grade levels have been created in 26 states (Neill, 1999).

Rothstein (1998) also noted that the reporting of standardized test scores has often been misleading. The media has exaggerated the incremental differences between academic strengths between students in the United States and those of other powerful countries around the globe (Berliner & Biddle, 1998). Critics of education have ascribed

far too much precision and accuracy to students' scores on standardized achievement tests (Popham, 2000). Researchers have questioned the validity of the testing data used to launch national debates over the quality of public education (Bracey, 1999) In *A Place Called School*, Goodlad (1984, p. 13) warned, "The facts about student achievement scores have been obscured by rhetoric regarding the decline in school effectiveness." Whether schools are in good or bad shape should not be determined by the curve of attainment on the test scores.

Parents expressed their views of standardized testing in a national survey conducted by Harris Interactive and sponsored by Sylvan Learning Center and the Association for Supervision and Curriculum Development. Based on the 600 responses, the findings included the following views of standardized testing:

- 50% were unsure or did not know what the state standardized tests measured.
- Parents were not informed about tests and could not help their children prepare.
- Majority disagreed with the use of mandated state testing as a valid measurement of what their children learned.
- 50% of parents believed that these tests should not determine promotion or graduation. (Of the 600 respondents, 311 were parents from high-stakes states and the remainder was from non-high stakes states.)
- Parents found inconsistencies between their children's standardized test results and their report cards. (National Survey..., 2000, p. 1)

While policy makers worry about statistics, parents worry about their children. Parents are more concerned with whether their children enjoy school, seem safe and well-cared for, and seem to be performing reasonably well (Goodlad, 1984).

The reforms created by standardized testing have targeted teaching practices and learning resources while ignoring differences among students such as opportunities to learn, poverty, parental values, or cognitive abilities (Rothstein, 1998). While schools with affluent demographics will use favorable test scores to garner public support, schools in poverty areas will be severely hampered by the poor performance of their students (Neill, 1999). Instead of focusing upon teaching kids to take tests, teachers should be preparing kids to solve life's problems (Tomlinson, 1999). Unfortunately, findings from the TIMSS showed that teachers only ask students to memorize and recall information at low levels of cognitive ability rather than insisting on reasoning and problem solving (Silver, 1998).

Brown and Moffett (1999) had a different opinion of standardized tests and how schools should use them. Teachers in high-performing schools accept change as their professional obligation, that is, the process of integrating the latest research on teaching and learning into their own classrooms. Rather than cling to outdated methods, the teachers collectively evaluate innovative practices and then take realistic steps toward the implementation of new teaching techniques. "These approaches are vital for creating a society that prospers from continuous learning and are revolutionary in what they imply for how teachers and students should go about learning" (Hargraves & Fullan, 1998, p. 47). However, a competitive community was developed in Denver where the best teachers are moving to the neighborhoods of affluent students and high performance

(Schofield, 1999). During the fall of 1999, a two-year pilot program was begun which provided pay raises based on student achievement. Annual bonuses of up to $2000 were given to the teachers of students who improved on their test scores.

Conversely, members of a diverse school community focus on matters that unite them and not issues that divide them. There is strong evidence of team building and a collective commitment to common goals. The United States Department of Education has created a lengthy list of best practices as a result of studies of high performing schools where economically and culturally diverse groups of students consistently score well on standardized tests (Brown & Moffett, 1999).

Some Texas educators and parents filed a lawsuit in protest of the TAAS while other Texas educators were fired for cheating on the state's high stakes test. In Virginia, SOL was originally the acronym for Standards of Learning, but after 98% of the students failed the exam, those letters have come to represent "Standards of Lunacy" (Bracey, 1999). Wisconsin legislators repealed the major consequences tied to the high stakes tests required of students attending public schools (Blair, 1999). In the modified plan, a state exam became one of four criteria used to determine if the student should receive a high school diploma. Scores from the exam appeared on students' transcripts; however, graduation was based on grades, teacher recommendation, and other criteria established by the local school board. Opponents of exit exams in Wisconsin persuaded the state legislature in 1999 to repeal laws regarding the high stakes test in that state. Critics worked to halt testing programs in Massachusetts, Ohio, and Texas. Policy makers were influenced through student boycotts, political lobbying, and lawsuits. In Texas, the Mexican American Legal Defense and Educational Fund filed a suit unsuccessfully

against the Texas Educational Agency to stop the use of the exit test as requirement for high school graduation (Zehr, 1999). There has been the implementation of such graduation exit examinations in 26 states. Even testing experts advised that states and districts should cautiously use standardized test results. Using a single test as a tool for reaching educational decisions with serious consequences for individuals and schools lacks professional credence (Viadero & Blair, 1999).

Although the TAAS had also been used as a graduation requirement, the results of the 2004 TAKS administration was the first implementation of its high stakes consequences for students. All middle school students who did not pass the mathematics portion of the TAKS were required to attend remediation summer school. At the conclusion of summer school, they were given the opportunity to retake the TAKS. If successful in summer school and the TAKS, students were then promoted to the next grade (Texas Education Agency, 2003).

The explanation of test results indicates the number of questions answered correctly and the number of questions tested for each objective. A scaled score is also given to show the student's performance in comparison with the performance standards. There are three categories for student performance on the TAKS:

(1) Commended Performance: Performance at a level considerably above the state passing standard. Student possesses through understanding of the knowledge and skills for the grade level.

(2) Met the standard: Performance at a level that was at or somewhat above the state passing standard. Student possesses sufficient understanding of the knowledge and skills for the grade level.

(3) Did not meet the standard: Performance at a level that was below the state passing standard. Student did not show a sufficient understanding of the knowledge and skills tested for the grade level (TEA, 2003).

As shown in Table 2, the middle school mathematics tests for grades 6-8 include six objectives with various levels of instructional targets that are linked to the essential elements for each grade. These specific elements, referred to as TEKS (Texas Essential Knowledge and Skills), are provided at each grade level and are part of the daily instruction in the mathematics classroom.

Table 2: TAKS Mathematics Objectives for Grades 6-8

Objective 1	Numbers, Operations, and Quantitative Reasoning Students must be able to show their understanding of numbers, basic four operations, and quantitative reasoning.
Objective 2	Patterns, Relationships, and Algebraic Reasoning Students must be able to show their understanding of patterns, relationships, and algebraic reasoning and to represent real-world situations with symbols.
Objective 3	Geometry and Spatial Reasoning Students must be able to show their understanding of geometry and spatial reasoning.
Objective 4	Concepts and Uses of Measurement Students must be able to show their understanding of the use of appropriate measurement and how to apply measurement concepts.
Objective 5	Probability and Statistics Students must be able to show their understanding of probability (the chance that an event will occur) and statistics (the collection, organization, and interpretation of data).
Objective 6	Mathematical Processes and Tools Students must be able to show their understanding of problem-solving strategies, including formulas, rulers, pictures, graphs, and tables. (Texas Education Agency, 2003)

Based on results from the Texas Education Agency (2004), Table 3 shows the mathematics results of all students taking the TAKS in the spring of 2003. For sixth through eighth grades, approximately 842,608 students were tested with 72% to 79% scoring two standard error of measurements below the panel's recommendation.

Table 3: Texas Assessment of Knowledge and Skills for Students—Spring 2003

Mathematics	Grade 6		Grade 7		Grade 8	
	Number tested	Percent at 2 SEM	Number tested	Percent at 2 SEM	Number tested	Percent at 2 SEM
All Students	283,564	79%	283,305	73%	275,739	72%
African American	40,061	66%	39,523	59%	38,328	57%
Hispanic	115,426	72%	111,412	64%	105,587	63%
White	118,634	88%	122,498	84%	121,845	84%
Economically Disadvantaged	143,198	70%	133,103	61%	122,779	61%
Limited English Proficient	17,036	49%	14,666	35%	13,471	32%
Special Education	14,747	58%	13,430	48%	13,667	46%

During the last decade, students in Texas and North Carolina showed enormous growth in mathematics achievement by almost doubling the national rate of growth on standardized tests (Haycock, 2002). Despite the constant barrage of complaints about standardized test scores and lax standards, Goodlad (1984) and Bracey (1999) insist that American's education system is getting better, not worse. Both assert that educational quality cannot be defined solely by student performance on standardized tests. Therefore, international comparisons of test data are far from convincing proof of the superiority or inferiority of another country's education system.

