THE PERCENTAGE OF HIGHLY QUALIFIED MATH/SCIENCE TEACHERS AND VARIABLES THAT AFFECT THE LIKELIHOOD OF BEING HIGHLY QUALIFIED, BY STATE, BEFORE AND AFTER NCLB

A Dissertation

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Abstract

A major concern of educators today is to ensure that our nation's elementary and secondary schools are staffed with qualified teachers. The quality of teachers and teaching undoubtedly becomes one of the most important factors in shaping the learning and growth of students. The assignment of teachers to teach out-of-field is believed by some to be a contributor to low quality teaching. The No Child Left Behind (NCLB) Act of 2001 established a nationwide goal of reducing and eliminating gaps between groups of students, and recognized the key to improving student learning and closing achievement gaps depends upon access to highly qualified teachers for all students.

The purpose of this study was to see how state teacher certification requirements changed after No Child Left Behind Act and whether NCLB affected the percentage of highly qualified teachers in each state. The practical purpose of this study was to ascertain whether NCLB and middle school licensure requirement reform have had an effect on the number of highly qualified and non-highly qualified middle-school teachers in hard to staff areas like math and science.

Using Schools and Staffing Survey data from school years 1999-2000 and 2003-2004, this study found that on the average there was a slight increase in percent middle-school science teachers with science majors from 1999-2000 to 2003-2004 but a decrease in percent of fully certified math and science teachers and a decrease in middle-school math teachers with math majors. Certain states, Nebraska, Alabama, District of Columbia, New York and New Jersey were consistently high in percent majors while certain other states, Kentucky, Georgia, Tennessee, Arizona and North Carolina were consistently low with Kentucky low in both categories (percent fully certified middle-school math teachers with math majors, percent fully certified middle-school science teachers with science majors) during both school years. Some

states increased in both percent fully certified and majors in both math and science: Minnesota, North Dakota, and New Hampshire. Vermont, DC, Michigan and Ohio decreased in both of these categories. To show statistical significance, a logistic regression and odds ratio was done to compare states' likelihood of having *matched* teachers (which means fully certified with a major in the field taught) to Kansas's teachers' likelihood of being matched. This revealed that teachers who taught in DC were 615% more likely to be matched than those who taught in Kansas during 1999-2000. Only teachers who taught in Minnesota have greater odds of being matched than Kansas teachers during *both* 1999-2000 and 2003-2004. A regression analysis showed that certain teacher factors affected the likelihood of a teacher being *matched*. These variables were middle-school teacher who teaches in high school vs. middle-school teacher who teaches in middle school or elementary school, fully certified vs. not fully certified, and, male vs. female. The individual state certification requirements were compiled from before and after NCLB and compared to see if licensure changes affected how states fared in percent majors and fully certified.

After NCLB, several states added middle level endorsements in math and science that increased teachers' opportunities to become highly qualified. Some states increased the stringency to become highly qualified by adding content preparation requirements and/or "specific subjects required." These changes were considered positive changes in certification requirements after NCLB. A negative change after NCLB was the *decrease* in content preparation requirements, or changing from requiring specific subjects to not requiring these subjects. The results of this study did not show any particular trend in terms of which states tended to increase or decrease in the percent of full certification and major of middle-school math and science teachers from both years of SASS data. It showed that there were particular states that had increased or decreased in their percent of full certification and major but no correlation emerged.

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CHAPTER ONE

INTRODUCTION

1.01 Comparing Out-of-Field Teaching Data to State Teacher Certification Requirements

A major concern of educators today is to ensure that our nation's elementary and secondary schools are staffed with qualified teachers. Students are placed in the mandatory custody of teachers for a significant portion of their lives. The quality of teachers and teaching undoubtedly becomes one of the most important factors in shaping the learning and growth of students. Quality teaching has often been cited as the key to students' success. According to Darling-Hammond (2000, January) knowledge and effectiveness of teachers (which can be characterized as traits of *quality* teachers) is the most important school-based factor in student achievement. Teacher quality has been partially correlated to student success (Sanders and Rivers, 1996). Quality in education is a function of a teacher's preparation and ability to teach children.

The assignment of teachers to teach out-of-field (or *non-highly qualified* as defined in this study) is believed by some to be a contributor to low quality teaching (Ingersoll, 2001, May). The unacceptably high rates of out-of-field assignment in the nation's middle and high schools is the problem related to teacher quality that has received the most attention. Research suggests that teachers must be experts in the subjects they teach, as well as understanding adolescent pedagogy, in order to help students attain high academic standards (Craig, 2003, August). Unfortunately, out-of-field teaching is very common among certain types of schools (Ingersoll, 1996). Many teachers, particularly math and science teachers, are currently teaching in fields in which they are not certified (do not have a major in those fields). High schools rely far too much on assignment of out-of-field teachers, and the problem is far worse in the nation's middle grades. According to Ingersoll's analysis of the 1999-2000 School and Staffing Survey, out-of-field teaching still remains unacceptably high. Out-of-field teaching has been defined and measured, has long been a prevalent widespread problem, and varies among subjects and kinds of schools (Ingersoll, 2001, May).

Given the obvious benefits students have when taught by highly qualified teachers, it becomes important to investigate the possibility that a state's certification qualifications may influence the number of out-of-field, hence, non-highly qualified teachers in that particular state. United States middle school certifications are quite varied in regard to undergraduate training and licensure requirements, types available, and levels indicated on certificates. States also differ on their definitions of *highly qualified teacher*.

The No Child Left Behind (NCLB) Act of 2001 established a nationwide goal of reducing and eliminating gaps between groups of students, and recognized the key to improving student learning and closing achievement gaps depends upon access to highly qualified teachers for all students (Ingersoll, 2002, January). Schools that are staffed with high quality teaching play a key role in reaching this goal. Title IX of NCLB defines highly qualified as those who have acquired full state certification or passed a state teacher certification exam (Arhar, 2003, May).

The National Middle School Association (NMSA) defines highly qualified as "teachers who demonstrate proficiency in pedagogical knowledge, skills, dispositions, classroom management and overall effective teaching practices as well as content knowledge" (Thornton, 2004, March, p. 6). According to the Education Commission of the States (ECS) (retrieved September 13, 2006 from http://www.ecs.org/html/Issue.asp?issueID=129) many states define *highly qualified teacher* by listing specific requirements, some using a general statement similar to that of NCLB definition, and still others do not have a definition.

Meeting highly qualified status and licensure requirements may prove difficult at the middle level. One reason for the difficulty may be non-uniformity of undergraduate teacher education programs. Most teachers who teach middle level have either an elementary certificate, which may be lacking in middle-school content emphasis, or a secondary certificate, which may be lacking in age-specific pedagogy training. Recently, however, education programs have begun offering a middle school license. But, despite the fact that 43 states and the District of Columbia have established a middle level teacher credential, only 21 of these states require a middle level teacher license to teach in the middle grades (Gaskill, 2002, May). Rural districts have difficulty in meeting these requirements because they struggle with staffing schools with properly licensed teachers (U.S. Department of Education, 2004, March). Due to a shortage of teachers, many are asked to teach more than one subject, some of which they may not be qualified to teach. Another problem due to NCLB is that middle-school teachers, who had previously been allowed to teach more than one subject under traditional certification processes, now must demonstrate competence in each subject taught. The school districts must *switch over* to the more stringent requirements. Finally, the majority of middle-school teachers do not teach in K-8 (kindergarten through eighth grade/elementary) facilities. This creates the issue of middle-school-certified teachers teaching in junior or senior high schools without the content knowledge to teach subjects at that level. These more stringent requirements create difficulty in acquiring, recruiting and retaining middle school teachers.

Some state and district policies use *highly qualified* (as defined by NCLB) to determine teacher certification requirements. These requirements may affect training of middle-school teachers, which in turn may impact middle-school students' learning. Since middle-level students have unique needs, policy must dictate that they have teachers who are highly qualified, i.e., those with content knowledge and appropriate pedagogical skills. This requirement, that all teachers are highly qualified, have content knowledge and effectiveness, and are experts in handling the unique needs of middle school students, will likely affect the quality of middle-school teachers.

1.02 Statement of Problem

Too many of our nation's students (especially those in middle schools and high schools) are being taught by teachers who are non-highly qualified. Two reasons for this are that many teachers are out-of-field (teach subjects for which they may not have sufficient content knowledge), and, not all states have a similar definition for highly qualified teacher (Ingersoll, 2001, May).

Since one of the most important components in student learning is teacher quality, (Darling-Hammond, 2000, January), teachers who are not highly qualified may have a negative impact on their students' learning (assuming that highly qualified equals high quality). By determining the percent of teachers who are not teaching in their fields and comparing certification requirements among the states, which include states' definitions of highly qualified, it becomes possible to determine some of the factors impacting quality teaching.

Part of the cause of this problem, especially in middle schools, is mis-assignment and lack of credentials. Mis-assignment is caused by administrators assigning teachers to teach subjects they are not qualified to teach due to convenience, lack of funding, or shortage of teachers in hard to staff content areas (like math and science). Lack of credentials may result from undergraduate universities' *insufficient* (as per the definition of highly qualified teacher) teacher licensure requirements (Craig, 2002, August).

This descriptive study utilizes data from a nationwide survey and data from state departments of education in order to compare percents of out-of-field teachers and certification requirements among states. Through analyses of this information, the impact of policy enactment (NCLB and licensure requirements) may reveal a connection between policy and percent of highly qualified teachers before and after NCLB.

School officials strive to attract and retain quality teachers to provide students with the best possible education. Yet they can only hire/retain teachers if they are classified as *highly qualified.* It is possible that some of the best teachers do not fit the highly qualified definition set by NCLB and licensure requirements. Perhaps policymakers will see a need to standardize licensure requirements. They may need to provide staff development or financial aid to those who have the qualities of a good teacher (but are not defined as highly qualified) to take the needed courses to meet the requirements. These would-be highly qualified teachers (with quality potential) must be acquired, trained, and retained so they can become highly qualified per NCLB's definition.

1.03 Purpose of Study

The purpose of this study is to see how state teacher certification requirements changed after No Child Left Behind Act and whether NCLB affected the percentage of highly qualified teachers in each state. The practical purpose of this study is to ascertain whether NCLB and middle school licensure requirements reform have had an effect on the number of highly and non-highly qualified middle-school teachers in hard to staff areas like math and science. If indeed the results of the data analysis show that policy implementation does have a positive impact on teachers becoming highly qualified in their particular state, the study may suggest ways to impact the pool of highly qualified teachers in the future.

Each state's percent of highly qualified teachers and teacher credential requirements will be compared prior to and after NCLB. The definition of *highly qualified* used in this study is "teaches math/science and has a major in math/science" (i.e., is "matched") and has full certification and at least a bachelor's degree. This streamlined and stricter definition was created because of the inconsistencies of definitions among states, and the low standards set, which counters some research on quality teachers that highly qualified means high quality (Darling-Hammond, 2000, January, Hanushek, 1996, Sanders & Rivers, 1996). Based on highly qualified and quality teacher research, U.S. middle school teacher licensure research, and the analysis of the Schools and Staffing Survey (SASS) data of National Center for Education Statistics (NCES), this study, specifically, seeks to answer the following research questions:

1. During school years 1999-2000 and 2003-2004, what percent of middle-school teachers in each state who teach math and science are fully certified, and what percent of these teachers who teach math and science have majors in math and science?
2. A) During school years 1999-2000 and 2003-2004, which states are consistently ranked high or low in percent of middle-school math and science teachers with math and science majors, and, B) which states show an increase or decrease in percent middle-school teachers with full certification and major in math or science in their teaching field, and, C) which particular states, when compared to Kansas, are more likely to have math and science teachers with math and science majors (have teachers who are "matched") during school years 1999-2000 and 2003-2004?

3. What demographic and background factors affect whether or not a middle-school math or science teacher has a math or science major (what variables predict if teachers are “matched”), during school years 1999-00 and 2003-04?
4. How did state licensure requirements for middle-school math and science teachers change between 1999 and 2003?

1.04 Definitions

Highly Qualified “Matched” Math/Science Teacher

The definition of *highly qualified* used in this study is “teaches math/science and has a major in math/science” (i.e., is “matched”) and has full certification and at least a bachelor’s degree. This streamlined and stricter definition was created because of the inconsistencies of definitions among states, and the low standards set by certain states, which would go against some researchers’ belief that highly qualified means high quality. This study defines highly qualified teacher as one with full certification (a state-approved teacher certification or license with grade levels taught matching grade levels listed on license), and at least a bachelor’s degree with a major in the field in the content area taught. In other words, in addition to full certification and a bachelor’s degree, a teacher must be *matched* (have a major in the academic area in which he or she teaches) to be highly qualified.

Highly Qualified

Most states have adopted the No Child Left Behind Act of 2001 definition of the term highly qualified. In order to be highly qualified, any public middle or secondary school teacher teaching in a particular state must have fulfilled that state’s certification and licensing requirements, obtained at least a bachelor’s degree, and demonstrated subject matter expertise. Those new to the teaching profession, and teach in middle or high school, must demonstrate competency in each academic subject area they teach either by passing a state academic subject test, or, completing at least an undergraduate major, receiving a graduate degree or coursework equivalent to an undergraduate major, or an advanced certification. If teachers possess these attributes, they meet the criteria of highly qualified, according to NCLB Act (Hill, 2002). Experienced teachers are considered highly qualified if they satisfy the subject matter requirement in the same manner as new teachers or demonstrate subject knowledge through a state-determined high objective uniform state standard of evaluation (HOUSSE). This study includes some of the components of highly qualified definition established by NCLB (any public middle or secondary school teacher teaching in a particular state must have a state-approved teacher certification or license, obtained at least a bachelor's degree, and demonstrated subject matter expertise). In addition to these a teacher must be *matched* to be highly qualified (have full certification and a major in the academic area in which he or she teaches). To be considered *matched* in this study, it is not sufficient if the teacher has a math education major or science education major. The major must be in the specific content area.

Out-of-Field Teacher

In his studies, Ingersoll (1999, March, 2001, May, 2002, January, 2003, September), often used the term out-of-field teacher and defined it as one who does not have at least a minor in the field in which he or she is teaching. A teacher of this status would be considered *non-*highly qualified. A teacher who possesses the characteristic of being out-of-field would be considered *non-highly qualified,* (i.e., *not matched)* because, according to this study, a teacher must have this component of the definition (having a major *in field*) in order to meet the criteria of highly qualified. Being highly qualified means a teacher must meet the *matched* requirement and have an in-*field* major. This is in addition to having full certification and at least a bachelor's degree.

NCLB Act of 2001

The No Child Left Behind Act of 2001 (Public Law 107-110) is a United States federal law that reauthorized a number of federal programs aiming to improve the performance of U.S. primary and secondary schools by increasing the standards of accountability for states, school districts, and schools, as well as providing parents more flexibility in choosing which schools their children will attend. Additionally, it promoted an increased focus on reading and re-authorized the Elementary and Secondary Education Act of 1965 (ESEA). The Act was passed in the House of Representatives on May 23, 2001, United States Senate on June 14, 2001, and signed into law on January 8, 2002.

Mis-assignment

Mis-assignment is the assigning of a certified teacher to teach in a content area that he or she does not have an endorsement or major, and thus has insufficient content mastery.

1.05 Significance

This research is significant for several reasons. First, it addresses the prevalence of out-of-field teachers in middle-school math and science classrooms. In his studies, Ingersoll (2001, May, 2002, January, & 2003, September) emphasizes the problem of out-of-field teaching and its detriment to students' learning. These studies bring awareness to school leaders about practices that inhibit the opportunity for all students to be taught by the best possible teachers (i.e. those that are highly qualified). These practices include mis-assignment (which puts certified teachers out of their fields) allowing for improperly credentialed teachers to teach in our nation's middle-school math and science classrooms. According to Craig (2002, August) mis-assignment is a result of administrators' practices of assigning certified teachers to teach subjects for which there are not content-qualified, mostly out of convenience.

Second, the research defines quality teaching (Darling-Hammond, 2001, October 15 & Hanushek, 1996), highly qualified teacher (Ingersoll, 1999, March), NCLB act (Arhar, 2003, May), out-of-field teacher (Ingersoll, 2001, May), and mis-assignment (Craig, 2002, August) in order to come up with a concise, uniform definition for *highly qualified*. It also points to the potential for further studies needed to address the significance of being taught by highly qualified, high quality, teachers.

This study is also important because it suggests there is a *process* needed to ensure the presence of highly qualified teachers in math and science middle-school classrooms across all states. Educators can begin this process by utilizing a concise, uniform definition of highly qualified teacher.

Creation of such a definition was necessary in this study because definitions of highly qualified teacher are inconsistent among states. States vary in their determinants of highly qualified and researchers disagree on what constitutes quality. Many researchers agree that content knowledge is important to teach, but there is disagreement as to what extent (Cavanaugh, 2009, January 21) – is a math major necessary to adequately teach math or are several courses in math education enough? Defining highly qualified in this stricter manner is an important first step. What needs to be done next is to test this definition to see if it is valid in terms of student achievement. If the requirements essential to become highly qualified are established and tested, state officials will be able to decide who is and who is not highly qualified in their particular state. School officials then can attain accurate data on how many teachers in their districts are not highly qualified. At this point they must remove *non*-highly qualified teachers and put *highly* qualified teachers into their math and science classrooms. To help determine the percentage of highly qualified teachers per this study's definition and the variables that likely determine if teachers are "matched," (a component of *highly qualified*) data from two consecutive distributions of the Schools and Staffing Survey (1999-00 and 2003-04) were compared.

Policy reform may be the needed push for putting highly qualified teachers in middle-school math and science classrooms. Rules and policies must be enacted that address the issue of hiring highly qualified, credentialed teachers - policy that requires strict adherence to no out-of-field assignments (Griffin, 1999). A good starting point was the implementation of the NCLB Act which requires that teachers, in general, have a bachelor's degree, have state certification, and demonstrate subject area knowledge for each core subject they teach (General Accounting Office, 2003, July 17). Through their definition of highly qualified, state legislators have created a starting point to help teachers become highly qualified status. This will hopefully positively impact student learning. This study is significant, therefore, because this definition of highly qualified provides school officials with a clear picture of what a highly qualified teacher actually looks like, so they can move in the right direction – toward getting their teachers' highly qualified to improve student achievement.

Due to the disparity among schools, colleges, and Departments of Education in their teacher certification requirements and the type of licensure available, this study suggests that state teacher licensure standards be held high and made clear specifically for teachers in the middle grades. This study is significant as it may lay the groundwork for determining if teacher certification requirements need to be more stringent, clearer, or uniform. Depending on the results of this study, for example, state officials and policy makers may be encouraged (or discouraged) to insist that middle-school teacher certification (by types and grade level), be made uniform, from state to state, and the requirements to gain certification/licensure consistent across all states. So, this study examines where states are, and where they need to be in terms of having highly qualified math and science teachers given the definition employed here.

In summary, this research is significant because educators must be made aware of the prevalence out-of-field teaching. Next, if as suggested by literature reviewed in this study, out-of-field teaching is truly detrimental to students, school leaders must remedy this problem. Policy reform may increase the chances of all schools being staffed with highly qualified teachers which would create an environment conducive to students' learning.

CHAPTER TWO

LITERATURE REVIEW

Introduction

The presence of out-of-field teaching in schools can negatively impact student performance. Student success is partially dependent upon the quality of their teachers – the ability to communicate, the knowledge of what they are communicating, and the motivation to do so. One of the necessary components to accomplish academic success is to ensure that quality teachers teach each child. According to the National Board for Professional Teaching Standards (NBPTS), the level of training, knowledge of content, pedagogy, skills, dispositions and desire each play a part in creating such teachers (Retrieved December 9, 2009 from http://www.nbpts.org/userfiles/File/NBPTS_NCLB.pdf). The topics discussed in this chapter include: the effects of NCLB Act of 2001; the effects of quality teaching; the effects of out-of-field teaching; the significance and definitions of highly qualified teaching; the difficulty in meeting highly qualified status at the middle level; and the role policy plays on the percent of highly qualified middle-school teachers. This chapter shows that educational policy, high quality teaching, teaching within one's field (not out-of-field), and clearly defining highly qualified, may play a role in the percent of highly qualified teachers in our nation's classrooms.

2.01 <u>The Effects of No Child Left Behind (NCLB) Act of 2001</u>

The NCLB emphasizes the importance of teacher quality and required all public school teachers of core academic subjects to meet specific criteria in preparation for teaching by academic school year 2006 (National Science Foundation, 2006, February). According to Public Law 107-110 the purpose of NCLB Act of 2001 was to close the achievement gap with accountability, flexibility, and choice, so that no child is left behind (U.S. Department of

Education, 2002). To accomplish this, with the support of scientifically-based research that claimed teacher quality leads to greater student achievement (Darling-Hammond, 2000, January), the federal government created the NCLB Act of 2001. NCLB would not only require teachers to be highly qualified by 2006, but that schools meet adequate yearly progress (AYP). To determine if teachers were highly qualified, states used the standards set by this law to create their own definition of highly qualified teacher. To measure AYP, schools were required to test students at particular grade levels in math and reading.

The NCLB Act may have been the front runner in policy implementation that will impact/has impacted the way schools prepare teachers for licensure. In 2001, the government put stipulations on the time frame to attain highly qualified status and the requirements needed to be classified as highly qualified (General Accounting Office, 2003, July 17). By June of 2006, schools were required to employ only highly qualified teachers. This meant highly qualified be defined and opportunities for veteran teachers to become highly qualified in their fields be put in place.

Through the impetus of the inception the No Child Left Behind Act of 2001, states have attempted to ensure their teachers were highly qualified by June of 2006. States defined highly qualified by incorporating NCLB requirements. Some states had to modify their licensure requirements and add required hours of content preparation and endorsements to ensure the attainment of the status of highly qualified for all teachers within their particular state (U.S. Department of Education, March, 2004).

2.02 <u>The Effects of Quality Teaching</u>

A major concern of educators today is to ensure that our nation's elementary and secondary schools are staffed with qualified teachers. Students are placed in the mandatory custody of teachers for a significant portion of their lives. The quality of teachers and teaching undoubtedly becomes one of the most important factors in shaping the learning and growth of students. Quality teaching has often been cited as the key to students' success. Knowledge and effectiveness of teachers (which can be characterized as traits of *quality* teachers) is the most important school-related factor in student achievement (Darling-Hammond, 2000, January).

There is almost universal agreement that teachers do matter and, furthermore, there exists considerable support for the idea that student learning is affected by the qualifications of teachers. For example, Ingersoll (1999, March) stated that "there is a large body of empirical research devoted to isolating and assessing the effects of various measures of teacher qualification (education, training, and experience) on student achievement" (p.27). Early researchers on the sources of teacher effectiveness (e.g., Darling-Hammond & Hudson, 1990; Hanushek, 1996) claimed that subject knowledge, teaching skills and teacher preparation, and their congruence with assigned teaching fields, are important predictors of both teaching quality and student learning. In particular, Darling-Hammond and Hudson (1990) and Hanushek (1996) focused on the more traditional measures of teaching effectiveness to indicate teacher quality, including the academic background of college graduates entering the teaching force (because these attributes predict teacher subject mastery and verbal ability which are believed to be critical to effective teaching) and the alignment between teacher preparation and their assigned teaching fields.

Sanders and Rivers (1996) claimed that "the single most dominant factor affecting student academic gain is teacher effect" (p. 8). One of the findings in this study was that children assigned to effective math teachers scored much higher in math than students who had ineffective teachers. Thus, quality teachers are significant for improving student performance (Sanders and Rivers, 1996).

More recent studies support the claim that teachers' subject matter knowledge and certification are key components of teacher quality and are significantly associated with student learning (Greenberg, et al., 2004). Although there is substantial agreement that teacher quality is one of the most important influences on student learning, disagreement remains about what specific knowledge and skills constitute "quality." Greenberg's study supports the importance of certification and subject matter competency as key components of teacher quality. Hill et al. (2005, Summer) agree that subject-matter knowledge is important, but claim that what counts as *useful* subject-matter knowledge remains unspecified.

According to Goldhaber and Anthony (2004, April), additional factors, such as ability to motivate students, manage classroom behavior, maximize instructional time, and diagnose and remedy students' learning difficulties, may also play important roles in teacher quality. In addition, Goldhaber and Anthony feel that those certified by National Board for Professional Teaching Standards (NBPTS) were more effective than their non-NBPTS certified cohorts. The findings of these studies imply that policy investments in the quality of teachers may be related to improvements in student performance (National Science Foundation, 2006, February).

Since being in-field and knowledgeable are believed to be contributors to teacher quality, some studies attempted to measure the percentage of math and science teachers with math and science majors and then tie these to student achievement. In their study of 7-12 math and science teachers with majors, Blank and Toye (2007, September) found the percent of math teachers with math majors in secondary school math classroom to be 61%, while science teachers with science majors was 77%. This study, however, did not show whether or not these science and math teachers with science and math majors affected student academic success in science and math. The results of the 2008 study done by the National Assessment of Educational Progress (NAEP) in which standardized math test scores for 13 year-olds were analyzed showed a slight improvement in academic progress in math for 13 year-olds from 1973 to 2008 but claimed that student progress during the NCLB era was not very impressive (National Center for Education Statistics, 2009, April). This study, however, did not tie students' progress in math to whether or not their teachers had math majors.

Recent studies continue to support the idea that quality teachers are important in student success in the classroom. The results of the math and science portion of the NAEP reported in 2009 showed that student achievement in the middle grades is rising in most Southern Regional Education Board (SREB) states (Southern Regional Education Board, 2009). Standardized math and reading test scores have been improving slightly among 9 and 13 year-olds from 1971 to 2008 (in math) and from 1973 to 2008 (in reading). Perhaps there is a connection between these students' improvements and whether or not they were taught by quality, highly qualified, teachers (National Center for Education Statistics**,** 2009, April). This study did not, however, specifically tie student academic progress in math to whether or not their teachers had math *majors*.

Having quality teachers means that standards for teacher certification should be high. SREB states have been national leaders in setting higher standards for teacher preparation programs. Most of the states in this region also require teachers to pass performance tests for licensure and to have on-the-job evaluations. According to a report done by the U.S. Department of Education (2006), in 2005 Georgia, Tennessee, Florida, Delaware, Kentucky, Louisiana, South Carolina, Oklahoma, Mississippi, Alabama, Virginia and Texas, all of which belong to the

SREB, required content-specific degree for initial certificates, showing again that these states set high standards for their teachers by strengthening licensure requirements. And, perhaps the fact that Minnesota created clear and demanding academic standards for their teachers caused their improvement in percent certification and majors (Cavanaugh, 2009, December).

Since one of the main beliefs of the SREB is that every student must be taught by qualified teachers, it is necessary to have teachers with content preparation in every classroom, and to continue reform of teacher licensure (Southern Regional Education Board, 2009). However, because of the requirement of all teachers being highly qualified, at least 12 states have loosened teacher certification requirements, in some cases lowering test score minimums (Au, 2004).

Many support the belief that content knowledge is important, but there is question as to what content is instructionally relevant. One study suggested that since there is such uncertainty about *which* math teaching skills demonstrate whether or not a teacher is effective in the classroom, so this is where the action has to come next (Cavanaugh, 2008, March 21). Having a math major to teach math may not be enough.

According to research, then, student learning is impacted by certain teacher attributes that make them quality teachers. Quality teachers are defined by research as those that are effective, knowledgeable, skilled, in-field, and certified. Some studies show that quality teaching positively impacts student learning. The need for students to be taught by quality teachers is very apparent so it is important to look at what the effect might be on students who are taught by out-of-field teachers, a characteristic that may negatively affect their quality.

2.03 The Effects of Out-of-Field Teaching

Out-of-field teaching has been around a while, has been defined and measured, and continues to be a prevalent widespread problem. The consequences of it have been noted. Out-of-field teaching varies among subjects and kinds of classrooms and schools, especially middle schools.

Educators have long been aware of this phenomenon now called out-of-field teaching. James Conant called attention to the widespread “misuse of teachers” (Conant, 1963, p. 67) through out-of-field assignments in his landmark 1963 study “The Education of American Teachers.” Albert Shanker strongly expressed disapproval of out-of-field teaching as education’s “dirty little secret” (Hechinger, 1985, October 8) in an opinion piece in the New York Times. Former Secretary of Education Richard Riley stated in his 1999 State of American Education speech that “there is a unique American phenomenon that really makes no sense – the practice of assigning teachers to teach ‘out of field’” (U. S. Department of Education, 1999).

According to Ingersoll (1999, March), out-of-field teachers are those “who teach subjects for which they have little education or training” (p.26). Ingersoll argues that even using a minimum requirement for qualified teachers (a college minor in the subject they teach) the numbers of out-of-field teachers are “striking.” Using an upgraded definition of quality teacher to include "*only* those who hold college majors *and* teaching certificates in their fields, the amount of out-of-field teaching is substantially increased" (p. 29). According to National Science Foundation (2006, February), almost all public middle-school and high school math and science teachers held a bachelor's degree and teaching certification, yet many were teaching subjects for which they did not have certification or a college major or minor in the field.

The assignment of teachers to teach out-of-field is believed by some to be a contributor to low-quality teaching (National Center for Education Statistics, 2002, May). Research suggests that “teachers must be knowledgeable about the subjects they teach in order to help students achieve high academic standards” (Craig, 2002, August, p.11). The problem related to teacher quality that has received much attention is the unacceptably high rate of out-of-field assignment in the nation's middle and high schools. Many teachers are currently teaching in fields in which they are not certified. According to Ingersoll's (2002, January) analysis of the 1999-2000 Schools and Staffing Survey, out-of-field teaching is still unacceptably high. Although almost all public middle-school or high school mathematics and science teachers held a bachelor's degree and teaching certification, many were teaching subjects for which they did not have certification or a college major or minor in the field.

In his study, Ingersoll (1999, March) found that one third of all secondary mathematics teachers have neither a major or minor in math or related fields. One fourth of all secondary English teachers have neither a major or minor in English or related fields. One fifth of all science teachers have neither a major or minor in science or related fields. And, one fifth of social studies teachers had neither a major or minor in social studies or related fields. Forty one percent of 12th grade physical science students are taught by teachers without a major or minor in chemistry, physics, or earth science.

Out-of-field teaching varies across subjects, schools and classrooms (Ingersoll, 2003, September). Unfortunately, out-of-field teaching is very common among certain types of schools (Ingersoll, 1996). High schools rely too much on assignment of out-of-field teachers, and the problem is far worse in the nation's middle grades. Those students in low track classrooms as opposed to high track have a higher proportion of out-of-field teachers (1/4 low track English classes taught by out of field teachers as opposed to only 1/10 high track English classes) according to Ingersoll (1999, March). The least qualified teachers teach the neediest students (those from poor and low-income families). This is held as the major reason why such students perform poorly in educational assessments (Ingersoll, 2003, September). Smaller as opposed to larger schools have more out-of-field teachers, as do private school students compared to public school students. More middle/junior high students are taught by out-of-field teachers as opposed to senior high students. Ingersoll (2003, September) claimed "one third of 7th grade science students are taught by out-of-field teachers as opposed to only 1/10 of 12th grade science students" (p. 17).

Craig (2002, August) summarizes who is most greatly affected by of out-of-field teaching. He argues that it is American secondary schools that have unacceptably high rates of out-of-field teaching in core academic subjects, with classes in high poverty and high minority schools much more likely to be assigned to an out-of-field teacher than classes in low poverty and low minority schools. The *biggest losers*, therefore, are those students in high poverty and high minority schools (they are most likely to get teachers lacking academic qualifications). Not only are there higher rates of out-of-field teachers in high poverty, high minority schools, it is becoming *worse*. He sums up by stating that "states differ widely in their levels of out-of-field teaching, and vary as well as in the extent to which the practice disproportionately affects poor and minority" students (Craig, 2002, August, p. 4). Regarding middle and high schools, he concludes that "high schools rely far too much on assignments of out-of-field teachers. But the problem is far worse in the nation's middle grades" (p. 5).

Craig (2002, August) also claims that no progress has been made in reducing out-of-field teaching in these particular classrooms. Through comparing the two sets of SASS results (1993-94 and 1999-2000), the nation made no progress reducing out-of-field teaching between 1993-94 and 1999-2000, with rates becoming slightly worse overall and the biggest increases occurring in high poverty and high minority schools.

According to Cornett (2004), putting teachers with content preparation in every classroom is crucial. In the 1980s and early 1990s educators in many states understood how important it was for teachers to know their subject matter so they moved to require high school teachers to have college content majors. Too few states and districts have worked seriously to abolish the practice of putting a teacher who is not prepared in the subject in a classroom even for one class a day. This is especially true in middle grades schools.

The reasons out-of-field teaching is so high for middle schools fall into one of two categories: lack of credentials or mis-assignment. When compared to high school teachers, teachers in the middle grades are more likely to lack credentials. Teachers who teach core subjects and particular electives in the middle grades are less likely to be credentialed than those in high school grades (Killion, 1998, March). Many middle school teachers have elementary certification, which does not require as rigorous content study as those certified at the high school level. Mis-assignment, on the other hand, is the result of putting teachers in classrooms for which they are not qualified. It is, in a sense, a form of lack of credentials. A discussion of lack of credentials and mis-assignment follows.

Lack of credentials

Three key issues impact the lack of credentials for many middle-school teachers. First, lack of credentials may be the result of inconsistency of certification types among states. Middle level credentials vary greatly among states. Some of these are as follows: K-6, 7-12, 1-8, 5-9, K-9, etc. Some states require only elementary certification to teach middle school (which is broad and does not specialize in content). Few states recognize middle schools in teacher licensure. Most teachers who teach middle school prepared in college for either elementary *or* high school teaching positions. Half of U.S. middle-school teachers had no special training for teaching young adolescents (Craig, 2002, August).

Another reason middle-school teachers lack credentials is the varying levels of requirements between teaching levels. An example of these varying levels shown in Missouri schools is as follows (retrieved September 13, 2006 from http://www.dese.mo.gov/divteachqual/teachcert):

- Elementary teachers (grades 1-6) are required to take 2 courses (6 hours) in methods in math and science, 2 courses in English (minimum 4 hours), 3 hours of history, and 3 hours of government.
- Middle school (5-9) must take 21 hours minimum in subject area, 10 hours in *middle school* methods, and 10 hours clinical experience. The *developmental* aspect of middle level is so often overlooked as a component of middle level certification – "these are the formative years" (Retrieved September 13, 2006 from http://www.dese.mo.gov/divteachqual/teachcert).
- High school (9-12) must compile 32 hours minimum in subject area, 8 hours in foundations, 8 hours of methods courses, and 10 hours of clinical experience.

A third reason that teachers lack credentials to teach middle school is that nationwide middle-school standards are not clear and strict (Craig, 2002, August).   Some states are more lenient about the academic training of middle-school teachers than high school teachers. States grant generic kindergarten through eighth grade (K-8) teaching licenses, but, according to Craig (2002, August), should instead get universities to work closely with potential middle-school teachers to create preparation programs specifically for those middle grades. Despite the possibility that doing this may result in fewer middle-school teachers, he believes that teacher preparation programs should be focused on rich academic content and should be aligned with state curriculum standards.

Mis-assignment

Mis-assignment is when a teacher may be highly qualified to teach particular subjects but is placed in a classroom in which he or she is not highly qualified, resulting in a teacher placed out of his or her field of expertise. Mis-assignments may happen for several reasons. First, research shows that mis-assignment is a result of administrative *practices* and *attitude*. Mis-assignment is “not a result of teacher shortage, rather administrative practices” (Association for Supervision and Curriculum Development Research Brief, 2003, March 5, p. 1). This could also happen due to convenience or to a shortage of teachers who are qualified to teach that *particular* core subject. Some administrators re-assign teachers due to teacher shortage, lack of funding, or convenience. Out-of-field teachers are characteristically *experienced* and *qualified* but have been assigned to teach in content areas that do not match their training or educational background (Ingersoll, 2002, January).

Secondly, transition among levels (teachers moving from elementary to middle school or high school to middle school) or changing levels taught in the physical school buildings (reconfiguring), from 1-6 grade elementary, 7-9 junior high and 10-12 high school, to 1-5 elementary, 6-8 middle school and 9-12 high school, are two examples of practices that may result in a *licensed* teacher being *mis-assigned*. Finally, the middle school *structure and philosophy*, of which one component is teaming (Mertens, et al., 2004, May) may also result in a *licensed* teacher being *mis-assigned*. For example, the “team” approach may result in teachers who are certified to teach 7^{th} grade but may be asked to teach 9^{th} grade - to teach 4 hours in the field in which they are *prepared* to teach, and 1 hour in another field, for which they were *not prepared* to teach.

There are consequences of teachers teaching out-of-field, i.e., being mis-assigned. Low achievement may be due to high percentage of out-of-field teaching. Someone without a strong background in science may rely heavily on the text, and may be more likely to "teach to the test" in hopes that the students actually perform better on the standardized test. But on the other hand, an out-of-content teacher will have trouble teaching critical thinking skills and instilling interest in the subject (Ingersoll, 1999, March).

Teachers who teach one class out-of-field may spend a greater amount of time preparing for the class for which they have no background, decreasing the amount of time they spend preparing for their regular (in-field) classes. This may have a negative effect on learning environment (Ingersoll, 1999, March). In addition, according to Ingersoll's (1999, March) interpretation of data from Schools and Staffing Survey (SASS) for 1999-2000 school-year, teaching out-of-field is directly related to a decrease in teacher morale and commitment. This may impact teachers' classroom behaviors or desire to remain in the field.

Educators must put an end to assigning teachers out-of-field (Craig, 2002, August). The likelihood of students being taught by teachers who are highly qualified, have high morale, are good disciplinarians, and are committed may possibly improve if out-of-field teaching is alleviated.

2.04 <u>The Significance and Operational Definition of Highly Qualified Teaching</u>

Given the benefits students have when taught by teachers who are qualified, it is important to determine what makes a teacher highly qualified. Putting highly qualified teachers in every classroom may be difficult because the definitions of highly qualified teachers vary among states and organizations. So, it becomes a complex task to study the issue of having a highly qualified teacher in every classroom. A consensus of what constitutes a highly qualified teacher must be made in order to define then analyze the impact of highly qualified teachers. The foundation for the definition would likely be that established by NCLB. It provides the *minimum* requirements on which individual states can develop their definitions (which in this study are used as the building blocks for the definition).

Several entities have defined *highly qualified teacher*: NCLB, U.S. State Departments of Education, National Middle School Association, and others. The variation among the states is due primarily to the differences in certification requirements within each state. Thus, *highly qualified* is defined by each state depending on its teacher certification requirements.

In order to compose an operational definition of highly qualified, it is necessary to investigate the degree of leniency or stringency of a state's certification qualifications. This may affect the likelihood of a teacher being highly qualified. If certification requirements are more lenient, for example, the teachers are more likely to be highly qualified in their state. This may weaken the legitimacy of receiving a license in that particular state in terms of actual quality of its teachers. If the requirements are more stringent, there will more likely be a greater number of under-qualified (out-of-field) teachers in that particular state. Important to consider when defining highly qualified is that U.S. middle-school licensures are quite varied. Besides differences in undergraduate training and licensure requirements provided by teacher preparation institutions, only certain types and levels are available on middle level licenses in each state. In addition, some universities do not offer middle level licenses. These factors all contribute to disparity of qualifications within states, thus the differences in definitions.

The No Child Left Behind (NCLB) Act of 2001 established a nationwide goal of reducing and eliminating gaps between groups of students, and recognized that the key to raising student learning and closing achievement gaps lies in access to highly qualified teachers for all students. Schools staffed with high quality teachers play a key role in reaching this goal. However, definitions among states and organizations differ. For example:

- Title IX of NCLB defines highly qualified as those who have obtained full state certification or passed the state teacher licensing exam (Arhar, 2003, May).
- The National Middle School Association (NMSA) defines highly qualified as “teachers who demonstrate proficiency in pedagogical knowledge, skills, dispositions, classroom management and overall effective teaching practices as well as content knowledge” (Thornton, 2004, March, p.6).
- States differ on their definitions of *highly qualified teacher.* Many states define it by listing specific requirements, some use a general statement similar to that of NCLB definition, and still others do not have a definition. Some simply allow passing a content exam. Many states, prior to the conclusion of the 2006-07 school year had used the High Objective Uniform State Standard of Evaluation (HOUSSE) as a measure of highly qualified veteran teacher. This HOUSSE rubric has allowed veteran teachers to be considered highly qualified by being *grandfathered in*. This rubric is a mechanism for veteran teachers to become highly qualified through assessment of teaching experience, college course work and professional development in the content area using a point system. There is a minimum requirement of 100 points, 45 of which must be obtained in the college coursework category. Many states have phased out, or are phasing out, this route to be highly qualified (National Council on Teacher Quality, 2007). As of July of 2006, Kansas had phased out the HOUSSE Rubric.