CHAPTER 3

METHODOLOGY/PROCEDURES

In this chapter, the researcher restates the research problem, research questions, and the null hypotheses to be tested. The researcher describes the methodology that was used in conducting this study. The research design, sample, instrumentation, data collection, and analysis techniques are discussed in this chapter. Descriptions of procedures to increase validity of the results are also addressed.

Restatement of the Problem

The purpose of this study was to compare mathematics teacher preparation and experience to the achievement of middle school students (grades 6-8) on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS). The researcher examined the relationship between factors of teacher preparation, certification, and experiences upon the academic achievement of their students. Measures of teacher qualifications included the following variables: (a) number of mathematics content hours, (b) level of teaching certification, (c) number of years teaching experience, and (d) number of years teaching middle school/junior high mathematics. The level of teacher certification was categorized as elementary certification, middle school certification, secondary mathematics, certification, temporary/emergency certification, alternative certification, and other certifications including those outside the field of education.

Comparisons of TAKS scores were made between the middle school students of the various mathematics teachers in the Spring Independent School District and the Spring Branch Independent School District. Based on the review of literature, and especially the work of Darling-Hammond (2000), Bradshaw and Hawk (1996), and Wilkins (1999), the researcher chose to explore the issues related to teacher preparation and certification when searching for highly qualified mathematics teachers in the middle school grades.

Research Questions and Hypotheses

The following is a list of research questions used to focus this study:

1. To what degree do the factors of teacher qualifications predict middle school student achievement on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS)?
2. Do middle school students who have teachers with varying content hours of mathematics score significantly higher on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) across the sampled school districts?
3. Do middle school students who have teachers with varying teacher certification levels score significantly higher on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) across the sampled school districts?
4. Do middle school students who have teachers with varying years of teaching experience score significantly higher on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) across the sampled school districts?
5. Do middle school students who have teachers with varying years of middle school mathematics teaching experience score significantly higher on the mathematics

section of the Texas Assessment of Knowledge and Skills (TAKS) across the sampled school districts?

The research hypotheses for this study are as follows:

H_1. A significant relationship exists between teacher factors and middle school student achievement on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS).

H_2. A significant difference exists in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying mathematics content hours across the sampled school districts.

H_3. A significant difference exists in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying teacher certification levels across the sampled school districts.

H_4. A significant difference exists in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying years of teaching experience across the sampled school districts.

H_5. A significant difference exists in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying years of mathematics teaching experience in the middle grades across the sampled school districts.

For statistical purposes, the following list states the null hypotheses:

H_1. No significant relationship exists between teacher factors and middle school student achievement on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS).

H_2. No significant difference exists in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying mathematics content hours across the sampled school districts.

H_3. No significant difference exists in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying teacher certification levels across the sampled school districts.

H_4. No significant difference exists in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying years of teaching experience across the sampled school districts.

H_5. No significant difference exists in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying years of mathematics teaching experience in the middle grades across the sampled school districts.

Research Design

The researcher used a causal-comparative research design to determine the extent to which the teacher qualification variables are related to the student achievement on the Texas Assessment of Knowledge and Skills (TAKS) test for middle school mathematics. The researcher chose this quantitative framework since the groups being studied were previously established prior to this research. Casual-comparative research allows the researcher to determine if there are any possible relationships that might exist between the groups that were already created. (Crowl, 1996).

The independent variables were the teachers' qualifications of (a) number of years teaching experience, (b) number of years teaching middle school/junior high mathematics, (c) number of mathematics content hours, and (d) level of teaching certification. The dependent variable was the students' scores on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for the April 2004 test administration. Crowl (1996) suggested that the researcher determine the variance by identifying what the variables have in common. For example, the researcher should examine the similarity in the number of years teaching experience and the number of years teaching middle school mathematics. The researcher must also exhaust other possible causes of the dependent variable. To ensure the control of this study, the researcher compared students, by classrooms, using the average TAKS mathematics score of the teacher's classroom on the mathematics section of the TAKS test. For this study, the teacher's classroom included all students taught by that teacher regardless of the class period for mathematics and ranged from 7 to 143 students.

Sample

The researcher utilized a nonprobability strategy of sampling because the students, teachers, and schools in this study were considered to be typical of the population. As in Table 4, the schools in both districts had a diverse student population based on ethnicity. Both districts are located in north Houston and have students living in various residential situations including commercial properties.

This sampling was employed as the researcher was attempting to determine the relationship between teacher qualifications and student achievement on the TAKS mathematics test for grades 6-8. In the sample, there were a total of fourteen middle schools in the Spring Independent and the Spring Branch Independent School Districts. The demographical information in Table 4 shows the number of students, schools, and teachers in addition to the student ethnicities at the middle schools during the 2003-2004 academic school year.

Table 4: Comparison of Sampled School Districts

	Spring ISD	Spring Branch ISD
Total Student Enrollment	26,700	33,005
Number of Middle Schools	5	9
Number of Middle School Students	6,198	6,923
Student Ethnicity for District	31.6% African American 31.3 % White 31.2 % Hispanic 5.8 % Asian/Pacific Islander 0.2% Native American	53% Hispanic 34.5% White 6.2% African American 6.2% Asian
Approximate number of middle school math teachers	61	80

Approximately 10% of the middle school students were exempt from the TAKS tests due to either special education exemptions or limited English exclusions. Therefore, these students were not included in the sample. The sample for the teacher survey was approximately 140 teachers with a return rate of 76%.

Instrumentation

The researcher examined the TAKS mathematics results of all of the middle school students in the Spring ISD and Spring Branch ISD. In the spring of 2002, a total of 5,140 students took the TAAS in Spring ISD, and more than 90% of the students met the minimum standard for mathematics (94% for 6th grade, 90% for 7th grade, and 93% for 8th grade). However, the TAKS is much harder, as evidenced by the benchmark testing done in spring 2003. The results from the April 2004 test administration were the first use of TAKS data for school accountability by the Texas Education Agency (2004).

No data were collected until the study was approved by the Human Subjects Committee at Louisiana Tech University (See Appendix A). The researcher also sent letters to the superintendents (See Appendix B) and completed research applications from the school districts departments of evaluation and research. Upon consent from the superintendents of the school districts and/or the appropriate departments (See Appendix C), the researcher sent letters to the principals (See Appendix D) of the fourteen middle schools requesting the participation of the mathematics teachers. The researcher included a letter to the teachers (See Appendix E) along with the teacher surveys (See Appendix F) to be distributed at the schools. These surveys were coded to denote the identity of the teacher and school. The teacher survey was adapted from the survey used by the National Assessment of Educational Progress (NAEP) which is given to 4th and 8th-grade teachers

annually in the United States. The categorical intervals used for years of teaching experience on this study's survey were exactly those created for the NAEP survey. The researcher analyzed the results of the teacher surveys to determine the groupings for the independent variables to determine the relationships between the various mathematics teachers' qualifications and the students' performance on the TAKS mathematics section.

Procedural Details

Step 1: The researcher made a request to the Human Subjects Committee at Louisiana Tech University for approval to conduct the study (See Appendix A).

Step 2: The researcher sent a letter to the superintendents and/or departments for evaluation and research requesting permission for each district's middle schools to participate in this study (See Appendix B).

Step 3: The researcher modified and revised a NAEP survey to access teacher qualifications including preparation, certification, and experience. The survey included two open-ended questions and four multiple-choice questions in order to obtain necessary data for the study (See Appendix F).