  Some states, like Alaska and Arkansas, are specific in the requirements that define highly qualified, experienced teachers. Most states that have a definition follow a format similar to this in defining highly qualified teacher. In Alaska, a highly qualified *experienced* middle school teacher is defined as:

- Holds at least a bachelor's degree;
- And holds a full Alaska Teacher certificate;
- And holds a major or degree in each subject taught;
- Or passes a State identified test;
- Or fulfills the requirements of the High Objective Uniform State Standard of Evaluation (HOUSSE)" (retrieved September 13, 2006 from http://www.eed.state.ak.us). Alaska, however, is phasing out this route (National Council on Teacher Quality, 2007).

In Arkansas highly qualified *experienced* middle school teacher is defined as:

- Holds at least a bachelor's degree;
- And is fully licensed with no requirements waived under emergency or temporary conditions;
- And demonstrates subject area competence in each core academic subject taught by:
  - Passing the Praxis II Middle Childhood assessment(s) associated with the academic subject area taught;
  - Or, meeting the criteria described in the Arkansas High Objective Uniform State Standard of Evaluation (HOUSSE). Arkansas, unlike some states, is not phasing out this route (National Council on Teacher Quality, 2007).

Other states like Colorado and Connecticut give broader definitions. Colorado defines highly qualified teachers simply as "those who are licensed and endorsed in each/all core-academic content area(s) in which they are teaching" (retrieved September 13, 2006 from http://www.cde.state.co.us).

Connecticut defines a highly qualified teacher as someone who holds full state certification as a teacher (including alternate routes) or has passed a state teacher licensing exam and holds state certification (retrieved September 13, 2006 from http://www.sde.ct.gov). Some states do not have definitions. For the most part, states have many similarities in definitions simply because they must meet the requirements of NCLB. Some of these definitions are very broad, so they do not guarantee all are held to a high standard.

The requirements for obtaining "highly qualified teacher" status in Kansas were clarified by United School Administrators of Kansas (retrieved September 13, 2006 from http://usa-ks.org).

- Any new teachers of core academic areas teaching in a program supported with Title I Part A funds have already met the requirements upon hiring, because they must already have met all highly qualified requirements *before* they are hired (U. S. Department of Education, 2008, October, p.64).
- All others, (except special education) including those in non-Title-I schools had until June 30, 2006, to meet these requirements.
- *New* Kansas teachers licensed under the state's new licensure system had to meet the highly qualified criteria based on achieving a passing score (set in January 2005) on a content assessment in all endorsement areas.
- In Kansas, a highly qualified veteran teacher must have a bachelor's degree and a Kansas license. Additional criteria must be used to demonstrate competence. In Kansas, almost 95% of educators hold a license to teach which requires at a minimum, a bachelor's degree. Most veteran teachers had already demonstrated competence because they held an endorsement, a graduate level degree, had completed an approved program, and had taught

for several years. As a result, Kansas State Department of Education (KSDE) did not require every veteran teacher complete a verification form to ensure they were highly qualified.

- However, *two* groups of teachers who *were* required to have their qualifications verified were:

1. Any teacher who was kicked out of the certified personnel report. *Kick outs* are defined by Elementary and Secondary Education Act (ESEA) as having one of the following traits:

- No license/out-of-assignment
- Provisional/one-year non-renewable or waivers
- If certified before 1982 - might not meet today's standards, so must complete HOUSSE rubric
- Holds a K-9 license and teaches in core subject, so must complete rubric (retrieved March 29, 2004 from https://ks.nea.org/profession/highlyqualified.html?mode=print).

2. Any teacher who holds an elementary certificate and is assigned to teach a core content area in the middle or junior high school.

Kansas defined the term highly qualified (*fully qualified*, in 2003, rather than *highly qualified*, in 2005) as a staff member who holds a valid Kansas license with the appropriate subject and grade level endorsement for the assignment. By 2003, approximately 94% of Kansas's teachers were fully qualified for their reported assignments. Fully qualified personnel filled approximately 94.5% of all assignments (retrieved December 17, 2005 from http://www.ksde.org/Default.aspx?tabid=1648).

Table 1 shows which subject areas fell below this overall average. Since language arts and science fully/highly qualified percent both went down from 2003 to 2006, it is very likely that qualified math teachers did also. All subjects are listed in Table 1 whereas only core subjects are listed in Table 2. This is due to the fact that the information available from the 2003 report (Table 1) was slightly different than that from the 2006 report (Table 2).

Table 1
Certified Personnel Report: Subjects Taught in Kansas in which less than 94% of the Teachers were Highly Qualified (Kansas State Department of Education, Certification Requirements, 2003).

Subject Taught	Percent of Teachers that are *Fully* Qualified, 2003
Special Education	83.4
Foreign Language	88.7
Bilingual/ELL	89.5
Computer Studies	91.0
Natural Science	92.3
Agriculture	93.6
Language Arts	93.7

Notice that in this report KSDE used the term *fully* qualified as opposed to *highly* qualified. In its 2005-06 preliminary report, in Table 2 that follows, KSDE changed the terminology to *highly* qualified teachers. Perhaps this change was made for the purpose of defining highly qualified according to NCLB requirements.

Table 2
Licensed Personnel Report: Core Academic Subjects Taught in Kansas in which less than 94% of the Teachers were Highly Qualified (Kansas State Department of Education, Certification Requirements, 2006).

Core Academic Subject Taught	Percent of Teachers that are *Highly* Qualified, 2006
History	76.2
Economics	83.0
Language Arts	85.3
Foreign Language	85.7
Mathematics	86.9
Science	86.9
Geography	89.4
Fine Arts	90.1

The KSDE maintains a *highly qualified teacher* database on all licensed teachers in the state and collects assignment and class data on each teacher employed in Kansas every year in the Licensed Personnel Report (retrieved July 21, 2008 from www.ed.gov/programs/teacherqual/hqtplans/ks.doc). These data are used to generate a list of core content teachers who are not highly qualified. It is then the district's responsibility to aid these teachers in becoming highly qualified for their particular teaching assignments.

According to research, there are many variables defined by several entities that play a part in determining the definition of a *highly qualified teacher*. It is very difficult, without a concise, streamlined definition of highly qualified to see the *significance* of students being taught by such teachers. If all states and organizations would agree on a common definition it would be easier to determine its importance. For the purposes of this study, a simple concise definition is used. The teacher must *be licensed, have at least a bachelor's degree, and be "matched"* (full certification plus major in subject taught). It is important to add this component for two reasons: first, states' definitions are not uniform, and, second, highly qualified per NCLB may fall short of the meaning of the term *highly qualified*. According to Erb (2004, March), the criteria set by NCLB actually describe a teacher who should be considered *probationary,* one who *could* become "*proficient* or even *excellent* by meeting rigorous standards of performance" (p. 4). This implies that there is a need for a stricter, higher standard definition like the one used for this study. Some states include a pedagogy component in training and certifying middle-school teachers, while others do not. States vary in their certification requirements, including the number of hours required in subject-matter training.

2.05 The Difficulty Staffing Certain Classrooms with Highly Qualified Teachers

Rural districts have difficulty in meeting the highly qualified requirements because they struggle with staffing schools with properly credentialed teachers, that is, assigning content-specific teachers to teach *each* class. Due to this shortage, many teachers are asked to teach more than one subject, some of which they may not be qualified to teach (Neill, 2006). Urban schools usually have a higher population of poor and minority students (Ingersoll, 2002, January). Because of this low socio-economic population, urban schools also have difficulty in staffing classrooms with highly qualified teachers. The better teachers are not in those classrooms in which students, those from poor, minority, and disadvantaged communities, need them most. Instead they are taught by the least qualified teachers. Because low-income and high-minority schools are unable to offer competitive salaries, benefits, or resources, they simply cannot compete for the available supply of trained teachers (Ingersoll, 2002, January).

Another problem lies in staffing middle level core classes with highly qualified teachers. Middle-school teachers had previously been allowed to teach more than one subject under traditional certification processes, but now must demonstrate competence in each core subject taught. In Kansas, the school districts were required to *switch over* to these more stringent requirements (United School Administrators of Kansas, 2006).

2.06 The Difficulty Meeting Middle Licensure (Certification) Requirements

Meeting highly qualified status and licensure requirements may prove difficult at the middle level. One reason for the difficulty may be non-uniformity of the certification requirements of undergraduate teacher education programs. In Kansas, for example, middle school is considered grades 5-8 and the state's teacher education programs' credentials offered are K-9, 5-9, 7-9, 7-12, and K-12. In Hawaii, the grade span for middle school is 4-8, and the credentials offered are 7-12 and K-12 only (Gaskill, 2002, May). Many middle-school teachers obtain a K-9 license but the majority of middle-school teachers do not teach in K-9 facilities. Historically, teaching institutions offered either an elementary or secondary license that included overlaps with middle level grades. This led to most teachers teaching middle level with either an elementary license, which may be lacking in content emphasis, or a secondary license, which may be lacking in age-specific pedagogy training. Recently, though, education programs have begun offering a middle-school license. But, despite the fact that 43 states and the District of Columbia have established a middle-level teacher credential, only 21 of those states *required* a middle-level teacher license to teach in the middle grades (Gaskill, 2002, May).

According to Gaskill (2002, May) and Jackson and Davis (2001), the results of the study done by National Association of Secondary School Principals (NASSP) in 2004 confirm those of other studies. Although progress has been made in the area of certification specific to the middle level, there is still much work to be done (Gaskill, 2002, May; Jackson & Davis, 2001). The sad fact remains that throughout the history of the middle school movement, the majority of teachers have not been educated to teach at this level (Dickinson & Butler, 2001, September). This study revealed that most of teachers had secondary certification in half of the middle schools. Most teachers had elementary certification in about 30% of their middle schools. On a more positive note, the percentage of schools with a majority of teachers who hold middle level certification had increased from 11% in 1992 to 18% in 2000 and to 25% in highly successful schools (Petzko, 2004, March).

There is a movement for common curriculum standards in core classes (Suffren, 2009, July 21). States have invested significant resources into the development of student academic standards and for these standards to be effective, teacher preparation and certification must be aligned with them, so it only makes sense that there should also be a push for standardizing *teacher* requirements. It may be quite a challenge, but a worthwhile one for state departments of education to persuade colleges and universities to align teacher preparation programs with state standards.

Therefore, the discrepancies in available licenses among teaching institutions, the lack of emphasis on the importance of requiring a middle-level credential, the mismatch of middle-school teachers to their physical building (middle-school teachers actually teaching in a middle-school *building*), the difficulty in rural areas, and the now more stringent teacher-licensure requirements create difficulty in acquiring, recruiting and retaining highly qualified, middle-school teachers.

2.07 <u>The Possible Effects of Policy on Licensure (Certification) and Degree Requirements</u>

Since middle level students have unique needs, policy could dictate that school children have teachers who are highly qualified or "matched." Some states and districts have changed their policies regarding certification requirements and hours required in subjects taught to meet the *highly qualified* component of NCLB. This may encourage states to tighten teacher licensure and degree requirements and increase hours required to teach a particular subject. These changes that make licensure requirements more stringent could be made in a timely manner to eliminate the chance that this might create a shortage of middle-school teachers. The hope is that these stricter requirements will impact the training of middle-school teachers, which, in turn, may positively influence middle-school students' learning. The condition that all teachers are highly qualified will likely affect the quality of middle-school teachers. The level of training, knowledge of content, pedagogy, skills, dispositions and desire each play a part in creating such teachers. The research referenced supports the need for quality teachers in the classrooms, that out-of-field teaching is prevalent in middle schools and high schools and could possibly be the reason for low achievement (especially in math and science), and that policy dictates that teachers must be highly qualified. Further research that examines all these issues together is needed.

In answer to this need, NCLB has dictated that schools put a highly qualified teacher in every classroom. Since individual state's definitions of highly qualified vary this issue becomes significant. And, since undergraduate teacher training programs and middle-school licensure requirements among states vary, it becomes difficult for middle-school teachers to become highly qualified in their fields and difficult to *staff* some middle school math and science classrooms.

Research supports this need for quality teachers in the classrooms. Out-of-field teaching is prevalent in middle schools and high schools and could possibly be the reason for low achievement (especially in math and science), and NCLB dictated that teachers must be highly qualified. Based on the issues identified in this review of literature, this study examines if NCLB, which created the mandate for highly qualified teachers, impacted the number of fully certified math and science middle-school teachers (defined as having a license and a major in the content area) and those particular factors affecting the outcomes of policy.

CHAPTER THREE

METHODOLOGY

3.01 Purpose of Study

The purpose of this study is to see how state teacher certification requirements changed after No Child Left Behind Act and whether NCLB affected the percentage of highly qualified ("matched") teachers in each state. The practical purpose of this study is to ascertain whether NCLB and middle school licensure requirements reform have had an effect on the percent of non-highly qualified middle school teachers in hard to staff areas like math and science. Such an analysis may reveal the possible effects of policy implementation (NCLB and middle level licensure requirements reform) on whether or not teachers are teaching out-of-field in their particular state. In other words, will this analysis suggest that NCLB and licensure requirements reform has decreased the percent of out-of-field teachers in each state? Is there any relationship between policy implementation and the percentage of teachers who are not out-of-field?

The purpose of this chapter is to describe the methods and procedures used to conduct this research in order to answer the research questions formulated for the study. The chapter also describes the *type of study*, the *sources of data used*, the *development of the data sets,* and *how the data were analyzed*.

3.02 Research Questions

Specifically, this study seeks to answer the following research questions:

1. During school years 1999-2000 and 2003-2004, what percent of middle-school teachers in each state who teach math and science are fully certified, and what percent of these teachers who teach math and science have majors in math and science?

2. A) During school years 1999-2000 and 2003-2004, which states are consistently ranked high or low in percent of middle-school math and science teachers with math and science majors, and, B) which states show an increase or decrease in percent of middle-school teachers with full certification and major in math or science in their teaching field, and, C) which particular states (when compared to Kansas) are more likely to have middle-school math and science teachers who have math and science majors (have teachers who are "matched")?
3. What demographic and background factors affect whether or not a middle-school science or math teacher has a science or math major (what variables predict if teachers are "matched"), during school years 1999-2000 and 2003-2004?
4. How did state licensure requirements for middle-school math and science teachers change between 1999 and 2003?

3.03 Data Sets, Design and Analysis Procedure

Data Sets Sources

This study is considered descriptive/quantitative research meaning it uses already established data. The data sets and sources include:

- Teacher and school characteristics data from National Center for Education Statistics (NCES) Schools and Staffing Surveys (SASS) from 1999-00 and 2003-04, which were used to answer Research Questions 1-3.
- Certification requirements and highly qualified teachers definitions from individual state's web sites, Teacher Certifications Publications, and subject matter endorsement listed on teacher certification (nasdtec.org), which were used to answer Research Question 4.

The design and analysis procedure for the SASS data will be addressed first since the first three of the four of this study's questions can be answered using these data. The certification requirements data answers Question 4 “how did state licensure requirements for middle school math and science teachers change between 1999 and 2003?” This question was answered by compiling information from various sources and its design and analysis procedure will be addressed later in this chapter.

Schools and Staffing Survey Design and Analysis Procedure

<u>SASS History</u>

One of several data collection projects that National Center for Education Statistics (NCES) sponsors is the Schools and Staffing Survey (SASS). SASS is the most comprehensive sample survey of the Nation’s elementary and secondary schools and their staffs. SASS is considered an integrated public use microdata series (IPUMS) and is one of the frequently used microdata data resources distributed by NCES. It has two important purposes: to provide data that describe and track schools and their staffing; and to provide data to gain insight to changing issues concerning teaching and schools. SASS has several strengths (National Center for Education Statistics, 2000, March). Those related to this study are:

- it is a measure of a comprehensive range of characteristics of teachers, careers, administrators, school programs and school districts
- it is a sample design of national and statewide data
- its samples are very large
- its data come from multiple respondents (teachers, principals, district administrators, and librarians)

These strengths allow researchers and policy makers to paint a state-by-state and nationwide picture of schools. Because it is such a comprehensive database, disaggregation and comparison of data along several key traits of teachers and schools are possible. SASS was used to answer Research Questions 1 through 3.

Forms of SASS

The NCES Schools and Staffing Survey has been conducted during these school years: 1987-88, 1990-91, 1999-2000, 2003-04 and, most recently, 2007-08 by the United States Census Bureau. Results from the1999-00 and 2003-04 surveys were compared in this study (the 2007-2008 data were released after analysis for this study was completed). Two forms of the SASS, the Public Schools Questionnaire (PSQ), and the Public School Teacher Questionnaire (PSTQ), were used.

3.04 Populations from 1999-00 and 2003-04 SASS Compared

The 1999-2000 SASS surveyed approximately 15,500 principals or school heads and 77,000 teachers in 15,500 schools (National Center for Education Statistics, 2000, March). The 2003-2004 SASS surveyed about 63,000 teachers and 13,300 principals in 13,300 schools (National Center for Education Statistics, 2006, March). See Appendix C for detailed characteristics of the 1999-00 and 2003-04 Schools and Staffing Surveys. These survey traits include: Questionnaire Design, Sample Design, Data Collection, Weighting, and Response Rate.

3.05 Using SASS Questions to Establish Data Sets

Many of the questions from 1999-00 and 2003-04 Schools and Staffing Surveys were similar so they could easily be utilized in a comparative study. A list of the comparable survey questions used to create the data sets from the four surveys (99-00 PSTQ vs. 03-04 PSTQ and 99-00 PSQ vs. 03-04 PSQ) are shown in Table 3.

Table 3

Survey Questions Compared to Develop SASS Data Sets

Questions from Public School Teacher Questionnaire (PSTQ) Schools and Staffing Survey 1999-2000 School Year	**Questions from Public School Teacher Questionnaire (PSTQ) Schools and Staffing Survey 2003-2004 School Year**
Training (PSTQ) **8a. Do you have a bachelor's degree?**	Training (PSTQ) **20a. Do you have a bachelor's degree?**
8c. What was your major field of study?	**20d. What was your major field of study?**
Certification (PSTQ) **13a. Do you have a teaching certificate in this state in your MAIN teaching assignment field?**	Certification (PSTQ) **30a. Which of the following describes the teaching certificate you currently hold in this state?** (Mark only one box).
Teaching Assignment ("Out-of-field") (PSTQ) **12. THIS school year, what is your MAIN teaching assignment field at this school, that is, the field in which you teach most classes?**	Teaching Assignment ("Out-of-field") (PSTQ) **17. This school year, what is your MAIN teaching assignment field at this school?**
13b. What type of certificate do you hold in this field? (If yes, mark only one box).	**30a. Which of the following describes the teaching certificate you currently hold in this state?** (Mark only one box).
15a. This school year are you assigned to teach classes in OTHER fields at this school in addition to your MAIN teaching assignment field?	**19. For each class (or section) that you currently teach at THIS school, complete a row/line of information.**
16a. Do you have a teaching certificate in this state in your OTHER teaching assignment field at this school?	**30b. Some certificates may allow you to teach multiple content areas. In what content area(s) does the teaching certificate marked above allow you to teach in this state? Which of the following grade ranges does this certificate apply to?** Mark all that apply.
16b. What type of teaching certificate do you hold in this field? (If yes, mark only one box).	**30c. If there is an additional content area that the certificate described above allows you to teach, please list it below.** Record content area code from Table 3. **Which of the following grade ranges does this certificate apply to?** Mark all that apply.
Questions from Public School Questionnaire (PSQ) Schools and Staffing Survey 1999-2000 School Year	**Questions from Public School Questionnaire (PSQ) Schools and Staffing Survey 2003-2004 School Year**
General information regarding your school (PSQ) **6. What grades are offered in this school?** Mark all that apply.	General information about this school (PSQ) **7. Which of the following grades are offered in this school?** Mark all that apply.
Admission, programs and performance (PSQ) **13. What type of school is this?** Mark X the box that best describes this school.	Admission, programs and performance (PSQ) **14. Which of the following best describes this school?** Mark only one box.
Students and class organization (PSQ) **21. Does this school use the following methods to organize classes or student groups?**	Student and class organization (PSQ) **27. THIS school year (2003-04), does this school use the following methods to organize classes or student groups?** (Answer yes or no)
Staffing (PSQ) **35a. Were there teaching vacancies in this school for this school year – that is, teaching positions for which teachers were recruited and interviewed?**	Staffing (PSQ) **38a. For THIS school year (2003-04) were there teaching vacancies in this school, that is, teaching positions for which teachers were recruited and interviewed?**
35b. Did this school use the following methods to fill these vacancies? (Answer yes or no)	**39. For THIS school year (2003-04), did this school use the following methods to cover the vacancies?** (Answer yes or no)
36. How difficult or easy was it to fill the vacancies for this school year in each of the following fields? (Choose from: not applicable in this school; no vacancy in that field; easy; somewhat difficult; very difficult; couldn't fill the vacancy) ❑ Mathematics ❑ Biology or life sciences ❑ Physical science	**38b. How easy or difficult was it to fill the vacancies in each of the following fields?** (Choose from: no positions in this school; no vacancy in this field; easy; somewhat difficult; very difficult; could not fill the vacancy) ❑ Mathematics ❑ Biology or life sciences ❑ Physical sciences

Prior to determining which data sets to create and what research questions would be answered by this study, questions that were similar in both surveys were aligned and these comparable questions were chosen from both years of both surveys (99-00 and 03-04 PSQ and PSTQ) to get an overview of how school and teacher traits compare. Specifically, select survey questions were used to establish the following variables: teacher status, demographics of the school in which that teacher taught, and possible reasons for out-of-field teachers and mis-assigning teachers. To determine teacher certification status, for example, question 13a from 99-00 PSTQ was "do you have a teaching certificate in this state in your MAIN teaching assignment field?" The similar question from 03-04 PSTQ was question 30a, that read "which of the following describes the teaching certificate you currently hold in this state (mark only one box)?" To determine degree status, 8a and 20a respectively were compared. To determine if a teacher was teaching in-field these questions were compared: 12 & 17, 13b & 30s, 15a and 19, and 16a & 30b, respectively. These survey questions were used to answer Research Question 1 & part of Research Question 2 and to create the "matched" variable which in turn was used to answer part of Research Question 2 and Research Questions 3 & 4.