Step 4: Upon consent from the superintendents and/or departments for evaluation (See Appendix C), the researcher sent each middle school principal a cover letter (See Appendix D) explaining the teacher surveys and the purpose of the research. The teacher participant letters and surveys were enclosed (See Appendixes E and F). The researcher requested that the principals distribute the surveys to the math teachers at one time so that they could be completed and returned immediately. The principals were asked to collect the surveys and return them to the researcher.

If the surveys were not returned, the researcher followed with emails and phone calls to the schools to collect the surveys.

Step 5: The researcher compiled and compared the data from the teacher surveys regarding their qualifications. This information was used to compare and determine relationships to student performance.

Step 6: The researcher contacted the Directors of Assessment for the Spring ISD and Spring Branch ISD. A request was made to obtain all of the middle school reports for the mathematics section of the Texas Assessment of Knowledge and Skills for the April 2004 test administration.

Step 6: The researcher calculated the mean score for all students according to each teacher at each grade level in the districts.

Step 7: The researcher analyzed the scores of students who were taught by teachers of various qualifications to determine any significant differences or relationships.

Validity and Reliability

The three types of validity include content validity, criterion-related validity, and construct validity and were determined by the purpose of the reseacher and the form of information provided (LoBiondo-Wood & Haber, 1994; Popham, 2000). Content validity determines whether the test and its questions are representative of the content that the investigator intends to measure. The researcher piloted the teacher survey in order to ensure content validity. By administering the survey to others not involved in the study, the researcher may ascertain the face validity to determine the readability and clarity of content in order to ensure that the survey is obtaining the desired data from the teachers (LoBiondo-Wood & Haber, 1994).

According to the Texas Education Agency (2004) the Texas Assessment of Knowledge and Skills is a criterion-referenced test based on the Texas' Essential Knowledge and Skills (TEKS). Popham (2000) emphasized the importance and validity of criterion-referenced tests over norm-referenced due to the increased measure of students' academic ability instead of a general conclusion. The use of the criterion-referenced test ensures that the students' performance on the test is closely related to the students' actual knowledge of the subject (LoBiondo-Wood & Haber, 1994).

Several committees of educators worked to align the curriculum with the assessment at each grade level (Texas Education Agency, 2003). Teachers, test development specialists, and TEA staff members developed test objectives, instructional targets, specifications, and test item types in order to insure the content validity of the TAKS. Based on field testing, items were revised and edited for content and bias with the help of the test developers from Harcourt Educational Measurement, Pearson Educational Measurement, and BETA, Inc. All mathematics teachers are to incorporate the TEKS into their daily instruction and assessment. Therefore, the TAKS is to be an exact measurement of the students' performance of the TEKS.

To establish construct validity, the researcher must determine how a test measures an affective trait or characteristic by using multiple studies and approaches. "The researcher could use hypothesis-testing to obtain data to test the hypotheses, to make inferences, and to explain the results" (LoBiondo-Wood & Haber, 1994, p. 370). With the criterion referenced TAKS, the construct validity and content validity are closely related since the "construct tested is the academic content required by the statewide curriculum" (Texas Education Agency, 2003, p. 109). At the conclusion of the 2003-2004 school

year, a correlation study was compared the TAKS performance with other national testing programs in order to ensure criterion-related validity.

Crowl (1996) defined reliability as the consistency of measurement in that the same person could take the same test and make the same exact score. However, the reliability of the test does not ensure the validity or the use of the test to make inferences or predictions of future test results. Using internal consistency measures, the TAKS reliabilities use the Kuder-Richardson Formula 20 (KR-20) due to the multiple choice items and rely on the stratified coefficient alpha for the tests with essay prompts and short answer items (Texas Education Agency, 2003). The range is high .80s to low .90s for the internal consistency reliability of the TAKS test. There are no measures for alternate form reliability since no student takes more than one form of the test during the TAKS administration.

Data Analysis

The data were analyzed using analysis of variance for the first four hypotheses and linear regression for the fifth hypotheses by evaluating the independent variables to determine if there was a significant relationship between teacher qualifications and student performance on the Texas Assessment of Knowledge and Skills. Since there were more than two groups being examined and there were four independent variables, a analysis of variance was used to test whether group means differ statistically, the variation among all groups, and any interaction between independent variables and the dependent variable. Groups were (a) number of mathematics content hours, (b) levels of teacher certification, (c) years of teaching experience, and (d) years of mathematics teaching experience of teachers.

The dependent variable was the achievement scores of students for the TAKS mathematics portion for the spring 2004 test administration. Alpha for all statistical tests was set at .05. Effect sizes for any significant differences will be computed using Cohen's *d*. Descriptive data, including return rate, frequencies, means and standard deviations are presented in chart and table form with accompanying narratives. Linear regression and ANOVA were used to test the hypotheses in order to determine any significant differences and relationships between groups. In those cases where a significant F value was found, a Duncan post hoc test was used to determine between which groups the differences existed. Results of this data analysis are presented in tables and discussed with appropriate, accompanying narratives in the following chapter.

CHAPTER 4

RESULTS OF DATA ANALYSIS

The purpose of this study was to compare mathematics teacher preparation and experience to the achievement of middle school students (grades 6-8) on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS). This study focused on the middle school mathematics students and teachers in two metropolitan districts in Houston, Texas: Spring Independent and Spring Branch Independent School Districts. All five of Spring ISD's middle schools and eight of the nine middle schools in Spring Branch ISD participated in the study. The researcher examined the TAKS achievement levels of these middle grade students in comparison to the preparation and experience levels of their respective teachers to determine if there were any significant differences that might predict the academic performance of middle school students on the mathematics portion of the TAKS.

Student Test Data Analysis

Upon consent from the Human Subjects Committee at Louisiana Tech University the researcher also requested permission from the superintendents of each school district and the departments of evaluation and research. The individual school districts provided the spring 2004 archival student data which consisted of the TAKS mathematics mean scores for the students of each mathematics teacher in grades 6-8. Table 5 shows the number of student scores for each district and the mean score for each grade.

The means of the student scores were calculated for all teachers (n=97) according to each grade level of students taught by the teacher. The means of the students by teacher ranged from 1995.6 to 2628.4 with an overall mean of 2203.53. As seen in Table 5, the data for this study included the student TAKS mathematics scores for 6,391 students for grades 6-8 in the Spring and Spring Branch Independent School Districts.

Table 5: Student Test Data Analysis

School District	Grade	Number of Teachers	Number of Students	Mean TAKS score
Spring ISD	6	14	1091	2184.86
Spring ISD	7	15	1110	2148.20
Spring ISD	8	15	1374	2167.73
Spring Branch ISD	6	17	967	2270.75
Spring Branch ISD	7	20	1011	2178.64
Spring Branch ISD	8	16	838	2264.07
TOTALS		97	6391	2203.53

Teacher Survey Data Analysis

After obtaining the districts' approvals, the researcher mailed letters to each of the principals of the middle schools along with the teacher letters and surveys. Personal phone calls and emails were also sent to some of the principals in order to seek their involvement in this study. As seen in Table 6, thirteen of the fourteen middle school principals agreed to disseminate the surveys and for their teachers to participate in the study during the 2004-2005 school year.

The data in Table 6 indicate there was a teacher survey return rate of 76% with 97 teachers participating in the study. This number of teachers only included teachers who were at these schools during the 2003-2004 school year; thus, having given the TAKS test to their students.

Table 6: Teacher Survey Data Collection Results

Schools	Surveys Received	Number of Teachers	Percent Received
Middle School A	11	9	60%
Middle School B	9	15	80%
Middle School C	8	10	80%
Middle School D	7	8	88%
Middle School E	9	9	100%
Middle School F	4	5	80%
Middle School G	4	4	100%
Middle School H	8	13	62%
Middle School I	6	10	60%
Middle School J	8	12	67%
Middle School K	13	14	93%
Middle School L	6	10	60%
Middle School M	4	4	100%
TOTALS	97	128	76%

Each mathematics teacher in grades 6-8 was asked to complete the teacher name and name of school in order to compare the teacher's data with the students' test data.