To determine demographics of the school in which the teachers taught (elementary, middle, junior high, high school, or an overlap; and private or public; and teaming), these traits were compiled: grades offered (questions 6 & 7), type of school (13 & 14), and methods to organize classes (21 & 27, respectively). These questions were used to include elementary and high school data because some of these schools housed middle level students. This helped set up variables to compare "matched" used in Research Questions 2 and 3. The teaming questions were included to support its importance in middle grades and to possibly identify implications for future studies.

To determine possible reasons for out-of-field and mis-assigning (an administrator staffing concern), these variables were addressed through the following questions: vacancies (questions 35a & 38a), methods to fill vacancies (35b & 39), and, how difficult to fill (36 & 38b, respectively). These questions were used to verify that math and science positions are difficult to fill, thus addressing implications for future study in regard to reasons for out-of-field teaching and causes for mis-assignment.

SASS Data Sets Created

Codes were created for these data sets. Then the data sets were constructed using these SASS data to compare 1999-00 SASS middle schools to 2003-04 SASS middle schools. The four data sets were: 1999-00 middle schools, 1999-00 all schools, 2003-04 middle schools, and 2003-04 all schools. These data sets were weighted using teacher final weight and teacher repeated weight. Teacher weightings had to be done to account for the low numbers of teachers in some categories. For example, since there were not as many teachers surveyed in small, rural schools compared to larger suburban schools, those numbers had to be weighted.

In addition to the data that compared middle-school teachers among states, data comparing teachers in “all schools” were included in this study. All schools include all types, all grade levels. When the teacher was given the choice of “what type of school do you teach in” and “what grades are taught/offered at this school?” the type and grades might not match. There could be an overlap in types (elementary, middle, junior high, high school) and grades taught/offered (K-8, 5-8, 7-9, and 9-12, etc). For example, if someone teaches freshmen, it could be in a K-9 building or a junior high building or a high school. This creates difficulty in identifying a teacher who teaches in elementary school, middle school, junior high school and/or high school as a middle-school teacher. Using these combined data would eliminate a study limitation of how teachers classified their schools. The data sets and variables codes can be found in Appendix B.

Running SASS Descriptive Statistics

Limited descriptive statistics can be run using the 1999-00 and 2003-04 PSQ and PSTQ from SASS (public use data). Access to SASS for running tabulations that compare teacher traits across *multiple* variables is limited to those who have a restricted-use license obtained from the Department of Education. The author did not have a restricted use permit, so was assisted in obtaining such data by a licensed user. A restricted-use license allows for linkage across many more SASS components (e.g., main teaching assignment to certification in main teaching field), enriching potential analyses. Without a restricted-use license the comparisons would have been more limited (e.g., percent of teachers who teach math, *or* percent of teachers who have full certification). A restricted-use license allows for linkage across many more SASS components allowing for potentially richer comparisons and analyses of data (e.g., percent of teachers who teach math *and* have a major in math in their states; or, main teaching assignment *and* certification in main teaching field).

STATA was the statistics data analysis program used to run the descriptive statistics for this study. The first step in running statistics was weighting samples and creating do-files. Samples were weighted using tfnlwgt (teacher final weight) and brr (balanced repeated replication) prior to running tabulations and logistic regression. Balance repeated replication (brr) is a statistical technique for estimating the sampling variability of a statistic obtained by stratified sampling. There are advantages of replication: knowledge of the design is not needed, and disclosure of Primary Sampling Units (PSU's) and strata is avoided. Weighting accounts for selection probabilities, non-response, etc. Codes for weighting do-files can be found in Appendix B.

First, codes to run analyses were created for STATA. Tabulations were done with STATA to get information to compare across several variables. The comparisons run included middle-school teachers and all school teachers who had math majors, taught math, had science majors, and taught science for the 1999-00 and 2003-04 school years. Specifically, data sets included comparisons such as: middle-school math and science teachers' majors by state in 99-00 and 03-04; and, all schools math and science teachers' majors by state in 99-00 and 03-04. Also, certification type and state for 99-00 and 03-04 school years were coded and analyses were run. These included: middle-school math and science teachers' certification by state in 99-00 and 03-04; and, all schools math and science teachers' certification by state in 99-00 and 03-04. These tabulations helped answer Research Questions 1 and 2.

For part of Question 2, a logistic regression was done, using STATA, to determine what states have a higher percent of teachers with full certification and majors when compared to Kansas and what that likelihood is (using odds ratio), and in which states this would be statistically significant. Kansas data are used in this study to compare all other states' status of being "matched" (fully certified with a major in subject taught), because Kansas was typically in the middle of the states in percent certified and percent with majors and so served well as baseline state. In addition, Kansas was chosen as the baseline state because it typically falls in about the middle of the states in funding (in 2006 it ranked 30th with \$8,392 per pupil spending), ranked 21st in per capita income (KS = \$34,743 & U.S. = \$36,276), and scored well above the nation on national assessment tests. In 2007, 80% of Kansas 8th grade math students scored basic or higher on the NAEP test as compared to the U.S. average where only 70% scored basic or higher (Kansas Association of School Boards, 2009, June).

For Question 3 a logistic regression was done to determine the possible factors that affect the likelihood (odds) that a teacher is "matched." *Matched* is defined as a fully certified teacher who teaches math and has a major in math, or a fully certified teacher who teaches science and has a major in science. This study defines highly qualified teacher as one with full certification (a state-approved teacher certification or license with grade levels taught matching grade levels listed on license), and at least a bachelor's degree with a major in the field in the content area taught. In other words, in addition a bachelor's degree, a teacher must be *matched* (be fully certified and have a *major* in the academic area in which he or she teaches) to be highly qualified. This logistic regression helped answer Part C of Research Question 2 and Research Question 3. Tabulations and Logistic Regression do-files can also be found in Appendix B.

Using Data Sets to Answer Research Questions

For the SASS data set, analyses (tabulations, comparisons and logistic regression) were performed to answer specific research questions. To begin to answer Research Question 1, "during school years 99-00 and 03-04, what percent of middle-school teachers who teach math and science in each state are fully certified, and what percent of these teachers who teach math and science have majors in math and science?" the following descriptive statistics were run:

1. Tabulate certification types of middle-school teachers, across all states, who teach science and who teach math
2. Tabulate teachers with major in math and teach math in middle schools, and with major in science and teach science in middle schools
3. Tabulate the distribution of middle-school teacher credentials (has major and fully certified) across states

4. *Compare* percent of fully certified middle-school math and science teachers in 99-00 to percent of fully certified middle-school math and science teachers in 03-04, by state
5. *Compare* percent of 99-00 middle-school math and science teachers who have math and science majors to percent of 03-04 middle-school math and science teachers who have math and science majors, by state

The above tabulations and comparisons were also used to answer Research Question 2 – Parts A and B, "which states are consistently ranked high or low in percent of middle-school teachers with full certification and major in math or science in their teaching field; and, which states show an increase or decrease in percent of middle-school teachers with full certification and major in math or science in their teaching field?" States were then ranked by sorting high to low in percent fully certified and percent majors in their fields, then, taking the top and bottom 15, these states were compared, looking for those that were consistently ranked high or low. Finally it was determined if there were particular states that decreased or increased in certification and major, or both.

Research Question 2 – Part C is "during school years 1999-2000 and 2003-2004, which particular states (when compared to Kansas) are more likely to have math and science teachers who have math and science majors (have teachers who are "matched")? Research Question 2 – Part C can be answered by doing a logistic regression and odds ratio. This regression and odds ratio included an analysis that compared the dependent variable "matched/ not matched" middle-school math and science teachers to the independent variable, state. "Matched" means is a fully certified science (or math) teacher who has a science (or math) major. The state of Kansas "matched" math and science teachers was used as the baseline state (Kansas = 1.0).

Research Question 3 is “what demographic and background factors affect whether or not a middle-school science or math teacher has a science or math major (what variables predict if teachers are “matched”), during school years 99-00 and 03-04?” “Matched” and what variables affect the likelihood of being matched had to be determined to more clearly define *highly* qualified. Research Questions 3 was answered by doing a logistic regression. This is the logit output for math and science teachers only, with the dependent variable being an indicator of whether the teacher is a science teacher with a science major or math teacher with a math major – identified as “matched” if yes (1, all else 0). As predictors (independent variables) of matched teachers, the grade level of the school they were in was used (all were middle-school teachers). Whether they held full, regular certification in their main field was also used as a predictor of “matched.” (This variable had to be built with each piece of certification for 2003-04 survey, but for 1999-00 survey Certification in Main Field was used. This had to be done because of the difference in how the question was asked on the two surveys). This regression included an analysis that compared “matched” (the dependent variable) across the following independent variables:

- Middle school teachers who teach in high schools (6, 7, or 8 through 12 schools) and middle-school teachers who teach in middle schools (6 to 8 or 7 to 9 schools) compared against middle-school teachers who teach in elementary school (K-8 school)
- Fully certified, vs. not (teachers were defined as “not fully certified” if they had any other type of certification: provisional, emergency, etc. regardless of content background)
- Natural log of years experience
- Years since Bachelor’s degree
- Minority

- Male (vs. female)
- Suburb (vs. urban)
- Rural (vs. urban)

3.06 State Teacher Licensure/Certification Design and Analysis Procedure

State Teacher Licensure/Certification Data Set Created

One goal of this study was to collect data on teacher licensure requirements in each state in order to determine if there were any changes from before NCLB to after. It was necessary to contact several entities in order to create this data set on teacher licensure in each state. These included: as many State Departments of Education web sites as possible, Education Commission of the States (ECS) web site, National Council on Teacher Quality (NCTQ) web site, and National Association of State Directors of Teacher Education and Certification (NASDTEC) Knowledge web site. These were referenced and examined to create a state teacher certification/licensure descriptive data set.

Question 4 "how did state licensure requirements for middle-school math and science teachers change between 1999 and 2003?" was answered by compiling information from each of the following sources:

Licensure/Certification Requirements Web Sites Data

- The University of Kentucky web site features a link to 50 State's Certification Requirements (www.uky.edu/Education/TEP/usacert.html).
- Academic Employment Network (www.academploy.com/certif.cfm) is another web site that links to states' certification requirements. These web sites were utilized to obtain web addresses for each state's department of education to examine certification requirements. Highly qualified experienced middle-school teacher definitions and rubrics were also found on state department web sites.

States' Web Sites Data

- Specific certification data from states web sites included: type of license offered, number of hours required for a major, and whether or not bachelor's degree is required to teach. Teacher licensure requirements, definitions of highly qualified, and HOUSSE (high objective uniform state standard of evaluation) rubrics were obtained from State Department of Education web sites. (Not all 50 states' web sites were referenced due to the difficulty in navigating some of these for teacher certification requirements).

Various "Other Sources" Data

- The Teacher Certification Publications and the Academic Employment Network were also used to find state information on teacher licenses and endorsements.
- National Association of State Directors of Teacher Education and Certification (NASDTEC Knowledgebase). Endorsements listed on teaching certificate were obtained from NASDTEC Clearinghouse, a searchable database administered by education departments of members that contains information on certification requirements for U.S. states and Canada.
- National Council for Teacher Quality (NCTQ) was used to find progress on teacher quality within the U.S. states. This was done periodically to attempt to keep up with any changes. Certification data were compiled and put into Excel spreadsheets for analysis and comparison to SASS data. These analyses were done to determine if policy implementation and reform might affect the percent of highly qualified middle-school science and math teachers.
- Three studies, one by Gaskill (2002, May), one by Pinney (2005), another by McEwin (2007, January). These studies were cited for middle-school certification requirements comparisons before and after NCLB. This information was compiled and put into Excel spreadsheets for analyses and can be found in Tables 14 and 15 in Chapter 4.

Finally, to answer Research Question 4, these data on teacher licensure requirements from 1999-00 were compared to teacher licensure requirements from 2003-04 to analyze the emergence of trends in individual state's licensure policy.

3.07 Limitations

There were several limitations, variables that were not or could not be controlled, in this study. These limitations will be discussed within the following categories: SASS data sets, highly qualified status, and certification requirements.

Components of the SASS data sets limit this study. Elementary, middle school, junior high and high schools were not clearly defined within SASS surveys and data sets. There were grade levels variations indicated for grade level taught. This created an overlapping of grade level identification. A certain grade level (like 6th grade) may have been identified as elementary by one teacher or as middle school by another teacher (depending on what physical building they taught in). Likewise, a ninth grade teacher could be considered a high school teacher or a junior high/middle school teacher. This could result in middle school data not being *true* middle school data. The definition of a school as elementary, middle, junior high or high school in terms of grades included varies among, and within, states. Teachers may not have had a clear cut grade-level status choice when answering survey background questions. This confusion may have led to inaccurate reporting of information. All data for the Schools and Staffing Survey were self-reported by teachers so there were no validity checks. It is possible that this information was not completely accurate.

This study used the definition of highly qualified to draw comparisons and make conclusions. With regard to teachers' highly qualified status, there are several limitations. First, the number of highly qualified teachers was self-reported by each state. If not reported accurately and honestly the validity of these numbers can be questioned. It can only be assumed that these are accurate and honest numbers. Second, since *highly qualified* definitions differ among states, meaningful conclusions about the number of highly qualified teachers cannot be made using these definitions. Because of these variations, the study uses a tighter definition of highly qualified. A highly qualified teacher has full certification, at least a bachelor's degree and a major in the content area taught (i.e., is *matched*). This limits the study but allows for clearer conclusions. Third, the Federal Government has loosened the restrictions set by NCLB for *highly qualified* especially in rural areas where there may be teacher shortages. Because of this, many of these teachers would not be considered highly qualified according to this study's definition. Fourth, since the inception of NCLB, some states have implemented, or changed, the requirements necessary for teachers to be considered highly qualified. Therefore, teachers may be highly qualified according to the new requirements, whereas they may not have been according to the old requirements. This change can create difficulty in drawing meaningful conclusions regarding the number of highly qualified teachers. This is why a different definition had to be made for this study. Finally, this study assumes highly qualified teachers equals high quality teachers. Some literature (e.g. Erb, 2004, March) would argue that being highly qualified is only *one* component necessary for a teacher to be high quality, or may not mean high quality at all.

The teacher's ability, or inability, to obtain certification is a limitation of this study. Each state certifies teachers differently. In other words, the requirements to obtain fully certified status varies among states. This can limit the study in that a teacher may be certified in one state but not in another. The comparison of being certified prior to NCLB vs. after would only be reasonable if the unit of comparison was "state." Many states have not finalized their requirements for middle level certification, so since it cannot be determined if the teachers in these states hold a middle-level licensure, they would be eliminated from this study. States may not be accurate and/or honest in their reporting of percent of teachers teaching in their field and percent of teachers who are fully certified. This potential inaccuracy is a limitation to the study.

For this study, "major" was defined as major in science or major in math for these data sets. This precluded those who had a math or science *education* major. Due to the study's requirement to have a major in the field in which they teach, it is possible that very qualified math teachers were eliminated from this number, thereby limiting any conclusions. It may be argued that math or science *education* majors have as much background in their content area (if not more than) as math or science majors (which would suggest they be included in the study as part of the definition that says "has a major in the field taught").

Much of the certification and highly qualified data were obtained from ECS (Education Commission of the States) and NCTQ (National Council on Teacher Quality). Due to the fact that ECS data are quite limited and therefore may possibly be incomplete or inaccurate, and NCTQ is an interest group whose conclusions are not reviewed, reliance on quality of these analyses to answer Question 4, "How did state licensure requirements for middle-school math and science teachers change between 1999 and 2003," may be problematic. Along these same lines, some of the state departments of education also had incomplete data. Many state teacher-education universities make middle level licensure accessible while others do not have middle level certificates available. This limits that opportunity for some teachers to obtain middle level licensure so comparing middle level licensure among states is not completely fair.

Despite the limitations of this study, important conclusions can be drawn with regard to the effect of policy implementation on the number of highly qualified (not out-of-field) middle-school math and science teachers in the U.S.

CHAPTER FOUR

RESULTS

The purpose of this study is to see how state certification requirements changed after NCLB and whether NCLB affected the percentage of highly qualified teachers in each state. The practical purpose of this study is to ascertain whether NCLB and middle school licensure requirements' reform have had an effect on the number of non-highly qualified middle school teachers in hard to staff areas like math and science.

Middle-school math and science teachers' certification and majors in their teaching fields across states, from school years 1999 and 2003, were compared. The comparison of these characteristics determines the percent of not out-of-field (highly qualified) teachers in each state. An analysis was done to determine which demographic and background factors of a particular middle-school math or science teacher predict whether or not that teacher has a math or science major and is fully certified (which is defined as "matched"). Next, 1999 state licensure requirements for middle-school math and science teachers was compared to 2003. Lastly, any certification requirements changes from before NCLB to after NCLB were noted. This chapter includes discussions of the study results to answer the research questions.

4.01 Research Question One: During school years 1999-00 and 2003-04, what percent of middle-school teachers in each state who teach math and science are fully certified, and what percent of these teachers who teach math and science have majors in math and science? Tables 4-9 and Figure 1 help answer this question.

Table 4 shows middle-school math teachers who were fully certified. In 1999, the percentage of math teachers who were fully certified ranges from 100% to 51.8%. The overall average percent of teachers with full certification was 86.8%. In 2003, the range was from 100%

to 52.5%. The average was 85.1%. This indicates an overall *decrease* in percent of middle-school *math* teachers with *full certification* from 1999-00 to 2003-04. The top three states in fully certified math teachers in 1999 were Rhode Island, South Dakota and West Virginia, and the bottom three were South Carolina, Delaware, and North Carolina. In 2003, the three states at the top were Montana, North Dakota and South Dakota, and the bottom three states were New York, Colorado and Michigan. There was a big drop in RI, from 100% to 91.5% math certified. There was a big jump in KS, from 80% to 99% math certified. CO and NC remained near the bottom both years in math certified. SD, MT, IN, and ND stayed near the top for both years in math certified.

Table 4

Percent of Middle School Math Teachers Fully Certified and Teach Math - by State 1999-2000 vs. 2003-2004

1999-2000		2003-2004	
RI	100	MT	100
SD	100	ND	100
WV	100	SD	100
MO	98.84	KS	99.31
MT	98.77	WA	98.68
WI	98.57	CT	97.84
IN	98.42	MN	97.83
ND	97.85	VA	97.21
PA	97.68	IN	97.05
GA	97.56	OK	96.79
NY	97.45	NJ	96.71
UT	97.33	HI	96.61
OR	97.06	ID	96.23
MA	96.31	NE	96.08
AR	96.29	WY	95.87
NE	95.22	SC	95.1
IA	94.63	WV	94.84
WY	93.58	UT	94.62
WA	93.15	MS	94.48
MN	92.42	CA	94.46
OK	92.03	TN	93.88
ID	91.85	AR	92.29
NJ	91.17	MD	91.77
ME	90.41	RI	91.54
OH	90.4	IA	91.05
MD	90.39	NH	90.43
IL	89.44	WI	89.69
LA	89.21	MO	89.3
NM	88.8	LA	88.34
AL	88.04	NM	87.71
NV	86.75	AZ	86.3
AK	85.57	AL	86.23
MS	85.42	NV	85.77
MI	83.05	GA	85.24
CA	82.17	PA	84.78
VT	81.03	IL	84.19
KS	80.86	TX	81.86
VA	80.65	OH	81.85
NH	80.14	KY	81.63
HI	78.21	ME	80.67
DC	77.45	AK	78.09
KY	75.65	VT	76.94
TX	75.33	MA	75.49
FL	74.95	FL	74.37
TN	74.68	NC	73.79
CO	74.57	OR	72.97
CT	74.54	DC	66.91
AZ	72.83	DE	66.21
SC	69.42	NY	63.45
DE	60.88	CO	58.17
NC	51.84	MI	52.46
Average	86.78	Average	85.13

A similar trend in middle-school science teachers is shown in Table 5. In 1999, science teachers who were fully certified ranges from 100% to 51.9%. The overall average percent of science teachers with full certification was 88.4%. In 2003, the range was from 100% to 61.1%. The average was 84.1%. This also indicates an overall *decrease* in percent of middle-school *science* teachers with *full certification* from 1999-00 to 2003-04. Indiana and Idaho had 100% science teachers fully certified in both 1999 and 2003. The bottom states in fully certified science teachers in 1999 were New Hampshire, Georgia and New Jersey. The bottom states in 2003 were Texas, Tennessee and District of Columbia. IN and ID were high in science certified both years, while CA & DC were low in science certified both years.