The teacher survey (See Appendix F) included four multiple choice questions: (a) number of mathematics content hours, (b) level of teaching certification, (c) number of years teaching experience, and (d) number of years teaching middle school or junior high mathematics. The results for question one regarding number of mathematics content hours are shown in Table 7. The grouping categories of these hours were determined from a similar survey used by the National Assessment of Educational Progress and given to eighth grade teachers nationwide. One-third of the teachers had more than 27 graduate and undergraduate hours in mathematics. Seven percent of the middle school mathematics teachers had less than nine hours of mathematics.

Table 7: Survey Results for Number of Mathematics Content Hours

Survey Question: How many graduate and undergraduate mathematics hours (not including methods courses have you completed)?

Number of Math Hours	Number of Responses	Percent
Less than 9 hours	7	7.2%
9 – 15 hours	17	17.5%
16 – 21 hours	20	20.6%
22 – 27 hours	21	21.6%
More than 27 hours	32	33.0%
TOTAL	97	100.0%

The second question on the teacher survey was directed at the level of certification possessed by the teacher. Since Texas Education Agency does offer a middle school mathematics certification, that was offered as a choice. In addition, alternative

certifications were included for those teachers still working towards teacher credentialing. The levels of certification were coded as follows: (1) other certifications, (2) temporary or emergency certification, (3) alternative certification, (4) elementary education certification, (5) middle school certification, and (6) secondary mathematics certification. This coding was done for the purpose of this study based on the research which indicated that teachers having certification in secondary mathematics produced higher student achievement (Darling-Hammond, 2000; Hawk et al., 1985). Table 8 shows the frequencies for each level of certification for the 97 teachers in this study. Eighty percent of the teachers had received certifications in either elementary education or secondary mathematics educations; whereas, only 15% had received the specialty certification for middle school education. The alternative certification and other certifications only comprised 4% of the teacher surveys. None of the teachers surveyed had temporary or emergency certifications.

Table 8: Survey Results for Levels of Certification

Survey Question: What type of certification or teaching certificate do you have?

Levels of Certification	Number of Responses	Percent
Elementary Education	39	40.2%
Middle/Junior High School	15	15.5%
Secondary Mathematics	39	40.2%
Temporary/Emergency Certification	0	0.0%
Alternative Certification	2	2.1%
Other	2	2.1%
TOTAL	97	100.0%

The remaining two survey questions addressed the number of years of experience, but were divided into two categories: (1) total number of years experience and (2) number of years teaching middle school mathematics. The year ranges were duplicated from the teacher survey used by the National Assessment of Educational Progress. As self-reported by the teachers, Table 9 shows the data for number of total years experience.

Table 9: Survey Results for Years of Teaching Experience

Survey Question: Counting this year how many years in total have you taught at the elementary, middle/junior high level, or secondary level?

Number of Years	Number of Responses	Percent
2 years or less	5	5.2%
3 – 5 years	21	21.6%
6 – 10 years	27	27.8%
11 – 24 years	31	32.0%
25 years or more	13	13.4%
TOTAL	97	100.0%

The differences in Table 10 reflect that many teachers have changed subject areas since the number of years experience varies. Most of the teachers were not beginning teachers, but had several years of experience. One major difference was the number of teachers who had taught 25 years or more. Only 13% of the teachers had taught for at least 25 years; whereas, only 5% had taught middle school mathematics for that number of years. Similarly, only 7.2% of the teachers had two years or less teaching experience.

Table 10: Survey Results for Years of Middle School Math Teaching Experience

Survey Question: Counting this year how many years in total have you taught middle school or junior high mathematics?

Number of Years	Number of Responses	Percent
2 years or less	7	7.2%
3 – 5 years	33	34.0%
6 – 10 years	34	35.1%
11 – 24 years	18	18.6%
25 years or more	5	5.2%
TOTAL	97	100.0%

Linear Regression Analysis

Using the teacher surveys and the student test data, a linear regression using the independent variables was used to determine if there was a significant relationship between teacher qualifications and student performance as addressed by the first hypothesis of this study.

H_1. No significant relationship exists between teacher factors and middle school student achievement on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS).

The dependent variable was the students' mean score on the mathematics portion of the Texas Assessment of Knowledge Skills for the spring 2004 test administration. The independent variables were (a) number of mathematics content hours, (b) level of

teaching certification, (c) number of years teaching experience, and (d) number of years teaching middle school/junior high mathematics.

The results of the linear regressions are shown in Table 11 along with the R squared calculations. Alpha for all statistical tests was set at .05. According to the linear regression, the significance level was .04 for the variables used in this study.

Table 11: Linear Regression Analysis

	R	R Square	df	F	Sig
Regression	0.33	0.11	4	2.71	.04

The analysis also showed the relationship according to the independent variables as can be seen in Table 12. The number of years teaching middle school mathematics had the greatest level of significance at .03 with relationship to student achievement. The results of the linear regressions addressed the null hypothesis: No significant relationship exists between teacher factors and middle school student achievement on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS). Since there was a significant relationship, this hypothesis was rejected.

Table 12: Regression of Independent Variables

Independent Variable	Beta	t	Sig
Number of Math Hours	.06	0.54	.59
Level of Certification	.09	0.85	.40
Years Teaching Experience	-.02	-.15	.88
Years Teaching Math Experience	.30	2.17	.03*

Note. * $p < .05$

ANOVA Results

In addition to analyzing the data according to linear regressions, the researcher also examined the results of one-way ANOVA data for the remaining four null hypotheses:

H_2. No significant difference exists in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying mathematics content hours across the sampled school districts.

H_3. No significant difference exists in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying levels of certifications across the sampled school districts.

H_4. No significant difference exists in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying years of teaching experience across the sampled school districts.

H_5. No significant difference exists in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying years of mathematics teaching experience in the middle grades across the sampled school districts.

Number of Mathematics Content Hours

The results of the ANOVA for number of mathematics content hours are shown in Table 13. Again, the range of mathematics hours was derived from a similar teacher survey used as part of the National Assessment of Educational Progress (NAEP). The

significance level was only .49; thus, this null hypothesis was accepted for the number of mathematics content hours.

Table 13: ANOVA for Number of Mathematics Content Hours

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	71341.13	4	17835.28	0.86	.49
Within Groups	1917964.50	92	20847.44		
TOTAL	1989305.70	96			

However, the teachers with more than 27 hours of mathematics did have students with the highest mean scores on the TAKS according to the mean data shown in Table 14.

Table 14: Means for Number of Mathematics Content Hours

Number of Math Hours	Mean	N	Std. Deviation	Std. Error of Mean
Less than 9 hours	2211.13	7	123.24	46.58
9 – 15 hours	2185.76	17	131.42	31.88
16 – 21 hours	2161.86	20	140.20	31.35
22 – 27 hours	2208.12	21	130.96	28.58
More than 27 hours	2234.34	32	164.03	29.00
TOTAL	2203.53	97	143.95	14.62

Levels of Teacher Certification

As shown earlier, most of the teacher certifications were either elementary education or secondary math education. Only 15% of the teachers had middle school certification, 2% alternative certification, and 2% other certification, while 40% had

secondary mathematics certification. The ANOVA results for teacher certification levels and their relationships to student achievement are shown in Table 15. The significance for teacher certification level as it related to student achievement was .31; therefore, the null hypothesis for level of certification was accepted.