Table 5

Percent of Middle-School Science Teachers Fully Certified and Teach Science - by State 1999-2000 vs. 2003-2004

1999-2000		2003-2004	
ID	100	AR	100
IN	100	ID	100
ME	100	IN	100
NV	100	KS	100
RI	100	MN	100
SC	100	ND	100
SD	100	WI	100
VT	100	WY	100
WA	100	NE	98.1
WV	100	UT	97.75
NC	98.89	MD	97.5
OK	98.55	NM	97.41
FL	98.49	OK	96.93
VA	97.88	AK	96.68
WI	97.69	SD	96.68
AR	97.52	LA	95.88
IA	97.47	SC	95.59
KS	96.94	AL	95.0
ND	96.81	NJ	94.51
AK	96.77	GA	94.3
MA	96.03	WA	94.02
NY	95.81	VT	93.7
OR	95.64	HI	93.32
TN	94.98	PA	92.65
UT	93.21	MT	923
WY	92.47	MS	89.63
TX	92.13	WV	89.5
MN	90.87	MO	88.72
AL	89.19	NV	88.03
MT	89.01	AZ	87.63
NE	88.34	CT	87.38
MS	87.96	NH	85.96
IL	87.25	VA	85.79
DE	86.83	DE	84.75
OH	86.12	NY	83.6
CO	83.92	RI	83.47
MO	83.8	MA	83.06
PA	83.3	OH	82.41
NM	82.03	OR	81.97
HI	82.0	KY	81.65
MI	81.68	NC	81.21
LA	80.49	IA	80.8
MD	7918	CO	80.57
AZ	78.8	FL	80.13
CT	77.92	CA	7514
CA	75.17	MI	74.47
KY	69.92	IL	72.42
DC	67.68	ME	71.23
NH	62.92	TX	67.48
GA	57.62	TN	61.68
NJ	51.87	DC	61.08
Average	88.42	Average	84.06

Table 6

Percent Middle-School Math Teachers Have Math Majors and Teach Math - by State 1999-2000 vs. 2003-2004

1999-2000		2003-2004	
DC	67.17	MN	52.66
NE	58.68	ND	48.94
PA	56.32	SD	48.87
AL	51.98	NE	47.34
SD	50.32	CT	46.31
MN	49.65	NY	39.36
WY	49.4	IN	39.03
OH	48.94	WY	34.65
MT	45.68	RI	34.5
NY	45.53	AL	34.11
HI	44.98	IA	33.61
NJ	44.88	NH	33.51
SC	43.56	NJ	29.68
MA	42.75	UT	29.34
ND	41.58	ID	28.1
RI	40.87	AR	27.67
MD	39.12	CA	27.08
ME	37.92	PA	25.88
VT	37.15	DC	24.84
NM	36.58	MT	24.56
AR	35.92	OH	24.08
MI	35.44	VT	23.74
IA	32.79	OK	23.6
WI	32.12	AK	23.49
UT	31.8	OR	22.02
DE	31.08	DE	21.79
OK	29.64	TX	20.96
IN	28.01	HI	20.69
OR	27.36	WI	20.46
WV	24.81	MO	20.02
FL	24.8	MI	19.57
GA	24.8	TN	19.32
VA	23.92	LA	18.39
LA	23.68	NC	17.88
MS	22.82	MS	17.66
KS	22.21	CO	17.57
NV	18.65	KS	14.19
CA	17.83	ME	13.63
AK	16.21	WV	12.14
TX	16.1	MD	11.62
WA	15.9	AZ	10.61
CO	15.81	WA	10.35
ID	13.93	NM	9.55
AZ	13.55	MA	9.0
IL	13.22	SC	8.31
MO	10.66	GA	8.1
KY	10.64	NV	8.03
NC	10.43	VA	5.51
CT	8.85	KY	5.32
NH	6.36	FL	3.47
TN	4.99	IL	0.54
Average	28.94	Average	21.34

Table 6 shows middle-school math teachers who have majors in math. This percentage is considerably lower than that of fully certified middle-school math teachers. During 1999, the percent of math teachers who had math majors ranged from 67.2% majors in District of Columbia to 5.0% majors in Tennessee. The overall percentage of math teachers with math majors was 28.9%. In 2003, the range is from 52.7% in Minnesota to 5.4% in Illinois. The overall average in 2003 is much lower at 21.3%. This indicates an overall *decrease* in percent of middle-school *math* teachers with *math majors* from 1999-00 to 2003-04. For math teachers with math majors NE, SD, MN, WY, and NY were high both years, while KY & IL were low both years.

Table 7 shows middle-school science teachers with science majors. This percentage is also much lower than that of fully certified middle-school science teachers. In 1999, science teachers with science majors ranged from 67.0% in District of Columbia to 0% in Georgia and Louisiana. The overall average percent of science teachers with science majors was 28.3%. In 2003, the range was from 68.6% in New York to 3.5% in Tennessee. The overall average percent was much higher than in 1999 at 40.3%. This indicates an overall *increase* in percent of middle-school *science* teachers with *science majors* from 1999-00 to 2003-04. Tennessee was the lowest state for both math teachers with math majors in 1999 (5.0%) and science teachers with science majors in 2003 (3.5%). For science teachers with science majors AK, VT, CA, and MN were high both years. KY, TN, GA, and LA were low both years.

Table 7

Middle-School Science Teachers Have Science Majors and Teach Science - by State 1999-2000 vs. 2003-2004

1999-2000		2003-2004	
DC	66.98	NY	68.6
AK	66.63	TX	66.1
VT	63.05	MN	60.74
CO	59.22	AK	60.63
CA	53.48	NJ	57.05
MN	51.94	NE	56.49
VA	51.77	VT	55.55
UT	48.48	CA	53.94
MI	45.53	NV	53.79
IA	43.24	IN	53.03
WA	42.03	DE	51.63
WI	41.49	AL	50.84
AL	40.58	UT	47.54
PA	40.24	DC	46.96
NE	40.2	OR	46.73
SC	37.62	MT	44.17
NV	37.58	ND	44.11
CT	34.87	MO	44.0
RI	33.7	MD	43.25
SD	33.3	CO	43.2
IL	32.91	IL	41.79
IN	32.71	MI	41.05
ID	32.24	IA	40.18
OR	31.85	HI	39.07
MT	31.78	WY	38.88
MO	30.29	SC	38.5
WY	29.62	RI	37.83
NM	29.56	NH	37.3
OH	28.35	WV	36.69
NH	25.97	ID	35.91
HI	25.01	WA	35.83
OK	23.91	MA	35.64
KS	23.26	FL	34.72
ME	23.06	ME	33.77
AZ	19.2	SD	33.5
ND	19.08	CT	33.4
MS	18.94	MS	31.46
AR	17.81	NM	31.32
MA	17.6	VA	30.88
MD	17.26	NC	30.15
NY	15.44	KY	29.63
KY	13.3	KS	29.21
WV	12.44	WI	28.43
NJ	10.91	PA	28.21
TX	10.04	AZ	26.4
NC	7.42	OK	21.77
TN	5.11	GA	18.73
DE	4.81	LA	16.51
FL	3.04	AR	11.7
GA	0	OH	6.47
LA	0	TN	3.45
Average	28.32	Average	40.29

Table 8 compares *overall* percent of fully certified middle-school math teachers in 1999 to fully certified middle-school math teachers in 2003, and the percent of middle-school math teachers with math majors in 1999 to middle-school math teachers with math majors in 2003. The percent of fully certified middle-school math teachers *decreased* from 1999 to 2003 as did the percent of math teachers with math majors, as shown in Table 8.

Table 8
Overall Percent Fully Certified Middle-School Math Teachers with Math Majors, Comparing 1999-00 to 2003-04

	Fully Certified & Teaches Math	Math Major & Teaches Math
1999-2000	86.78	28.94
2003-2004	85.13	21.34

Similarly, Table 9 compares *overall* percent of fully certified middle-school science teachers in 1999 to fully certified middle-school science teachers in 2003, and the percent of middle-school science teachers with science majors in 1999 to middle-school science teachers with science majors in 2003. The percent of fully certified middle-school science teachers *decreased* from 1999-2003, whereas the percent of middle-school science teachers with science majors *increased* from 1999 to 2003.

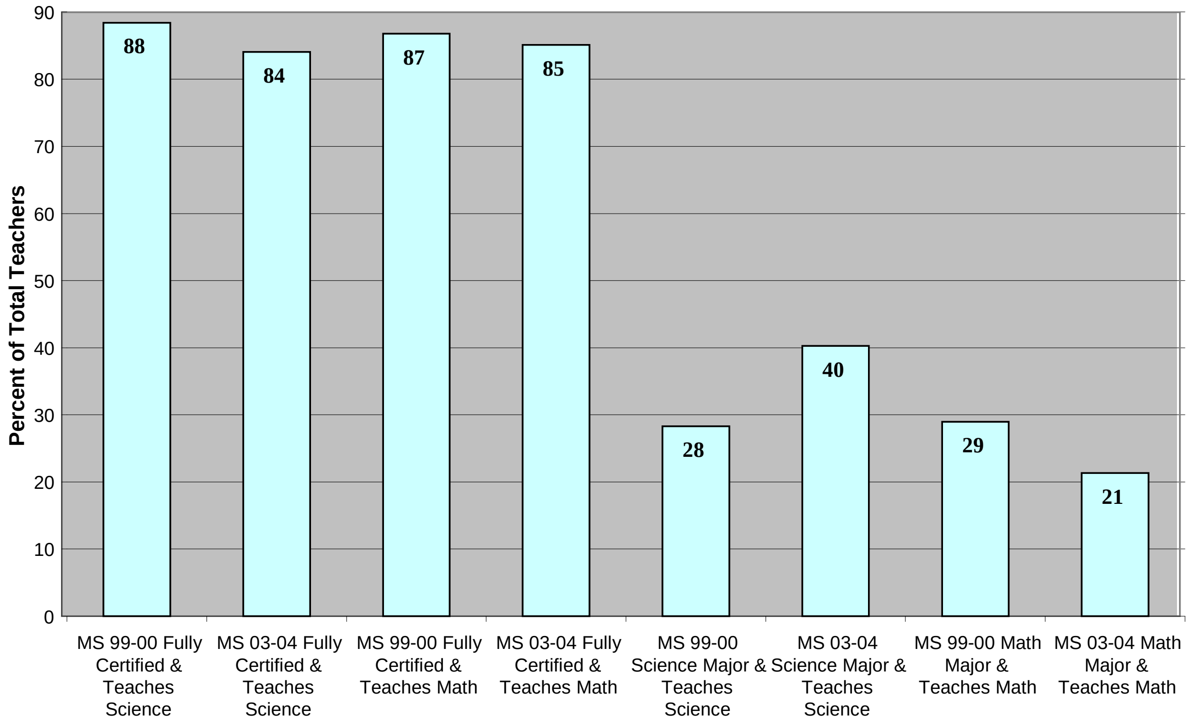
Table 9
Overall Percent Fully Certified Middle-School Science Teachers with Science Majors, Comparing 1999-00 to 2003-04

	Fully Certified & Teaches Science	Science Major & Teaches Science
1999-2000	88.42	28.32
2003-2004	84.06	40.29

Figure 1 compares all middle-school variables from Tables 4 through 9 on one graph. This graph shows that *both* math and science fully certified *decreased* from 1999-00 to 2003-04. Science teachers with science majors *increased* from 1999-00 to 2003-04 while math teachers with math majors *decreased*. This figure also displays that the percentage of teachers who are certified and teach science or math is much higher than the percentage who have majors and teach science and math.

Figure 1

Middle-School Fully Certified Math/Science Teachers with Math/Science Majors (1999-2000 vs. 2003-2004).



The four variables involved in determining the status of percent of middle-school teachers teaching out-of-field were: math teachers with full certification, science teachers with full certification, math teachers with math majors, and science teachers with science majors. The results of this study showed that in 3 of these 4 categories, there was an *increase* in out-of-field teachers from before NCLB (determined though the analyses of 1999-00 SASS data) to after NCLB (determined though the analyses of 2003-04 SASS data). There was an overall *decrease* in percent of *both* middle-school *math* teachers and *science* teachers with *full certification* from 1999-00 to 2003-04. Science percentage decreased more than math. There was a *decrease* in percent of math teachers with *math majors*. There was an *increase* in percent of science teachers with *science majors*. Notably, the percentage of science and math teachers with majors was consistently lower than the percentage of math and science teachers who were fully certified.

4.02 Research Question Two – Part A: During school years 1999-2000 and 2003-2004, which states are consistently ranked high or low in percent of middle-school math and science teachers with math and science majors? The percent of math and science teachers with math and science majors between years 1999-2000 and 2003-2004 ranking component can be answered by referencing Table 10 and Figures 2 through 7.

Table 10 shows middle-school teachers who teach math and science and have majors in math and science among states from highest percentage to lowest percentage during 1999-00 and 2003-04 school years. The top 30% (15 states) in all four categories are shown in green with those states that occur at the top in at least 3 of the 4 categories are shown in ***bold italic*** print. Those states that are top in *all* categories are underlined. The bottom states are shown in red with those states that occur at the bottom in at least 3 of the 4 categories are shown in ***bold italic*** print. The state (Kentucky) that was near the bottom in *all* categories is underlined.

Table 10
Percent of Middle-School Math/Science Teachers that Teach Math/Science & Have Majors in Math/Science - by State, 1999-2000 vs. 2003-2004

1999-2000 Middle-School Math Teachers Teach Math & Have Math Majors		2003-2004 Middle-School Math Teachers Teach Math & Have Math Majors		1999-2000 Middle-School Science Teachers Teach Science & Have Science Majors		2003-2004 Middle-School Science Teachers Teach Science & Have Science Majors	
STATE	Percent	STATE	Percent	STATE	Percent	STATE	Percent
DC	***67.17***	MN	52.66	***DC***	***66.98***	***NY***	***68.6***
NE	***58.68***	ND	48.94	AK	66.63	TX	66.1
PA	56.32	SD	48.87	VT	63.05	MN	60.74
AL	***51.98***	***NE***	***47.34***	CO	59.22	AK	60.63
SD	50.32	CT	46.31	CA	53.48	***NJ***	***57.05***
MI	49.65	***NY***	***39.36***	MI	51.94	***NE***	***56.49***
WY	49.40	IN	39.03	VA	51.77	VT	55.55
OH	48.94	WY	34.65	UT	48.48	CA	53.94
MT	45.68	RI	34.50	ME	45.53	NV	53.79
NY	***45.53***	***AL***	***34.11***	IA	43.24	IN	53.03
HI	44.98	IA	33.61	WA	42.03	DE	51.63
NJ	***44.88***	NH	33.51	WI	41.49	***AL***	***50.84***
SC	43.56	***NJ***	***29.68***	***AL***	***40.58***	UT	47.54
MA	42.75	UT	29.34	PA	40.24	***DC***	***46.96***
ND	41.58	ID	28.10	***NE***	***40.2***	OR	46.73
RI	40.87	AR	27.67	SC	37.62	MT	44.17
MD	39.12	CA	27.08	NV	37.58	ND	44.11
MN	37.92	PA	25.88	CT	34.87	MO	44.00
VT	37.15	DC	24.84	RI	33.70	MD	43.25
NM	36.58	MT	24.56	SD	33.30	CO	43.20
AR	35.92	OH	24.08	IL	32.91	IL	41.79
ME	35.44	VT	23.74	IN	32.71	MI	41.05
IA	32.79	OK	23.60	ID	32.24	IA	40.18
WI	32.12	AK	23.49	OR	31.85	HI	39.07
UT	31.80	OR	22.02	MT	31.78	WY	38.88
DE	31.08	DE	21.79	MO	30.29	SC	38.50
OK	29.64	TX	20.96	WY	29.62	RI	37.83
IN	28.01	HI	20.69	NM	29.56	NH	37.30
OR	27.36	WI	20.46	OH	28.35	WV	36.69
WV	24.81	MO	20.02	NH	25.97	ID	35.91
FL	24.80	MI	19.57	HI	25.01	WA	35.83
GA	24.80	TN	19.32	OK	23.91	MA	35.64
VA	23.92	LA	18.39	KS	23.26	FL	34.72
LA	23.68	NC	17.88	MN	23.06	ME	33.77
MS	22.82	MS	17.66	AZ	19.20	SD	33.50
KS	22.21	CO	17.57	ND	19.08	CT	33.40
NV	18.65	KS	14.19	MS	18.94	MS	31.46
CA	17.83	ME	13.63	AR	17.81	NM	31.32
AK	16.21	WV	12.14	MA	17.60	VA	30.88
TX	16.10	MD	11.62	MD	17.26	***NC***	***30.15***

WA	15.90	***AZ***	***10.61***	NY	15.44	***KY***	***29.63***
CO	15.81	WA	10.35	***KY***	***13.30***	KS	29.21
ID	13.93	NM	9.55	WV	12.44	WI	28.43
AZ	***13.55***	MA	9.00	NJ	10.91	PA	28.21
IL	13.22	SC	8.31	TX	10.04	***AZ***	***26.40***
MO	10.66	***GA***	***8.10***	***NC***	***7.42***	OK	21.77
KY	***10.64***	NV	8.03	***TN***	***5.11***	***GA***	***18.73***
NC	***10.43***	VA	5.51	DE	4.81	LA	16.51
CT	8.85	***KY***	***5.32***	FL	3.04	AR	11.70
NH	6.36	FL	3.47	***GA***	***0***	OH	6.47
TN	***4.99***	IL	.54	LA	0	***TN***	***3.45***
Average	28.94	Average	21.34	Average	28.32	Average	40.29

Figures 2 and 3 show the top states (top 30%), those with the highest percentage of middle-school math teachers with math majors, in 1999 and 2003. Figures 4 and 5 show the top states for highest percentage of middle-school science teachers with science majors, in 1999 and 2003, respectively. Figures 2 and 3 show seven particular U.S. states are consistently represented as top percent of middle-school *math* teachers with *math* majors, during both 1999 and 2003. These states are Nebraska, Alabama, South Dakota, Wyoming, New York, New Jersey and North Dakota. Figures 4 and 5 show three states, Alabama, Nebraska and District of Columbia, are also top in middle-school *science* teachers with *science* majors. Nebraska and Alabama were in the top 30% in all four categories (1999 math teachers with math majors, 2003 math teachers with math majors, 1999 science teachers with science majors, and 2003 science teachers with science majors). New York, New Jersey and District of Columbia were top in 3 of the 4 categories. States that were in the top 30% in at least 3 of the 4 categories were represented on the graphs as non-blue, patterned bars.

Minnesota moved from the middle of the pack to the top in both math and science. In math, Minnesota teachers moved from 37.9% to 52.7%, which was the very top percent. In science, they moved from 23.1% to 60.7% (third from the top).

Figure 2
Percent of Middle-School Math Teachers with Math Majors, 1999-2000 (States in Top 30%)

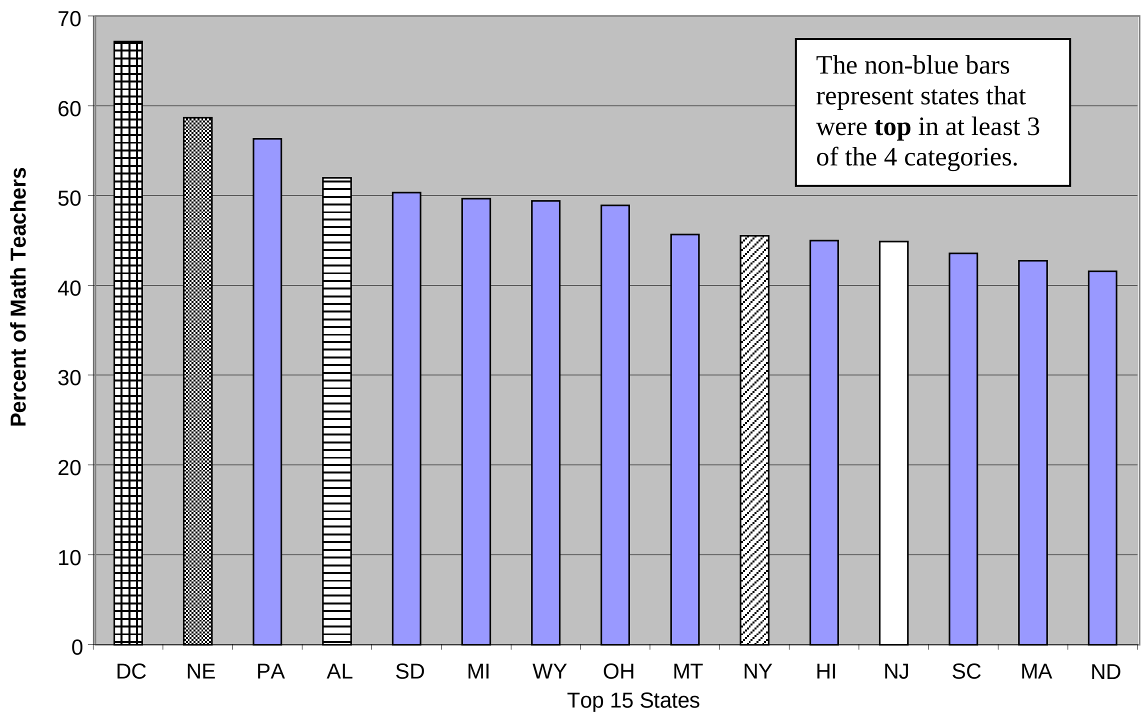


Figure 3
Percent of Middle-School Math Teachers with Math Majors, 2003-2004 (States in Top 30%)

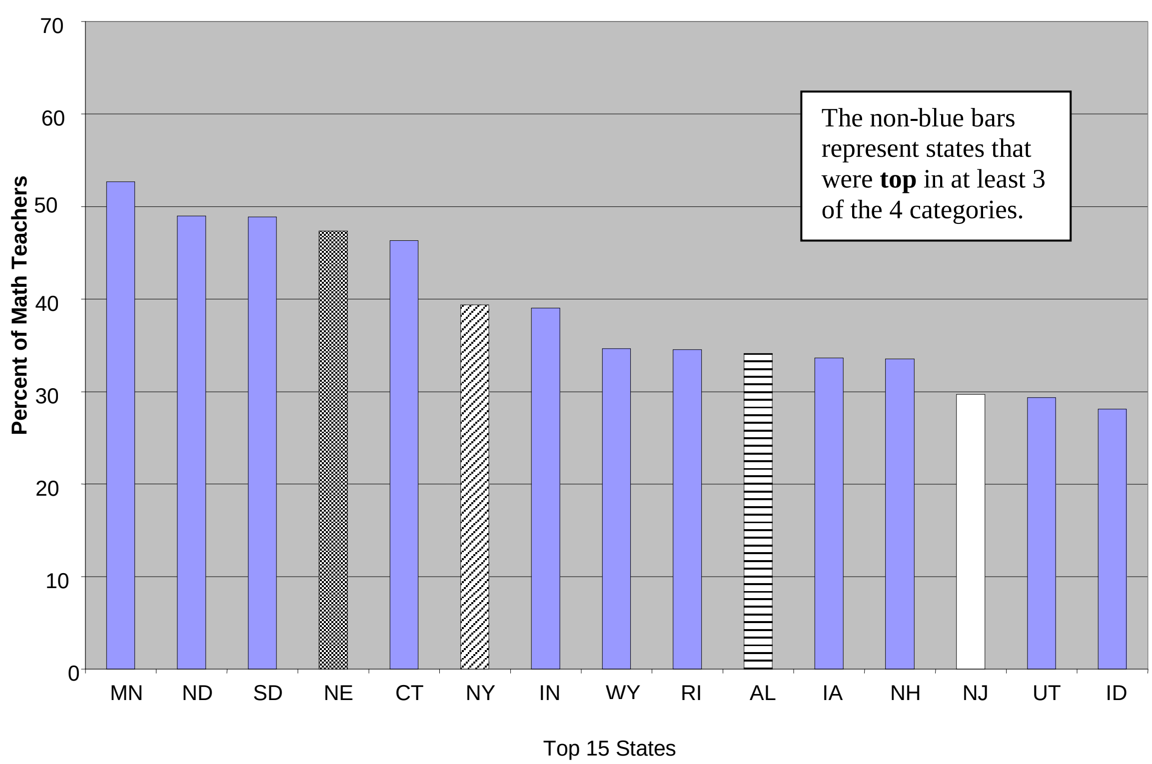


Figure 4

Percent of Middle-School Science Teachers with Science Majors, 1999-2000 (States in Top 30%)

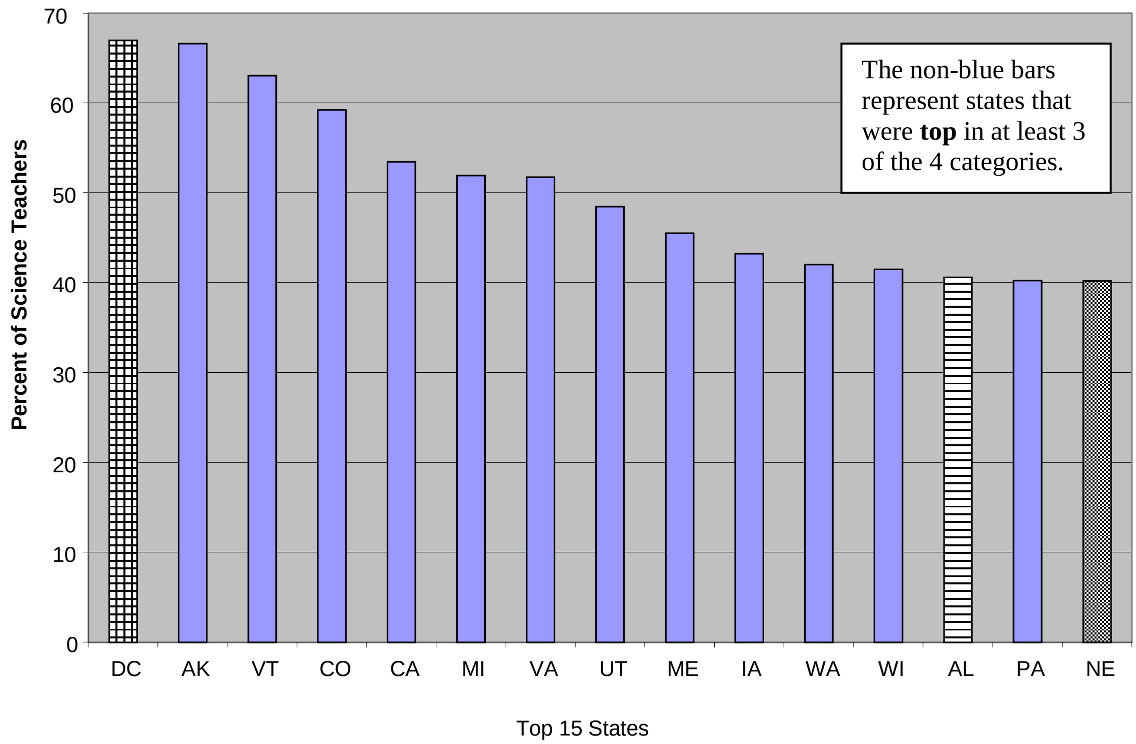
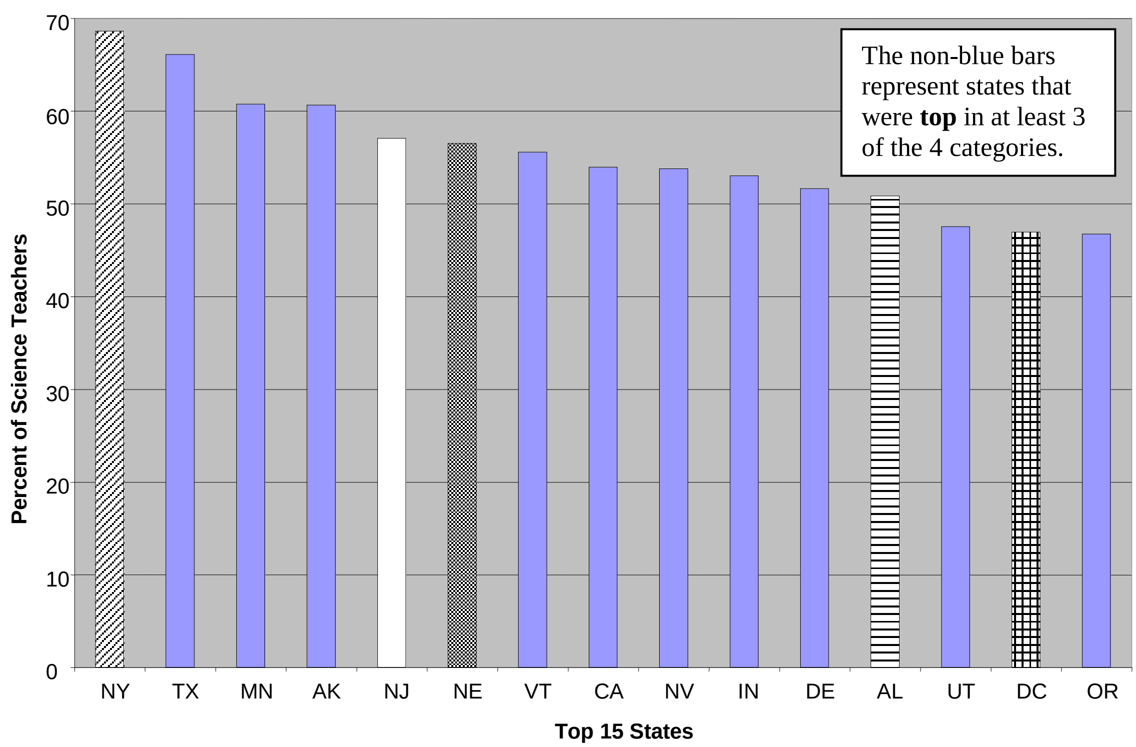


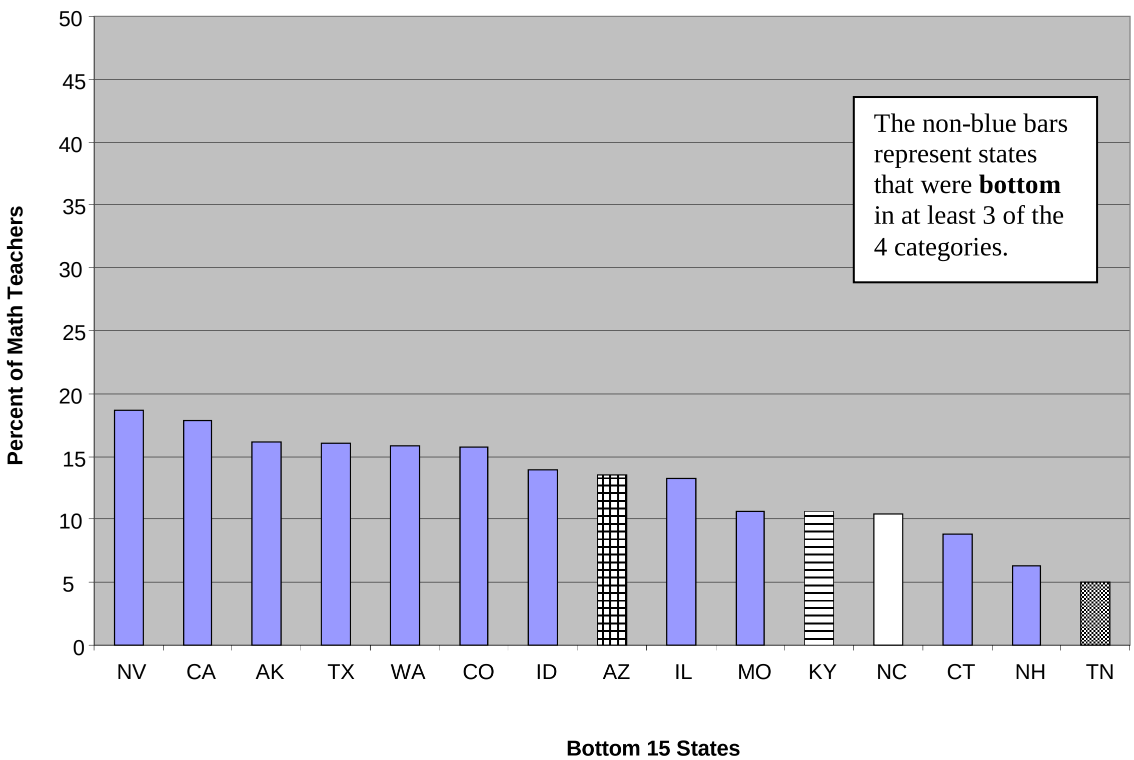
Figure 5

Percent of Middle-School Science Teachers with Science Majors, 2003-2004 (States in Top 30%)



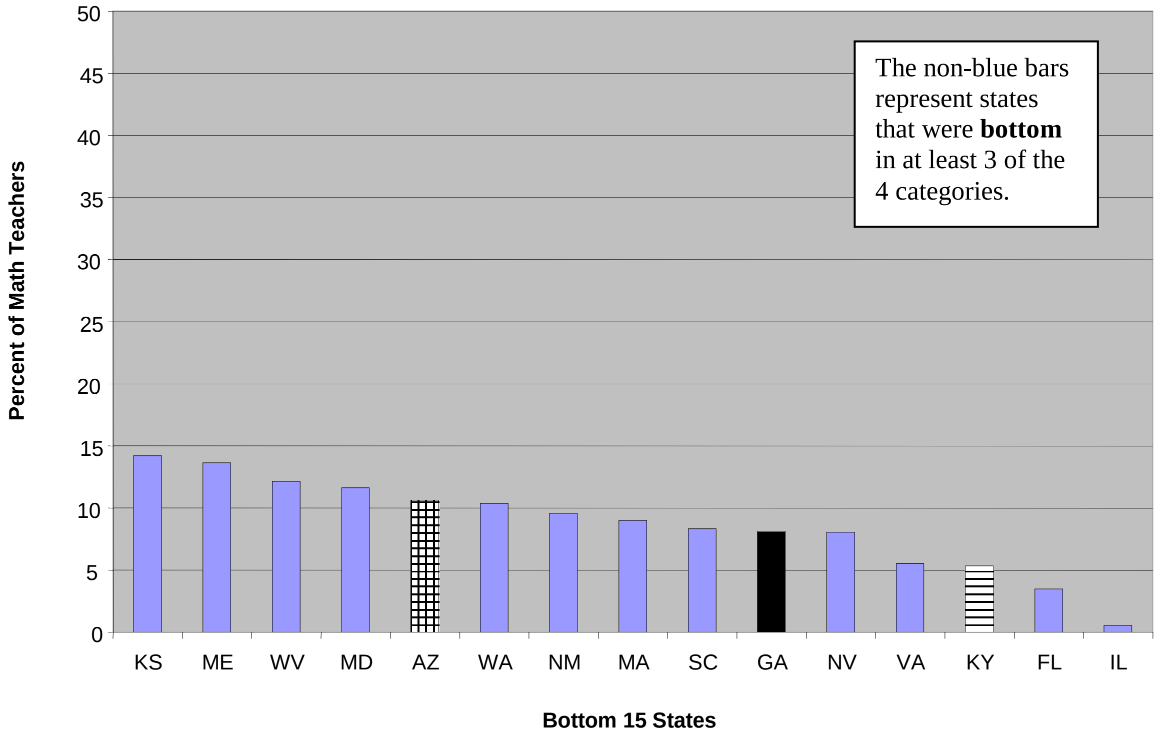
Figures 6 through 9 show the 1999-00 bottom states (bottom 30%) in which middle-school math and science teachers have math and science majors, and the bottom states in 2003-04 in which middle-school math and science teachers have math and science majors.

Figure 6
Percent of Middle-School Math Teachers with Math Majors, 1999-2000 (States in Bottom 30%)



States that were in the bottom 30% in at least 3 of the 4 categories were shown as non-blue, patterned bars.

Figure 7
Percent of Middle-School Math Teachers with Math Majors, 2003-2004 (States in Bottom 30%)



These figures (6 through 9) also show during 1999-00 and 2003-04 school years, three to five of the same states are consistently represented as bottom in percent of 1999 middle-school math teachers with math majors, 2003 middle-school math teachers with math majors, 1999 middle-school science teachers with science majors and 2003 middle-school science teachers with science majors. These five states were Kentucky, Arizona, Tennessee, North Carolina and Georgia.

Figure 8
Percent of Middle-School Science Teachers with Science Majors, 1999-2000 (States in Bottom 30%)

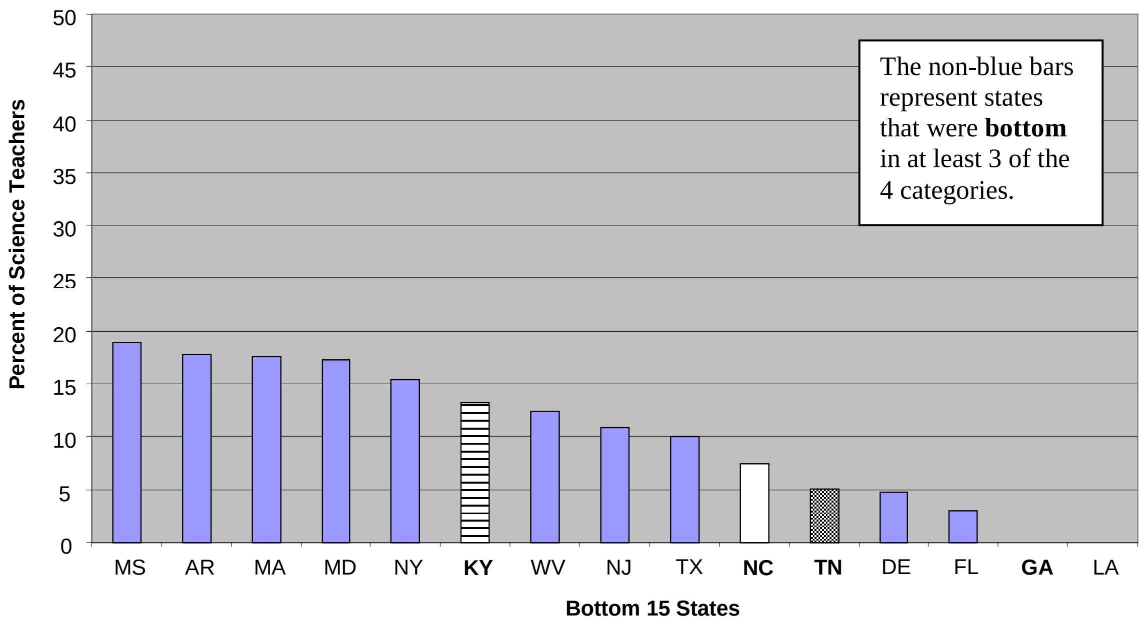
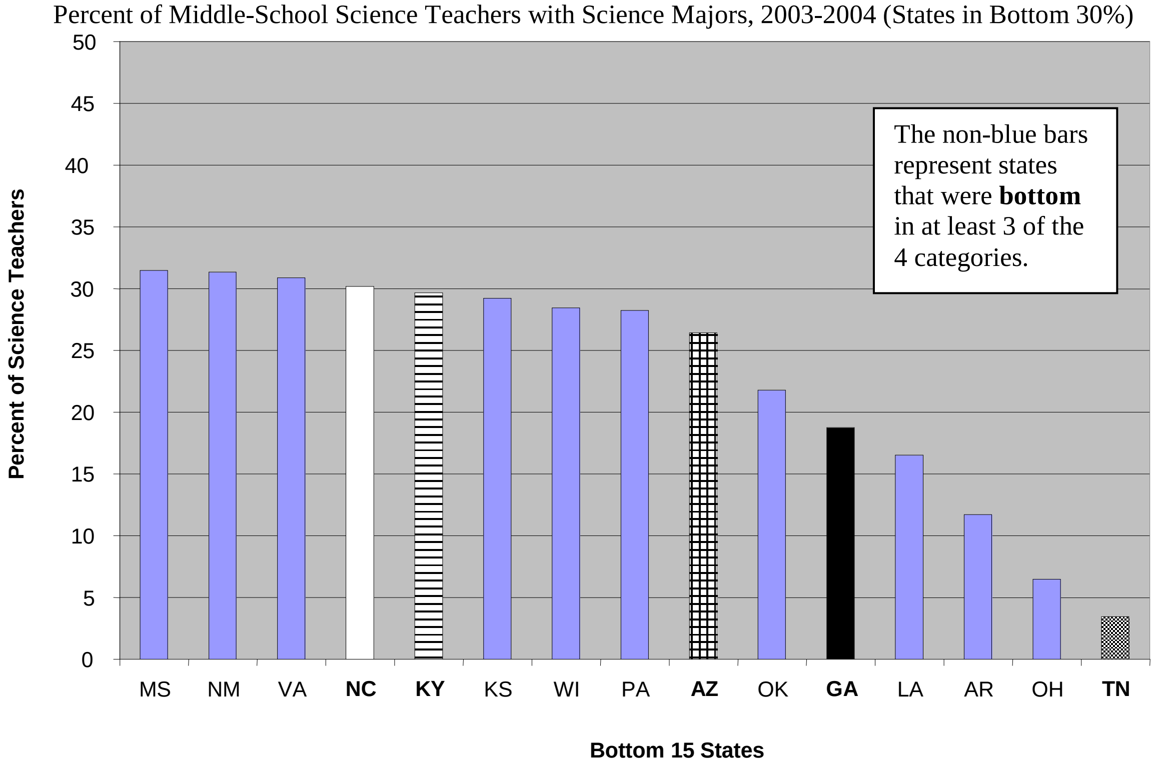


Figure 9
Percent of Middle-School Science Teachers with Science Majors, 2003-2004 (States in Bottom 30%)



Kentucky was in the bottom percent in both subjects and both years (math, science, 1999, 2003). In addition, Tennessee was in the bottom 30% of both middle-school math teachers with math majors and middle-school science teachers with science majors in 1999. Georgia was in the bottom percent in both math and science in 2003. Arizona *remained in* the bottom 30% in math and moved *to* the bottom in science. Tennessee and North Carolina were in the bottom 30% in math and science in 1999. Tennessee moved to the *very* bottom in science and *out of* the bottom 30% in math. North Carolina improved slightly in science (remained in bottom 30%, though) and moved out of the bottom in math. These are all southern states.