Table 15: ANOVA for Levels of Teacher Certification

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	100190.04	4	25047.51	1.22	.31
Within Groups	1889115.60	92	20533.87		
Total	1989305.70	96			

As shown in Table 16, teachers with secondary mathematics certifications had student mean scores of 2234.91; whereas, teachers with elementary education certifications had student mean scores of 2187.41. The teachers who had received middle school certifications or alternative teaching certifications had students with even lower mean scores of 2175.05 and 2071.50 respectively.

Table 16: Means for Levels of Teacher Certification

Level of Certification	Mean	N	Std. Deviation	Std. Error of Mean
Elementary Education	2187.41	39	126.44	20.25
Middle/Junior High School	2175.05	15	142.84	36.88
Secondary Mathematics	2234.92	39	156.08	24.99
Alternative Certification	2071.50	2	27.58	19.50
Other	2251.50	2	263.75	186.50
TOTAL	2203.53	97	143.95	14.62

Years of Teaching Experience

Finally, the years of experience were divided into two categories: (1) number of total years teaching experience and (2) number of years teaching middle school or junior high mathematics. The data in Table 17 showed a significance level of .19 for total years of teaching experience; thus, the null hypothesis was accepted for number of years teaching experience.

Table 17: ANOVA for Total Years of Teaching Experience

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	128356.69	4	32089.17	1.59	.19
Within Groups	1860949.00	92	20227.71		
Total	1989305.70	96			

However, the significance level for years teaching middle school or junior high mathematics was .03 according to the data in Table 18; therefore, this null hypothesis was rejected. The ANOVA results shown in Tables 17 and 18 were statistically different with only years of experience teaching middle school/junior high mathematics having a significant relationship of .03.

Table 18: ANOVA for Years of Teaching Middle School or Junior High Mathematics

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	224354.72	4	56088.68	2.92	.03*
Within Groups	1764950.90	92	19184.25		
Total	1989305.70	96			

Note. * $p < .05$

The average test score for each teacher's classroom according to the teacher's years of experience is shown in Tables 19 and 20 for these two hypotheses related to years of teaching experience. However, the data results were similar with the teachers having 11 – 24 years of experience that produced students with the highest means of achievement on the TAKS. The next two groups were teachers with 6 – 10 years experience, and then those teachers with 25 years or more experience in either total teaching years experience or years experience teaching middle school or junior high mathematics.

Table 19: Means for Total Years of Teaching Experience

Years of Teaching Experience	Mean	N	Std. Deviation	Std. Error of Mean
2 years or less	2101.34	5	74.06	33.12
3 – 5 years	2159.36	21	121.82	26.58
6 – 10 years	2220.75	27	162.65	31.30
11 – 24 years	2232.97	31	147.28	26.45
25 years or more	2208.22	13	130.29	36.14
TOTAL	2203.53	97	143.95	14.62

Table 20: Means for Years of Teaching Middle School or Junior High Mathematics

Years Teaching Experience Middle School/Junior High Mathematics	Mean	N	Std. Deviation	Std. Error of Mean
2 years or less	2123.43	7	75.919	28.70
3 – 5 years	2154.59	33	125.96	21.93
6 – 10 years	2230.24	34	149.71	25.68
11 – 24 years	2267.36	18	154.88	36.51
25 years or more	2227.30	5	137.104	61.32
TOTAL	2203.53	97	143.95	14.62

Summary of Post Hoc Analysis

Since a significant value was found only for the relationship between students' mean scores and number of years teaching experience for middle school or junior high mathematics, further analysis was done using Duncan post hoc as seen in Table 21. The teachers in this study with 11 – 24 years of middle school mathematics teaching experience had the students scoring the highest scores with a mean score of 2267.36. However, those teachers with 6 -10 years of experience also had slightly higher scores than teachers with 25 years or more experience. The teachers with the least number of years of experience in middle school or junior high mathematics had students with the lowest mean scores of 2123.43 on the mathematics portion of the TAKS in spring 2004.

Table 21: Duncan Post Hoc Analysis

Years Teaching Experience Middle School/Junior High Mathematics	N	Mean (alpha = .05)	
		1	2
2 years or less	7	2123.43	
3 – 5 years	33	2154.59	2154.59
6 – 10 years	5	2230.24	2230.24
11 – 24 years	34		2267.36
25 years or more	18	2227.30	2227.30
Significance		.10	.09

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to compare mathematics teacher preparation and experience to the achievement of middle school students (grades 6-8) on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS). Using a theoretical framework, the study examined the relationship between factors of teacher preparation, certification, and experiences. The researcher used a causal-comparative research design to determine the extent to which the teacher qualification variables were related to the student achievement. Measures of teacher qualification included the following four independent variables: (a) number of mathematics content hours, (b) type of teaching certification, (c) number of years teaching experience, and (d) number of years teaching middle school/junior high mathematics. "A high quality teacher is the single most significant factor on how well students achieve," according to former Secretary of Education, Paige (2002, p.1). In his annual report on teacher quality in July 2003, Paige emphasized teacher passage of content area standardized tests and reducing the barriers to the teaching profession (Emerick et al., 2004).

Wenglinsky (2000) also tried to determine the relationship between student achievement and teacher knowledge. He stated that teacher knowledge, assessment, and instructional methods had a higher impact on student achievement than class size.

Conversely, Goldhaber and Brewer (1998) found no significant difference when examining the degrees of teachers and the achievement of their students. However, in a study of high schools in California, teacher experience and preparation had a significant positive impact on student achievement after controlling for poverty and other student demographics (Fetler, 1999).

The participants in this study were students and teachers in thirteen of the fourteen middle schools in two school districts near Houston, Texas: Spring Independent and Spring Branch Independent. These school districts were selected because of their similarities in location, student diversity in ethnicity, and populations. The student data were from 6,391 students in grades 6-8 on the 2004 test administration of the TAKS. These archival data were obtained from the respective districts with the permission of the superintendents and departments of evaluation and research. Table 5 in chapter four showed the number of student scores for each district and the mean scores for each grade.

The other data source for this study was the teacher survey that was adapted from the National Assessment of Educational Progress (NAEP) survey. These surveys were mailed to the schools and administered through the middle school principals with permission from the superintendents and/or departments of evaluation and research. Table 6 indicated the rate of return for each school and the 76% rate of return overall with a total of 97 teachers participating.

The teacher surveys included four specific questions related to teacher qualification and experience that were described in tables 7-10. One-third of the teachers had more than 27 graduate and undergraduate hours in mathematics; whereas, 7% of the middle school mathematics teachers had less than nine hours of mathematics. Although

Texas does offer a middle school math certification, only 15% had received the specialized certification. Eighty percent had received certifications in either elementary education or secondary mathematics education. The last two questions of the teacher survey addressed the number of years experience and were broken into two categories of total experience and experience teaching middle school mathematics. The data showed that many of the teachers in this study had taught other subjects and/or grades since there was a discrepancy in the number of years. Five percent of the teachers had two years or less of teaching experience while 13% had 25 years or more. However, only 5% of the teachers had 25 years or more teaching middle school mathematics.

The student data and teacher data were analyzed using linear regression in address the following null hypothesis:

H_1. No significant relationship exists between teacher factors and middle school student achievement on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS).

Findings of the study were accepted at a .05 level of significance. As revealed in Tables 11 and 12, the data revealed that a significant relationship did exist between teacher factors and student achievement with a significance level of .04; thus, rejecting the null hypothesis.

The four independent variables (number of mathematics content hours, level of teacher certification, number of years teaching experience, and number of years teaching middle school mathematics) were then analyzed using one-way analysis of variance (ANOVA) to determine the remaining four null hypotheses as follows:

H_2. No significant difference existed in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying mathematics content hours across the sampled school districts.

H_3. No significant difference existed in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying certifications across the sampled school districts.

H_4. No significant difference existed in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying years of teaching experience across the sampled school districts.

H_5. No significant difference existed in the scores of the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) for middle school students of teachers with varying years of mathematics teaching experience in the middle grades across the sampled school districts.