Some states consistently fell in either the top third or bottom third in both science and math majors. During 1999-00 at least three of the same states fell in the *top* 30% among both math teachers with math majors and science teachers with science majors. At least three of the same states fell in the *bottom* 30% among both math teachers with math majors and science teachers with science majors during 1999-00. A similar pattern of top and bottom states was also apparent during 2003-04 where four of the same states fell in the *top* 30% among both math teachers with math majors and science teachers with science majors. Three of the same states fell in the *bottom* 30% in math teachers with math majors and science teachers with science majors during 2003-04.

Three of the same states were ranked in top third in science and math majors and five of the same states were ranked bottom in math and science majors. In other words, certain states either ranked high or low in both subjects in each year. Several states, NE, AL, NY, and NJ remained the top states in math teachers with math majors from 1999-00 to 2003-04. Two states, AZ and KY, remained the bottom states in math teachers with math majors. DC, AL, and NE were top states in percent science teachers with science majors from both years. KY, NC, TN, and GA were bottom states in science teachers with science majors from both 1999-00 and 2003-04. Only Nebraska and Alabama were top states from both years for both math and science majors. Kentucky was the only state that was in the bottom third of both math and science majors from both years.

In comparing top states in 1999-00 to top states in 2003-04, there are more consistently top states in 2003-04 (four) than in 1999-00 (three). District of Columbia was in both top categories in 1999-00, but only top in science during 2003-04. New York and New Jersey were top in two groups in 2003 but only in one group during 1999. Nebraska and Alabama were in both top categories for both years.

In comparing bottom states in 1999-00 to bottom states in 2003-04, there were three consistently *bottom* states in both 2003-04 and in 1999-00. In science, North Carolina, Kentucky, and Georgia are on the bottom during both years. In math, Kentucky and Arizona are in the bottom 30% during both years. Further study may reveal the reason that some states remained consistently high in percent major, whereas others remained low.

In addition to states being ranked in the top or bottom 30%, it is also interesting to note, as illustrated in Tables 10 & 11 (and Table 17 in Appendix D), that certain states *dramatically* increased or decreased in their percentages of majors from 1999-2000 to 2003-2004. These states *fell* considerably in percent math teachers with *math* majors: DC from 67 to 24% (-42%), SC 44 to 8% (-36%), MA 43 to 9% (-34%), PA 56 to 25% (-31%), OH 48 to 24% (-24%), HI 45 to 21% (-24%), and MT 46 to 25% (-21%). These states fell in percent *science* majors: DC from 70 to 47% (-23%), VA 52 to 31% (-21%), CO 59 to 43% (-16%), WI 42 to 28% (-14%), and PA 40 to 28% (-12%). Ohio decreased in science major from 28 to 6% (-22%).

Likewise, some states *rose* in percent math and science teachers with math and science majors. Some states in particular had very *large* jumps. NJ increased tremendously in percent science majors (from 11 % to 57% for an increase of 46%). Connecticut had a similar jump in math majors (from 9% to 46% for an increase of 37%) as did New Jersey (from 6% to 34% for an increase of 32%). These states increased considerably in percent science majors: In addition to New Jersey's jump, New York increased from 15 to 69% (+54%) and Texas from 10 to 66% (+56%). In order to reveal what caused these significant jumps from high to low and low to high in percent majors from 1999-2000 to 2003-2004, further research is recommended.

<u>Research Question Two – Part B</u>: During school years 1999-2000 and 2003-2004, which states show an increase or decrease in percent middle-school teachers with full certification and major in math or science in their teaching field? The states' trends in full certification and major in middle-school math and science teachers, 1999-00 vs. 2003-04, component of this question can be answered by referencing Tables 11A through 11D. Greater detail of these data with percentages can be found in Appendix D in Table 17. These tables show increases and decreases in states' middle-school math and science teachers with math and science majors and increases and decreases in full certification among states.

Table 11A shows the states that had an *increase*, from 1999-00 to 2003-04, in middle-school math and science teachers with full certification *and* majors in math and science. There are three states, Minnesota, North Dakota and New Hampshire, with an increase in percent of both math and science certification and percent of math and science majors. There are more states (18) that have science teachers that showed an increase in both certification and major than math teachers (9) that showed an increase in teachers who are fully certified and have majors.

Table 11A

*States that **Increased** in Both Percent Math/Science Teachers with Full Certification and Math/Science Majors from 1999-0000 to2003-04*

	Increase Percent Middle-School Math Teachers with Math Majors	Increase Percent Middle-School Science Teachers with Science Majors
Increase Percent Math Teachers with Full Certification	***MN*** CT TX ***ND*** ID TN ***NH*** CA NC	***MN*** ***ND*** ***NH***
Increase Percent Science Teachers with Full Certification	***MN*** ***ND*** ***NH***	***MN*** NJ MT HI NM AZ ***ND*** NE MO WY KY GA ***NH*** AL MD MS KS LA

Bold italic print signifies states that are on both science *and* math teacher lists.

Table 11B shows the states that had a *decrease*, from 1999-00 to 2003-04, in middle-school math and science teachers with full certification *and* majors in math and science. There are four states, Vermont, District of Columbia, Michigan and Ohio, with a decrease in percent of math and science teachers in both certification and math and science majors. There are more states (22) that have math teachers that showed a decrease in both percent certification and major than states (11) that have science teachers that showed a decrease in teachers who are fully certified and have majors.

Table 11B

*States that **Decreased** in Both Percent Math/Science Teachers with Math/Science Majors **and** Full Certification from 1999-00 to2003-04*

	Decrease Percent Middle-School Math Teachers with Math Majors	Decrease Percent Middle-School Science Teachers with Science Majors
Decrease Percent Math Teachers with Full Certification	***VT*** SD UT WI NM FL ***DC*** NY AR LA MA IL ***MI*** RI PA ME GA ***OH*** AL OR WV NV	***VT*** ***DC*** ***MI*** ***OH***
Decrease Percent Science Teachers with Full Certification	***VT*** ***DC*** ***MI*** ***OH***	***VT*** AK VA ***DC*** CO OK ***MI*** IA TN ***OH*** WA

Bold italic print signifies states that are on both science *and* math teacher lists.

Table 11C

*States that Increased in Percent Science or Math **Major Only** from 1999-00 to 2003-04*

Middle-School ***Science*** Teachers with ***Increase*** Percent ***Majors Only***		Middle-School ***Math*** Teachers with Increase Percent ***Majors Only***
NY (+40%)	RI	***IN***
TX (+40%)	WV (+30%)	IA
CA	ID	AK
NV	MA	MO
IN	FL	CO
DE	ME	
OR	SD	
IL	NC (+20%)	
SC		

Bold italic print signifies states that are on both science *and* math teacher lists.

Table 11C shows only Indiana *increased* in percent majors from 1999-00 to 2003-04 among both science and math middle-school teachers. Table 11C shows that New York and Texas increased science majors *only* by over 40%. West Virginia increased in science majors by over 30% and Indiana and North Carolina increased by over 20%. There were no similar *large* increases in percent math majors only. Table 11C also shows there were greater numbers of states (17) with increased percent science majors only as compared to the number of states (5) with an increased percent in math majors only, from 1999-00 to 2003-04, among middle-school teachers.

Table 11D
*States that Increased in Percent **Certification Only** from 1999-00 to 2003-04*

Increase Percent ***Certification only*** – Middle-School ***Science*** Teachers	***Increase*** Percent ***Certification only*** – Middle-School ***Math*** Teachers	
UT	MT	WY
CT	KS	SC (+26%)
WI	WA	MS
PA	VA	MD
AR	OK	AZ
	NJ	KY
	HI	DE
	NE	

Bold italic print signifies states that are on both science *and* math teacher lists.

Table 11D shows there were *no* states that increased in percent certification only from 1999-00 to 2003-04 among both science and math middle-school teachers. There were 15 states in which middle-school math teachers had an increase in percent certification only compared to only five states in which middle-school science teachers had an increase in percent certification only from 1999-00 to 2003-04. Table 11D shows a huge increase in percent math teachers with certification in South Carolina.

There were no states that decreased in percent majors *only* among middle-school science and math teachers. And there were no states that decreased in percent certification *only* among middle-school science and math teachers. Again, why some states had drastic changes while others had only slight changes requires further research.

Research Question Two – Part C: During school years 1999-2000 and 2003-2004, which particular states (when compared to Kansas) are more likely to have math and science teachers who have math and science majors (have teachers who are "matched")? Table 12 and Figures 10 and 11 will help determine which particular states are more likely to have middle-school math and science teachers who are "matched," 1999 vs. 2003. Research Question 2 – Part C was answered by doing a logistic regression and odds ratio. This regression and odds ratio included an analysis that compared the dependent variable "matched/not matched" middle-school math and science teachers to the independent variable, state. "Matched" means teaches math/science and has a major in math/science.

The state of Kansas "matched" math and science teachers was used as the baseline state (Kansas = 1.0). Kansas data are used in this study to compare all other states' status of being "matched" (fully certified with a major in subject taught), because Kansas was typically in the middle of the states in percent certified and percent with majors and so served well as baseline state. Kansas was chosen as the baseline state because it typically falls in about the middle of the states in funding (in 2006 it ranked 30th with $8,392 per pupil spending), ranked 21st in per capita income (KS = $34,743 & U.S. = $36,276), and scored well above the nation on national assessment tests. In 2007, 80% of Kansas 8th grade math students scored basic or higher on the NAEP test as compared to the U.S. average where only 70% scored basic or higher (Kansas Association of School Boards, 2009, June).

Table 12

Odds of states having "matched" middle-school math and science teachers, compared to teachers in Kansas

1999-2000

State	Odds Ratio	Standard Error	|t|	P
DC	**7.147468**	**6.904912**	**2.04**	**0.042**
VT	**3.558928**	**2.190028**	**2.06**	**0.039**
PA	**3.488069**	**1.97169**	**2.21**	**0.027**
MN	**3.421544**	**1.753925**	**2.4**	**0.016**
AK	**3.38938**	**2.189145**	**1.89**	**0.059**
AL	**2.856546**	**1.619295**	**1.85**	**0.064**
NE	**2.689859**	**1.394936**	**1.91**	**0.056**
SC	2.63204	1.685824	1.51	0.131
MT	**2.573388**	**1.301641**	**1.87**	**0.062**
MI	2.537765	1.557449	1.52	0.129
CO	2.473481	1.413401	1.58	0.113
IA	2.381857	1.321762	1.56	0.118
SD	**2.367062**	**1.184519**	**1.72**	**0.085**
MN	2.320653	1.606029	1.22	0.224
NJ	2.265562	1.517357	1.22	0.222
OH	2.201449	1.293259	1.34	0.179
VA	2.151087	1.206892	1.37	0.172
WY	2.064719	1.179704	1.27	0.205
CA	2.036954	1.092437	1.33	0.185
RI	2.021692	1.388302	1.03	0.305
WI	1.97439	1.187904	1.13	0.258
MA	1.73199	0.9990757	0.95	0.341
OR	1.723921	1.03482	0.91	0.364
HI	1.672483	1.215204	0.71	0.479
NY	1.639528	0.9667716	0.84	0.402
MD	1.636681	1.142594	0.71	0.48
IN	1.504429	0.9723899	0.63	0.528
NM	1.444691	0.8378191	0.63	0.526
CT	1.217073	0.8551231	0.28	0.78
NV	1.184436	0.8136174	0.25	0.805
ND	1.107022	0.5493237	0.2	0.838
OK	1.100004	0.5374183	0.2	0.845
UT	1.067729	0.5546732	0.13	0.9
KS	**1**			
IL	0.9738972	0.5661193	-0.05	0.964
MS	0.9555048	0.5702963	-0.08	0.939
WV	0.9323406	0.5520193	-0.12	0.906
FL	0.882991	0.7335533	-0.15	0.881
WA	0.843305	0.4899927	-0.29	0.769
AR	0.7423325	0.3758277	-0.59	0.556
AZ	0.7258154	0.4680021	-0.5	0.619
ID	0.7164509	0.4300041	-0.56	0.579
KY	0.7112736	0.4810751	-0.5	0.614
MO	0.699825	0.4226958	-0.59	0.555
LA	0.6886591	0.5297323	-0.48	0.628
GA	0.6299618	0.5595959	-0.52	0.603
TX	0.5303567	0.3002497	-1.12	0.263
NH	0.5039774	0.474244	-0.73	0.467
DE	0.4031173	0.3323191	-1.1	0.271
NC	0.3907261	0.2704212	-1.36	0.175
TN	**0.2250123**	**0.1350197**	**-2.49**	**0.013**

2003-2004

State	Odds Ratio	Standard Error	|t|	P
NJ	**5.520203**	**3.242244**	**2.91**	**0.004**
NY	**5.261228**	**3.243194**	**2.69**	**0.007**
MN	**4.618926**	**1.845284**	**3.83**	**0**
NE	**3.236276**	**1.480563**	**2.57**	**0.01**
CA	**3.230227**	**1.563125**	**2.42**	**0.015**
CO	**3.226636**	**1.868508**	**2.02**	**0.043**
TX	**3.135558**	**1.562108**	**2.29**	**0.022**
CT	**3.053233**	**1.808673**	**1.88**	**0.06**
MI	**2.947128**	**1.489115**	**2.14**	**0.033**
RI	**2.46469**	**1.29418**	**1.72**	**0.086**
SD	**2.402902**	**1.047904**	**2.01**	**0.044**
AL	**2.328192**	**1.07462**	**1.83**	**0.067**
ND	**2.315647**	**1.05923**	**1.84**	**0.067**
AK	**2.263421**	**1.02966**	**1.8**	**0.073**
NH	2.169051	1.143634	1.47	0.142
NV	2.137765	1.188413	1.37	0.172
IN	2.093477	1.002768	1.54	0.123
ME	1.950521	1.174669	1.11	0.267
DE	1.917405	1.133054	1.1	0.271
MO	1.91636	1.08093	1.15	0.249
MT	1.819871	0.8755528	1.24	0.213
ID	1.806113	0.7826928	1.36	0.173
IA	1.773777	0.8457039	1.2	0.229
OR	1.693502	1.077035	0.83	0.408
WY	1.685562	0.8519315	1.03	0.302
NC	1.680207	0.9718326	0.9	0.37
MD	1.65642	0.8884287	0.94	0.347
VT	1.619964	0.8804692	0.89	0.375
DC	1.583441	1.053336	0.69	0.49
UT	1.577652	0.707429	1.02	0.309
MA	1.425717	0.8817977	0.57	0.566
PA	1.356778	0.5763759	0.72	0.473
WI	1.3563	0.6570684	0.63	0.529
FL	1.352437	0.8199089	0.5	0.619
HI	1.27792	0.8304339	0.38	0.706
OH	1.15534	0.6350966	0.26	0.793
LA	1.150424	0.6324484	0.25	0.799
NM	1.148726	0.5983156	0.27	0.79
AZ	1.141246	0.6479235	0.23	0.816
WA	1.051992	0.4842531	0.11	0.912
KS	**1**			
MS	0.9499082	0.4786182	-0.1	0.919
VA	0.9407735	0.5241642	-0.11	0.913
KY	0.8965319	0.5725534	-0.17	0.864
SC	0.8238663	0.4926011	-0.32	0.746
WV	0.8237867	0.4774016	-0.33	0.738
AR	0.7043833	0.348965	-0.71	0.479
IL	0.6881113	0.5863353	-0.44	0.661
OK	0.6859758	0.2761097	-0.94	0.349
TN	0.5797178	0.4192207	-0.75	0.451
GA	0.4130905	0.3147208	-1.16	0.246

P<.10 is significant

Note. Table 12 and Figures 10 and 11 show state odds ratio. For 1999-00, the number of observations = 2558 and the population size = 160,705.99. For 2003-04, the number of observations = 2827 and the population size = 207,062.47). Baseline state is Kansas = 1.0.

Figure 10 shows in 1999-00, teachers in 16 states were *less* likely to be "matched" than were math and science teachers in Kansas. The red bars on this graph indicate significance (P<.10). During 1999-2000, DC was 7 times *more* likely to have teachers who were matched than Kansas. Teachers in Tennessee were 0.8 times *less* likely to be matched than Kansas teachers during that same school year.