The results indicated that only one of the teacher factors had a statistically significant impact on student achievement. Of these four null hypotheses, three hypotheses were accepted addressing the factors of mathematics content hours, levels of teacher certification, and total years teaching experience. Although the results did indicate slight differences, none of these factors showed statistical significance in relationship to student achievement.

However, the following research question could be answered: Do middle school students who have teachers with varying years of middle school mathematics teaching

experience score significantly higher on the mathematics section of the Texas Assessment of Knowledge and Skills (TAKS) across the sampled school districts? The level of significance was .03 for the variable of teaching experience in middle school or junior high mathematics. The Duncan post hoc analysis specified that teachers with 11-24 years of teaching experience at this level had the highest student scores on the TAKS. Table 21 revealed that the teachers in this study with 6-10 years had the second highest student test scores with the more experienced teachers coming in third. As predicted, teachers with less experience in middle school mathematics had students with lower test scores. The results of this study indicated a .03 level of significance for the factor of years of teaching experience in middle school mathematics; thus, rejecting the null hypothesis.

Conclusions

Findings from this study indicated that a significant relationship does exist between teacher factors and student achievement. Although Darling-Hammond (2000) found that teacher preparation and certification were the determining factors, the results of this study showed that teacher experience had a greater impact on student achievement. Specifically, the years of experience were defined as the number of years teaching middle school or junior high mathematics. Only 7% of the teachers in this study had two years or less experience. Hammond explained that the years of experience only mattered if the experiences were less than three years. These findings differ with the Duncan post hoc analysis of this study that showed teachers with 11-24 years had the higher student scores, then those teachers with 6-10 years, and thirdly, the teachers with 25 years or more experience. Hence, the number of years teaching experience did have a statistical impact on student achievement even beyond the beginning teachers. However,

the more years of experience did not result in the highest student scores. This finding can be explained by Rosenholtz (1986) who concurred that the benefits from years of experience tend to taper off after about five years of teaching experience and suggested that experienced teachers may stop growing professionally and become tired in their teaching positions.

These findings are unlike Wilkins' (2002) who found that neither teacher experience nor teacher advanced training presented a direct relationship to the achievement of students sample in West Virginia. Similarly, Herman (2000) used a self-assessment survey of 272 teachers to examine the hypothesis that teacher efficacy was the mediating factor that enabled teacher experience to affect student motivation, and ultimately student achievement. However, the results also showed that teaching experience was largely unrelated to the student's achievement and their motivation to learn.

Fetler (1999) found other results in a study of high school staff characteristics and mathematics test results in 795 schools in California. He concluded that teacher experience and preparation had a significantly positive impact on student achievement after controlling for poverty and other student demographics. Fetler's conclusions point to a limitation of this study that might would have produced more significant findings if the data analysis had controlled for socioeconomic status of the students sampled.

Another result of this study was the lack of significance based on the number of mathematics content hours completed by the teachers surveyed. Leinhardt and Smith (1995) stated that teachers should possess an expertise level of knowledge in the subjects that they plan to teach. Seven percent of the mathematics teachers in this study had less

than nine hours of mathematics. The No Child Left Behind legislation has required middle school teachers to have more content hours to become highly qualified (Bush, 2001). As school districts are examining which teachers are highly qualified, many are having trouble identifying which transcript hours should count towards qualifying requirements (Emerick et al., 2004).

Although 33% of the teachers in this study had more than 27 hours of mathematics content, this factor of teacher knowledge was not able to predict the student achievement scores on the TAKS. The independent variable related to the number of content hours of a teacher only had a significance level of .49 in relationship to student achievement. The survey results indicated that 17.5% of the teachers had 9-15 hours, 20.6% had 16-21 hours, and 21.6% and 22-27 hours. Even with all of the increased content requirements, 7% of the middle school mathematics teachers surveyed in this study had less than nine hours of mathematics. These results suggest that requiring teachers to complete more rigorous content hours is not having the desired impact on student achievement. As middle school mathematics changes, so should the mathematics classes required by teachers (Mann, 2000). A limitation to the study might be in the way this question was asked since teachers indicated the number of mathematics content hours not including methods classes. As noted by Silver (1998), the methodology for presenting the mathematics might be more closely related to student performance that the content hours in calculus and trigonometry which are required for secondary mathematics education majors.

The teacher's method of instruction might have a greater impact on student performance than the actual teacher's content knowledge. This conclusion is supported

by Brewer (2003) who found that teachers must find a balance between their subject knowledge and the methods they use to present the information effectively to their students. The subject knowledge only helps the teachers to connect the content through the presentation of the lesson (Leinhardt & Smith, 1985).

Certified mathematics teachers had better levels of instruction which suggested that teachers were more successful in presenting the material if they had the content knowledge (Hawk et al., 1985). These students had been given Stanford pretests and then given posttests after five months of classroom instruction. The researchers concluded that neither years of teaching nor degree level impacted the achievement of students, but the students of mathematics certified teachers had significantly higher achievement levels in mathematics than those students who had been taught by non-certified teachers according to the ANOVA. Suggestions for further study might include independent variables related to the instructional methods and assessment used by the mathematics teachers to improve student achievement.

After conducting research with the Southeast Center for Teaching Quality (SECTQ), Emerick et al. (2004) agreed that content knowledge is not sufficient in itself to measure teacher quality. They concluded that other areas should be emphasized including developmental student learning stages, various forms of student assessment, and changes in daily instruction for the classroom. After visiting 24 schools in four southern states, Emerick et al. found that approximately 30% of the teachers themselves were unsure of their highly qualified status based on teacher content knowledge.

Another requirement to be highly qualified is possessing teacher certification at the state level or having passed the state licensure exam. Matson (1999) concluded that

when classrooms have qualified and certified teachers, their students' achievement is higher. The grades of all middle school students taking Algebra I were higher when more than 68% of the teachers were certified. However, in this study, the level of teacher certification did not determine the level of student achievement and had only a .31 level of significance. Perhaps the statistical results would have been more significant if the sample had included students and teachers in high school mathematics rather than at the middle school level. In addition, other subject areas such as science or English might be examined that require advanced levels of teacher content knowledge in order to become teacher certified.

Ingersoll (1997) had found that almost one-third of all high school mathematics teachers had neither a major or minor in mathematics. Of the teacher surveyed for this study, 40% had secondary mathematics certification, but this factor did not have a significant relationship to their students' test scores. Other certification levels of the teachers included elementary education (40.2%) and middle school/junior high (15.5%). This finding was consistent with the study of Goldhaber and Brewer (1998) that concluded teachers with advanced degrees did not produce higher student results. Conversely, in a study in 1996, they had found that higher student performance scores were associated with teachers who were certified in mathematics. Schempp et al. (1998) did note that the teachers' levels of expertise impacted the attitudes and motivation of the students.

Since only 2% of the teachers had alternative or temporary certifications, no significant conclusions could be drawn in comparison to other types of certifications. However, the alternative certification research of Darling-Hammond (1990) provides

conclusions that are relevant to other findings of this study. She noted that teacher preparation training must include child development, learning theory, curriculum development, and teaching methods. Teacher preparation itself and the subject matter are important in determining teacher effectiveness especially in the areas of secondary science and mathematics. Sindelar and Marks (1993) also suggested that alternative certification programs should focus on the content mastery for secondary teachers and the pedagogical skills for elementary and special education teachers. These findings of other researchers and the results of this study indicate that the strategies used to prepare alternative certified teachers might need to be applied to traditional teacher programs as well. The weaknesses of alternative certified teachers were in (a) curriculum development, (b) pedagogical knowledge, (c) different learning styles, (d) classroom management, and (e) student motivation (Darling-Hammond, 1990; Miller, McKenna, & McKenna, 1998). Jackson and Davis (2000) added that middle school teachers have additional training in adolescent development. These areas of teacher training for alternative certifications and middle school certifications might be included for further research to compare teacher qualifications and student achievement.

Limitations

The teacher data for this study were collected using a self-reported survey which could be considered a limitation for this study. The information from the questions regarding number of mathematics content hours and years of experience could possibly have been obtained from the school districts' human resources departments. The levels of certification could have been identified from the State Board of Teacher Certification if the researcher had known the individual teacher names and social security numbers.

As stated previously, a limitation to the study may have been in the definition of the number of mathematics content hours. For the purpose of this study, these hours were defined as the number of mathematics content hours completed by the teacher, but did not include methods courses in mathematics. After reviewing other research studies and the results from this study, the teacher's knowledge of methodology and instructional strategies might have a significant impact on the student achievement.

Another drawback for this study was the timing in the collection of the student data as compared to the teacher data. The student data were the spring 2004 results of the TAKS administration, and these archival data were obtained from the districts during the 2004-2005 school year. The teacher surveys targeted those teachers that taught the middle school students during the spring of 2004; but these data were not collected until the fall of 2004. Therefore, some of the teachers who were at the sampled schools were no longer employed and could not be reached in order to complete the teacher survey for this study. This limitation had a significant effect on the sample size for the teacher surveys and on the survey return rate.

Since the student data were collected from the districts, the data were provided according to each middle school teacher's classroom and gave the statistical mean for each teacher's students. The statistics findings of this study could be improved by using the raw data for students' scores rather than finding the mean for each teacher's classroom of students. The individual student scores were not available from the school districts; thus, the data collection for this study was altered. The sample size for student data reflected the number of teachers' classrooms ($n = 97$) rather than the number of individual students ($n = 6,391$).

Recommendations

The following recommendations for further research are offered based on the review of literature and the findings from the study:

1. As noted by Goldhaber and Brewer (1998), further research should explore the subject-specific methods training of the teachers in the area of mathematics rather than the number of content hours or type of certification. In other words, studies should focus on the teacher's methodology and instructional methods to determine if there is any relationship to student achievement.
2. Further research could examine the impact of professional development of teachers to see if student performance would be significantly improved. Richardson (1998) concluded that higher student scores on mathematics assessment were the result of quality professional development for the teachers.
3. This research could be replicated using other measures for student achievement including norm-referenced and criterion-referenced tests. For example, the sample could include middle school students in Louisiana and measure their achievement using the LEAP 21 or IOWA tests. Rothstein (1998) noted that the reporting of standardized test scores has often been misleading; therefore, other measures of student achievement might be considered for further research.
4. The study could be revised to include hypotheses based on each grade level of the students to determine if the student achievement varied from sixth to eighth. Would the number of content hours of the teachers have a greater impact on the student achievement of eighth graders who are taking higher mathematics courses including algebra content?

5. This research could be expanded to include various subjects including science and English or could also be replicated at the high school level rather than just middle school. Goldhaber and Brewer (1998) had found significant differences in student achievement when examining the content knowledge of secondary mathematics and science teachers.
6. Further research might examine additional student variables including the socioeconomic status of the students, class sizes, and grouping of students. As Fetler (1999) noted, significant differences were found relating to teacher experiences after controlling for poverty and other student demographics.

Implications for Education

Based on the review of literature, results of this study, and conclusions, the following implications for education are suggested:

1. Since the teacher's number of mathematics content hours was not significant, then teacher pre-service programs might increase the number of methodology or instructional classes instead. Brewer (2003) concluded that there must be a balance between the subject knowledge and the methods use to present the information effectively.
2. The definition of highly qualified needs to be re-examined to reflect the teacher qualifications that impact student achievement. Perhaps the quality of a teacher could be measured by the students' academic performance rather than the teacher qualifications as in Tennessee (Robelen, 2003). Questions concerning NCLB and the "highly qualified" teacher requirements have been raised by the Southeast

Center for Teaching Quality (SECTQ) to determine if these efforts are producing "high-quality" teaching in the classroom (Emerick et al., 2004).

3. When hiring mathematics teachers, a principal may want to examine the number of years teaching middle school rather than the teacher's certification. In the past, principals have been able to easily shift middle school teachers from subject to subject because they were elementary certified in grades 1-8. Now with highly qualified requirements and accountability standards, principals are limited to the subjects that middle school teachers may teach. Scales (1993) found that the requirements for middle school certification may lead to teacher shortages. Based on this study, the longer a teacher remains in one subject, the more proficient they become, and ultimately, their students perform better academically.

4. Also, middle school principals may need to arrange for additional professional development opportunities in the content areas and instructional strategies to improve student achievement. Emerick et al. (2004) agreed that school districts and principals must provide more professional development opportunities including formal research based strategies and also informal trainings to help with standards, curriculum, and accountability.

5. School districts may need financial incentives to recruit qualified mathematics teachers with monies given to those with more years experience rather than rewarding those with higher degrees or levels of certification. Since no significant evidence supported that teachers with advanced degrees produced higher student results, then teachers with advanced degrees may not need to receive more pay (Goldhaber & Brewer, 1998). Perhaps, the question should be addressed as to

when the teachers received their certifications or degrees, and whether or not they have obtained any additional training or professional development since completing the certification or degree. The need for continued training has been addressed by the issuance of continuing education units in order to encourage teachers to be lifelong learners like their students.

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APPENDIX A

HUMAN USE COMMITTEE APPROVAL LETTER

LOUISIANA TECH
UNIVERSITY

OFFICE OF UNIVERSITY RESEARCH

MEMORANDUM

TO: Dr. Randall Parker, Mrs. Carrie Ferguson

FROM: Nancy Fuller, University Research

SUBJECT: HUMAN USE COMMITTEE REVIEW

DATE: 11/16/04

In order to facilitate your project, an EXPEDITED REVIEW has been done for your proposed study entitled:

"Differences in Teacher Qualification and the Relationship to Student Achievement"
Proposal # HUC-109

The proposed study procedures were found to provide reasonable and adequate safeguards against possible risks involving human subjects. The information to be collected may be personal in nature or implication. Therefore, diligent care needs to be taken to protect the privacy of the participants and to assure that the data are kept confidential. Further, the subjects must be informed that their participation is voluntary.

Since your reviewed project appears to do no damage to the participants, the Human Use Committee grants approval of the involvement of human subjects as outlined.

This approval is granted for one year from the date shown above. Projects should be renewed annually. Projects involving NIH funds require annual education training to be documented. For more information regarding this, contact the Office of University Research.

You are requested to maintain written records of your procedures, data collected, and subjects involved. These records will need to be available upon request during the conduct of the study and retained by the university for three years after the conclusion of the study.

If you have any questions, please contact Mary Livingston at 257-2292.

APPENDIX B

LETTER TO SUPERINTENDENTS

November 10, 2004

Dr. Michael Hinojosa, Superintendent
Spring Independent School District
16717 Ella Boulevard
Houston, Texas 77090

Dear Dr. Hinojosa,

The purpose of this letter is to seek your approval and assistance in gathering information for a research study titled "Differences in Teacher Qualifications and the Relationship to Student Achievement." The purpose of this study is to compare the teacher preparation and experience to the achievement of middle school math students (grades 6-8) on the mathematics section of the Texas Assessment of Knowledge and Skills test.

I am requesting your permission to survey the math teachers at all five middle schools in the Spring Independent School District. Also, I will need access to the mathematics spring 2004 TAKS results of the students at these middle schools. I will be matching the teacher data with the student performances for each teacher. One of the reasons that I selected your district is because of the vast diversity of the students and staff in addition to the emphasis placed on student performance.

The surveys will be sent directly to the principals to distribute to the teachers. I have attached a copy of the cover letter and survey for your approval. The questions simply ask about the teacher's preparation, certification, and experience which should take less than 10 minutes to answer.

The results of this research will be useful in school and district initiatives to improve teacher quality and student performance. Ultimately, both aspects will have impacts on the district and schools accountability performance. You and the principals in the participating schools may receive a summary of the results of the study upon request to share with teachers, administrators, and other stakeholders. The results will not mention teachers, administrators, or schools by name. However, the relationship between teacher qualifications and average student performance will be included.

Your permission is crucial in obtaining the data needed for this research project. I understand how busy you are, and sincerely appreciate your time and cooperation in this matter. Upon your decision, I will need a letter granting your permission to conduct the stated research in Spring ISD. If you have any questions, please feel free to contact me via email cferguson@lincolnschools.org or by phone at (318)251-1601.

Sincerely,

Carrie Ferguson

Carrie Ferguson, Principal
Ruston Junior High School

APPENDIX C

SCHOOL DISTRICT APPROVAL LETTERS

SPRING ISD

Reaching For The Stars

Office of the Superintendent
Michael Hinojosa, Ed. D.

16717 Ella Boulevard
Houston, Texas 77090-4299
281-586-1130
Fax: 281-586-1134
mhinojosa@springisd.org

November 5, 2004

Ms. Carrie Ferguson
Ruston Jr. High
481 Tarbutton Road
Ruston, LA 71270

Dear Ms. Ferguson:

I reviewed your request dated November 3, 2004. I hereby authorize you to conduct the research mentioned in your letter. In exchange for our participation, the District would like a copy of the results.

Good luck in your endeavors. Please contact me if further clarification is necessary.

Respectfully,

Michael Hinojosa, Ed. D.
Superintendent of Schools

Department of Assessment,
Accountability, & Research

Jennifer P. Cobb
cobbj@springbranchisd.com

Spring Branch
Independent School District
Quality without question!

November 18, 2004

Carrie Ferguson
102 Bonaparte Dr.
West Monroe, LA 71291

Dear Ms. Ferguson:

The Spring Branch Independent School District is pleased to approve your research study entitled, "Differences in Teacher Qualifications and the Relationship to Middle School Student Achievement in Math." This research seeks to compare mathematics teacher preparation and experience to the achievement of middle school students on the mathematics section of the TAKS test. The proposed study will be completed December 2004.

Approval to conduct the study in SBISD is contingent on your meeting the following conditions:

- The study is limited to the Spring Branch ISD middle schools.
- This study requires the surveying of mathematics teachers. The surveys should take no longer than 20 minutes to complete. No students will be contacted for this study.
- TAKS data will be provided at the district level.
- The school principal approves the participation of staff and the use of school premises to complete the study.
- Principals will receive a copy of the entire proposal.
- Participation in this study requires the active signed consent of all participants.
- The investigator will follow the guidelines of the Human Subjects Committee regarding confidentiality of the students, staff, and school data.
- The study does not interfere with districtwide instructional/testing program.
- The study involves no expense to the district.
- The district receives copies of the completed final report within 30 days of its completion.

Any changes or modifications to the current proposal must be submitted to the Department of Assessment, Accountability, and Research. Should you need additional information or have any questions concerning the process, please contact me at (713) 464-1511 ext. 2402.

Sincerely,

Jennifer P. Cobb
Assistant Administrator
Research and Evaluation

CC:
Keith Haffey
Ann Worley
Jill Wright
Jennifer Parker
Bob Price
Laura Schuhmann
Damon Murphy
Marianne Cribbin
David Sablatura
Cynthia Chai
Kathy Menotti

APPENDIX D

LETTER TO PRINCIPALS

<Date>, 2004

«Title» «FirstName» «LastName», Principal
«School»
«Address1»
«City», «State» «PostalCode»

Dear «Title» «LastName»:

With the approval of Superintendent <Superintendent's Name>, I am requesting your assistance in surveying the math teachers at your school. This survey will be used to investigate the relationship between teacher certifications and qualifications with student achievement as evidenced by the TAKS tests.

The results of this research will be useful in school and district initiatives to improve teacher quality and student performance. Ultimately, both aspects will have impacts on the district and school accountability performance. Principals in participating school may receive a summary of the results of the study upon request to share with teachers, administrators, and other stakeholders. The results will not mention teachers, administrators, or schools by name. However, it will reveal the relationship between teacher qualifications and average student performances.

Enclosed are surveys and cover letters for each of your math teachers at your school. Please disseminate these surveys to all of the math teachers at one time so that they may complete the survey and return them to you. The survey contains only 8 questions about teacher preparation and experience and should only take about 10 minutes to complete. I am asking that you please return the surveys to me within five days of your receipt of them.

Your participation and the participation of your teachers are critical to the success of this research. I truly value the teachers' responses and look forward to completing the data analysis to determine the results of this study. I understand how busy you are, and sincerely appreciate your time and cooperation in this matter. If you have any questions, please feel free to contact me immediately via email cferguson@lincolnschools.org or by phone at (318)251-1601.

Sincerely,

Carrie Ferguson

Carrie Ferguson, Principal
Ruston Junior High School

APPENDIX E

LETTER TO TEACHERS

December 3, 2004

Dear Classroom Teacher:

With the approval of Superintendent Michael Hinojosa and your principal, I am gathering information for a research study titled "Differences in Teacher Qualifications and the Relationship to Middle School Student Achievement in Math." The purpose of this study is to compare the teacher preparation and experience to the achievement of middle school math students (grades 6-8) on the mathematics section of the Texas Assessment of Knowledge and Skills test.

Your participation and completion of this survey is voluntary. The results will not mention teachers, administrators, or schools by name. However, the relationship between teacher qualifications and average student performances will be included. Participant responses will be kept confidential, identified only by the code number found at the upper right-hand corner of the survey. Please answer each item honestly and to the best of your ability. After completing the survey, please return it to your principal.

As a former middle school math teacher myself, I realize how busy your schedule can be and understand that your time is precious. The enclosed survey has only 6 questions and will take you less than 10 minutes to complete. Due to time constraints, your principal has the responsibility to collect and return the surveys to me within 5 days of receiving them.

If you would rather complete this survey electronically, please email me at cferguson@lincolnschools.org, and I will send you this survey as an attachment. You can then complete the survey and email it back to me. Your prompt response is greatly appreciated. Thanks so much for your time and participation in this research project.

Sincerely,

Carrie Ferguson

Carrie Ferguson, Principal
Ruston Junior High School

APPENDIX F

TEACHER SURVEY

Code #: _____

Teachers,

Please complete the following questionnaire regarding your personal information, educational background, and teaching experience. The results will be used for research analyzing the relationship of teacher experience and certifications to student achievement on the TAKS in grades 6-8. Thank you for your cooperation and time in helping with this data. Please return to your principal as soon as possible. By signing below, you indicate that you have read the description of the study and agree to participate.

Teacher Signature: _____

Personal Information

1. Name: _____

2. School: _____

Educational Background

3. How many graduate and undergraduate mathematics hours (not including methods courses) have you completed?
   (1) Less than 9 hours
   (2) 9 - 15 hours
   (3) 16 - 21 hours
   (4) 22 - 27 hours
   (5) More than 27 hours

4. What type of certification or teaching certificate do you have?
   (1) Elementary Education (K-8 or 1-8)
   (2) Middle/Junior High School Education (5-8)
   (3) Secondary Mathematics
   (4) Temporary/Emergency Certification (Certified, but teaching out of area)
   (5) Alternative Certification (Enrolled in certification program)
   (6) Other _____

Teaching Experience

5. Counting this year, how many years in total have you taught at the elementary, middle/junior high level, or secondary level? (including this year)
   (1) 2 years or less
   (2) 3 - 5 years
   (3) 6 – 10 years
   (4) 11 – 24 years
   (5) 25 years or more

6.. Counting this year, how many years in total have you taught middle school or junior high mathematics? (Include any permanent, full-time, or part-time assignments in grades 5-8, but not substitute assignments or student teaching.)
   (1) 2 years or less
   (2) 3 - 5 years
   (3) 6 – 10 years
   (4) 11 – 24 years
   (5) 25 years or more