Figure 10
Odds of States Having "Matched" Middle-School Math and Science Teachers, Compared to Kansas during 1999-2000

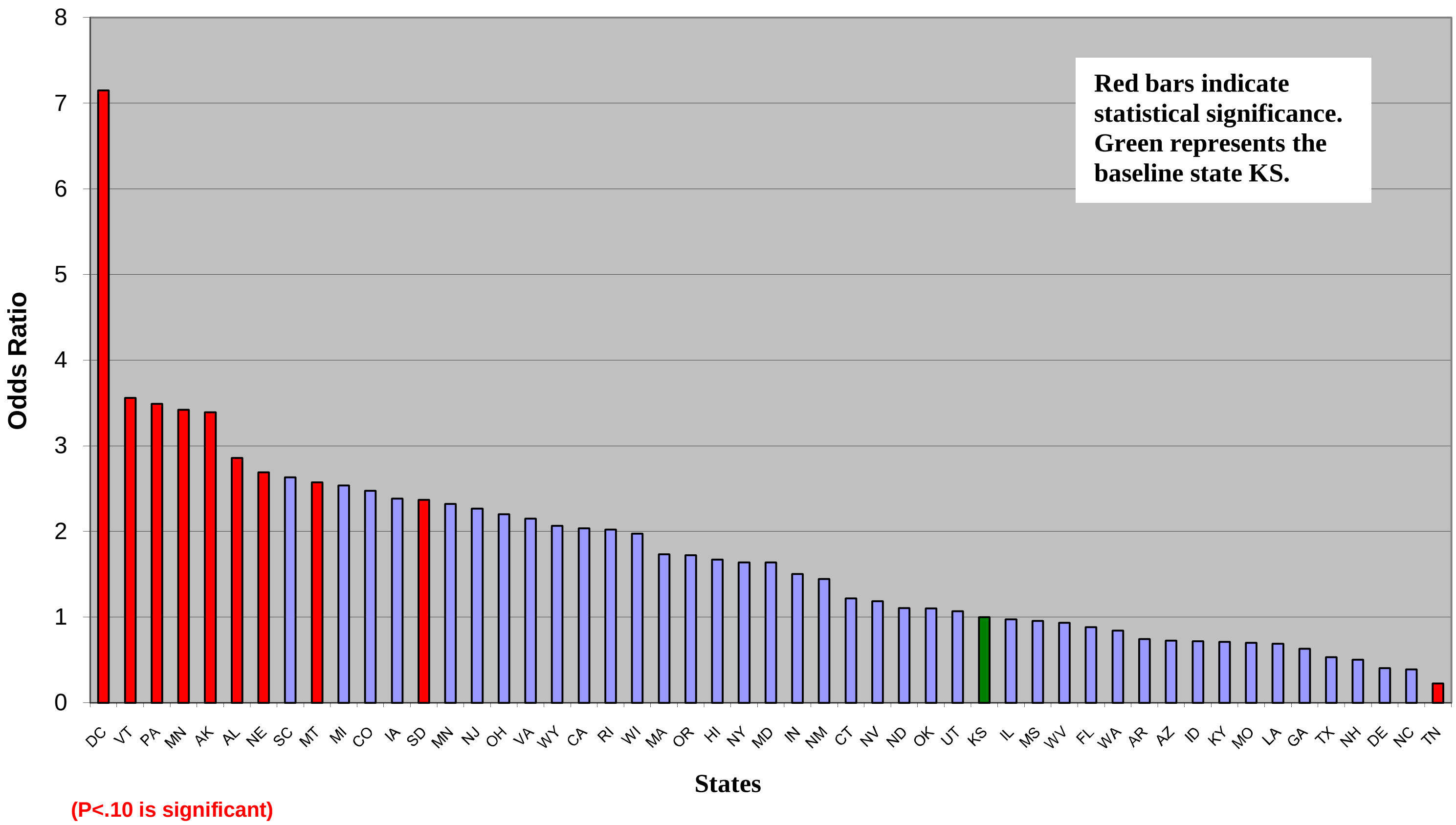
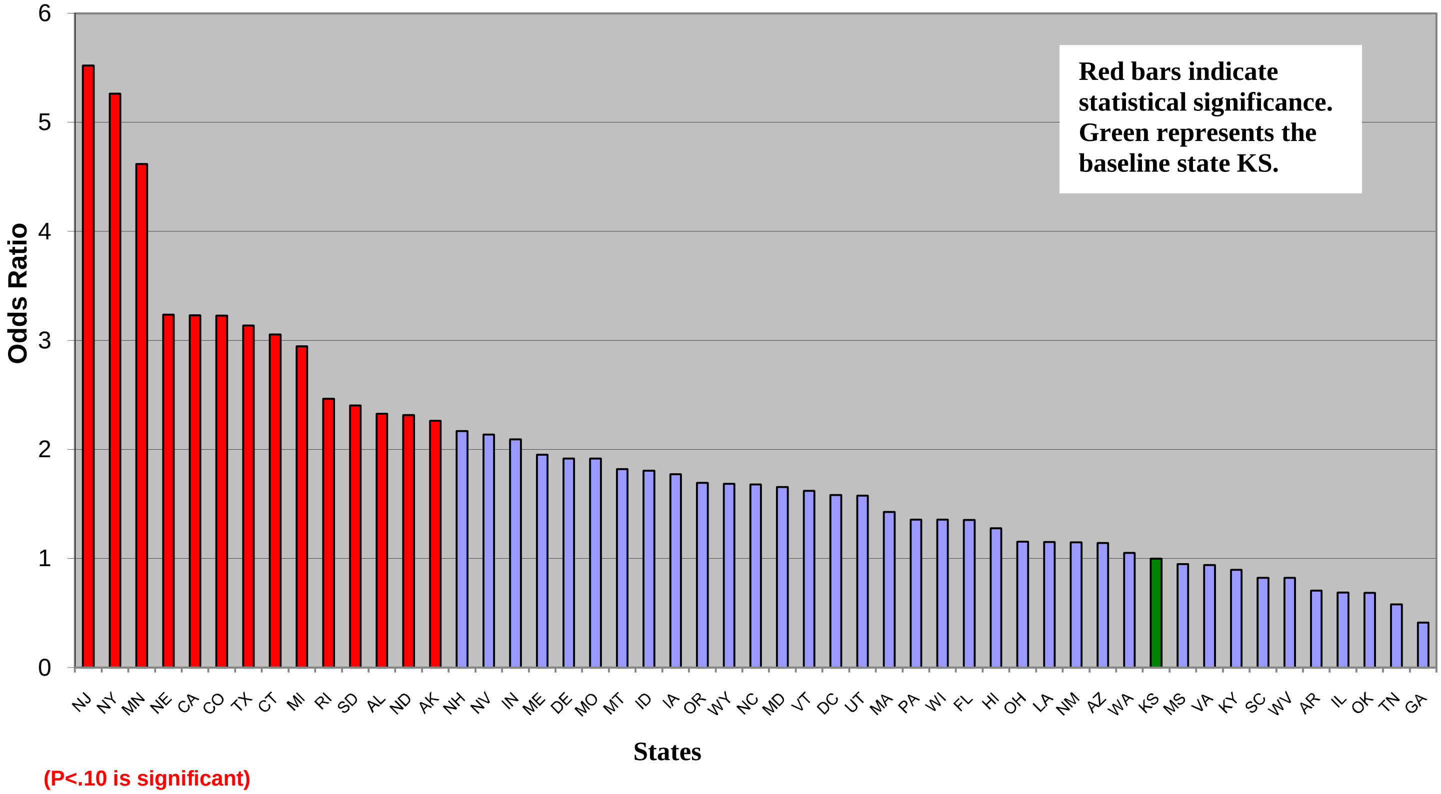


Figure 11 shows in 2003-04, teachers in only 10 states were *less* likely to have teachers who were "matched" than were math and science teachers in Kansas. Red bars indicate significance (P<.10). During 2003-2004, NJ was 5.5 times *more* likely to have teachers who were matched than were teachers in Kansas, while NY and MN were not far behind with 5.3

times and 4.6 times more likely, respectively. It is interesting to note that Kansas ranks in about the middle in terms of national assessment scores and money spent per pupil but seems to be toward the low end of likelihood of being matched during 1999-2000 and 2003-2004. Perhaps the results of the work done by some states to put teachers with majors in the middle-school math and science classrooms has not yet come to fruition. Further studies are needed.

Figure 11
Odds of States Having "Matched" Middle-School Math and Science Teachers, Compared to Kansas during 2003-2004



In 1999-00 teachers in 9 states (DC, VT, PA, MN, AK, AL, NE, MT, and SD) can be said, with statistical significance, to more likely be "matched" than teachers in Kansas, whereas, in 2003-04, thirteen states can be said ($P<.10$) to more likely be matched. The number of states that had greater odds of being "matched" when compared to Kansas *increased* from 1999-00 to 2003-04. The number of states that were *less* likely than Kansas to be "matched" *decreased* from 1999-00 to 2003-04. From 1999-00 to 2003-04 certain states declined in their likelihood to be "matched." Five states (MN, AK, AL, NE, & SD) can be said (P<.10) to have greater odds of being matched in both 1999-00 *and* 2003-04, when compared to Kansas. Many states also *remained* less likely than Kansas to have teachers who were "matched" (IL, MS, WV, AR, KY, GA, and TN) from 1999-00 to 2003-04. All but Illinois is from the south.

4.03 Research Question Three: What demographic and background factors affect whether or not a math or science teacher has a math or science major (what variables predict if teachers are "matched"), during school years 1999-00 and 2003-04? The information in Table 13 helped determine teacher demographic and background variables that affect middle-school math and science teachers' status of being "matched," 1999 vs. 2003. Table 13 discusses the odds of being "matched" by comparing "matched" middle-school math and science teachers who teach in high schools and middle schools to middle-school math and science teachers who teach in elementary schools.

Table 13
Variables that Affect the Likelihood of Middle-School Math and Science Teachers Being Matched

	matched	**1999-00**				**2003-04**			
		Odds Ratio	Std. Err.	P>|t|		Odds Ratio	Std. Err.	P>|t|	
Grade baseline = K-8***		1.0				1.0			
Grade 6 to 8 or 7 to 9 school	middle_sch~l	1.89783	0.518001	0.019	*	1.040358	0.197798	0.835	
Grade 6, 7 or 8 through 12 school	high	5.022875	1.314891	0	*	1.53445	0.32133	0.041	*
Fully Certified (vs. not)	certified	2.320331	0.51225	0	*	8.745947	1.650782	0	*
Natural log of years experience	ln_exper	0.7699121	0.068362	0.003	*	0.8688359	0.087505	0.163	
years since BA degree	ba_years	0.999012	0.000503	0.05	*	0.9980156	0.001032	0.055	**
minority	minority	1.24602	0.350538	0.434		2.086367	0.59781	0.01	*
male (vs. female)	male	1.401109	0.229879	0.04	*	1.241063	0.216221	0.215	
Suburb (vs. urban)	suburb	1.005946	0.220645	0.978		0.838497	0.192242	0.442	
rural (vs. urban)	rural	0.8145211	0.202597	0.41		1.20968	0.292962	0.432	

P<.05 * significant
P<.10 ** significant
***Baseline was middle-school math and science teachers who teach in elementary (K-8) schools.

Research Question 3 was answered by doing a logistic regression (logit). Table 13 is the logit output for math and science teachers only, with the dependent variable being an indicator of whether the teacher is a science teacher with a science major or math teacher with a math major – identified as "matched" if yes (1, all else 0). As predictors (independent variables) of matched teachers, the grade level of the school in which they taught was used (all were middle-school teachers). Whether they held full, regular certification in their main field was also used as a predictor of "matched." (This variable had to be built with each piece of certification for 2003-04 survey, but for 1999-00 survey Certification in Main Field was used. This had to be done because of the difference in how the question was asked on the two surveys). This regression included an analysis that compared "matched" (the dependent variable) across the following independent variables:

- Middle school teachers who teach in high schools (6, 7, or 8 through 12 schools) and middle-school teachers who teach in middle schools (6 to 8 or 7 to 9 schools) compared against middle-school teachers who teach in elementary school (K-8 school)
- Fully certified, vs. not (teachers were defined as "not fully certified" if they had any other type of certification: provisional, emergency, etc. regardless of content background)
- Natural log of years experience
- Years since Bachelor's degree
- Minority
- Male (vs. female)
- Suburb (vs. urban)
- Rural (vs. urban)

This table includes odds ratios, standard error, and significance (P >|t|). If P < .10, it was considered statistically significant. The baseline grade level (1.0) is K-8 (defined as an elementary school). Middle school is a building with either grades 6-8 or 7-9, and high school is a building with grades 6, 7, or 8-12. It was controlled for size.

According to Table 13, in 1999-00, middle-school math or science teachers who teach in middle schools were almost twice as likely (O.R.=1.89783) to be "matched" (have majors in their fields) than middle-school math or science teachers who taught math or science in elementary schools (K-8). This dropped off in 2003-04 (O.R. = 1.040358). These data also showed that 1999-00 middle-school teachers in high schools were 5 times (O.R. = 5.0222875) more likely than middle-school math or science teachers in elementary schools to have content majors in their fields. This dropped to 1.5 times more likely in 2003-04. There was a tighter connection (the likelihood in 2003-04 was greater than in 1999-00), however, between full regular certification and "matched" in 2003-04 (O.R. = 8.74) than in 1999-00 (O.R. = 2.32).

In 1999-00, middle-school teachers in middle schools were also *more likely* to have majors. But this faded somewhat by 2003-04. In 1999-00, middle-school teachers in high schools were *more likely* to have majors, but this dropped considerably in 2003-04, as well. Math and science teachers were *more likely* to be "matched" if fully certified in 2003-04 than in 1999-00.

Other significant findings were: in 2003-04 male teachers were 1.4 times more likely to be matched than female teachers. In 1999-00 the natural log (exponential growth curve) of years' experience decreased the likelihood of being matched. Years since obtaining a Bachelor's degree had basically no effect on the likelihood on being matched (was equally likely) during both 1999-00 and 2003-04. A minority teacher was 2 times more likely to be matched than a non-minority teacher in 2003-04.

4.04 Research Question 4: How did state licensure requirements for middle-school math and science teachers change between 1999 and 2003? Tables 14 & 15 illustrate the changes in the states' middle-school math and science teachers' licensure requirements before and after NCLB. Table 14 compares certification requirements before and after NCLB. After NCLB, several states added middle level endorsements in math and science that increased teachers' opportunities to become highly qualified. These 18 states were: AR, CA, GA, ID, IN, KY, LA, MD, MA, MO, MT, NM, NY, OH, OR, PA, SC, and WI. Some states also increased the stringency to become highly qualified by adding content preparation requirements. Those 10 states were: AK, CT, DC, ID, ME, MA, MS, NJ, NY, and OH. PA added "specific subjects required." These are considered positive changes in certification requirements after NCLB. A negative change after NCLB was the *decrease* in content preparation requirements in AZ, HI, IA, and KY. Another negative change was moving from requiring specific subjects to not requiring these subjects. This change was made in the following states: AL, AK, IL, KS, MN, MT, NE, NH and WA. Several states changed requirements after NCLB. Some of these changes increased opportunity and stringency. Others made middle level math and science certification easier, thus perhaps lowering teachers' standards to become highly qualified.

Table 14

*Certification Requirements and Credentials Offered, and Endorsement and Content Preparation Requirements **Before** and **After** NCLB*

State	* Middle Level Credential Offered	* Licensure/ Certificate	* Credential Required	* Grade Span	* Name of Credential	* Credential Grade Ranges Offered	Credential Grade Ranges Offered (each state's web site)	** Endorsement in science & math	** Content Prep Requirements *Before* NCLB	** Content Prep Requirements *After* NCLB	** Are Specific Subjects Required?
Alabama	X	X	X	4-8	Middle Level	6-12, 4-8	P-12	X	18 hours	18 hours	**No**
Alaska	X			5-9	Middle School	K-8, K-12, 7-12, 9-12		X		**15**	**No**
Arizona	X				Middle Grades	K-8, 7-12		X	18	**NA**	**Yes**
Arkansas	X	X	X	5-9	Middle Childhood	4-8, 7-12	4-8	**Middle/Secondary or only Secondary**			**Yes**
California						K-9, 7-12		**Only Secondary, or none**			**...**
Colorado	X			4-8	Middle School	K-12		X			**...**
Connecticut	X	X	X	5-9	Middle Grades	4-8, 7-12	7-12	X	18 (9 in 3 areas)	**24 (9 in 3 areas)**	**Yes**
Delaware	X	X	X	4-8	Middle Level	5-8, 7-12		X			**Yes**
D.C.	X			5-8	Middle School	MS, 7-12		X	NA	**21**	**...**
Florida	X	X	X	4-8	Middle Grades	5-9, 6-12	5-9, 6-12	X	18	18	**Yes**
Georgia	X	X	X	5-9	Middle Grades	4-8, 7-12		**Middle/Secondary, or none**	15	15	**Yes**

State	* Middle Level Credential Offered	* Licensure/ Certificate	* Credential Required	* Grade Span	* Name of Credential	* Credential Grade Ranges Offered	Credential Grade Ranges Offered (each state's web site)	** Endorsement in science & math	** Content Prep Requirements *Before* NCLB	** Content Prep Requirements *After* NCLB	** Are Specific Subjects Required?
Hawaii	X	X		4-8	Middle School	7-12, K-12		X	18	**NA**	...
Idaho						K-8, 6-12		**Middle/Secondary**	20	**44 in 8 areas**	**Yes**
Illinois	X		X	6-8	Middle Grades	K-9, 6-12		X	18	18	**No**
Indiana	X	X	X	5-8	Jr Hi/Middle Sch	5-9, 5-12, 9-12		**Middle/Secondary, or none**	18	18	**Yes**
Iowa	X			5-9	Middle School	7-12		X	30	**12**	**Yes**
Kansas	X			5-8	Middle Level	K-9, 5-9, 7-9, 7-12, K-12		X			**No**
Kentucky	X	X	X	5-9	Middle School	5-9, 8-12, P-12		**Only Secondary, Only Middle, or none**	24	**22 in 2 areas**	**Yes**
Louisiana						1-8, 7-12		**Only Secondary, Only Middle, Middle/Secondary, or none**			**Yes**
Maine	X			5-9	Content Areas	K-8, 7-12, K-12		X	16 in 4 subjects	**36 liberal arts**	...
Maryland					N-12, 1-6, Middle Sch	7-12, K-12		**Only Secondary, Only Middle, Middle/Secondary, or none**			...

State	* Middle Level Credential Offered	* Licensure/ Certificate	* Credential Required	* Grade Span	* Name of Credential	* Credential Grade Ranges Offered	Credential Grade Ranges Offered (each state's web site)	** Endorsement in science & math	** Content Prep Requirements *Before* NCLB	** Content Prep Requirements *After* NCLB	** Are Specific Subjects Required?
Massachusetts	X	X	X	5-9	Middle School	P-9. 5-9, 5-12, 9-12		**Only Secondary, Only Middle, Middle/Secondary, or none**		**36**	**Yes**
Michigan	X			5-9	Middle Level	K-8, 7-12, K-12		X	18	18	**Yes**
Minnesota	X	X		5-9		7-12, K-12		X	12	12	**No**
Mississippi						K-8, 7-12		**NA**	24	**36 in 2 areas**	**...**
Missouri	X	X	X	5-9	Middle School	5-9, 9-12		**Only Secondary, or Middle/Secondary**		21	**Yes**
Montana						K-8, 5-12, 7-12		**Middle/Secondary**	20	20	**No**
Nebraska	X			4-9	Middle Grades	K-9, 4-9, 7-12, 9-12, K-12		X			**No**
Nevada	X			5-8	Middle School	K-8, 7-12		X	36	36	**Yes**
New Hampshire	X			5-9	Science	K-8, 5-12, 5-8, 5-9, 7-12, K-12		X			**No**
New Jersey						N-8, N-12		**NA**		**30**	**...**
New Mexico	X	X		5-9	Middle Level	K-8, 5-9, 7-12		**All grades**	24 (6 hours in 4 subjects)	24	**Yes**
New York	X	X		5-9	Middle Childhood	5-9, 7-12, P-12		**Middle/Secondary, or none**		**36**	**Yes**

State	* Middle Level Credential Offered	* Licensure/ Certificate	* Credential Required	* Grade Span	* Name of Credential	* Credential Grade Ranges Offered	Credential Grade Ranges Offered (each state's web site)	** Endorsement in science & math	** Content Prep Requirements *Before* NCLB	** Content Prep Requirements *After* NCLB	** Are Specific Subjects Required?
North Carolina	X	X	X	6-9	Middle Grades	6-9, 9-12, K-12	6-9, 9-12	**NA**	18	18	**...**
North Dakota	X	X	X	5-8	Middle School	K-8, 1-8, 5-8, K-12		X			**...**
Ohio	X	X		4-9	Middle Childhood	4-9, 7-12, P-12		**Middle/Secondary, or see footnotes**	20	**24 in 2 areas**	**Yes**
Oklahoma	X	X		5-9	Mid. Lev. & Subject Areas	1-8, 6-12		X	24	24	**Yes**
Oregon	X	X	X	5-10	Middle Level	P-9, 5-12	5-10, 7-12	**Middle/Secondary, or Only Middle**	15	15	**...**
Pennsylvania	X	X		6-9	Middle Level	7-12, K-12		**Middle/Secondary, or see footnotes**			**Yes**
Rhode Island	X		X	5-8	Middle School	7-12, P-12		X	21	21	**...**
South Carolina	X	X	X	5-9	Middle Level	1-8, 7-8, 7-12		**Middle/Secondary, Only Middle, or none**			**Yes**
South Dakota	X	X	X	5-8	Middle Level	K-8, 7-12, K-12		X			**Yes**
Tennessee	X			5-8	Middle Grades	K-8, P-12, 1-8, 7-12		X			**Yes**
Texas	X	X	X	4-8	Middle School	4-8, 8-12, P-12		**none**			**...**
Utah	X			4-8	Middle Level	1-8, 6-12		X			**...**
Vermont	X	X		5-8	Middle Grades	5-8, 7-12		X			**Yes**

State	* Middle Level Credential Offered	* Licensure/ Certificate	* Credential Required	* Grade Span	* Name of Credential	* Credential Grade Ranges Offered	Credential Grade Ranges Offered (each state's web site)	** Endorsement in science & math	** Content Prep Requirements *Before* NCLB	** Content Prep Requirements *After* NCLB	** Are Specific Subjects Required?
Virginia	X		X	4-8	Middle Education	6-8, 6-12, P-12		X			...
Washington	X			5-9	Middle Level	K-8, 4-12		X			**No**
West Virginia	X		X	5-9	Middle Grades	5-9, 5-12, 9-12, K-12		X			**Yes**
Wisconsin	X	X		5-9	Middle Level	1-9, 5-9, 6-12, 9-12		**Middle/Secondary**			**Yes**
Wyoming	X	X	X	5-8	Middle Grades	K-8, 5-8, 7-12, K-12		X			**Yes**

- **green = after NCLB**
- **red shows negative change after NCLB**
- **blue shows positive change after NCLB**

***Gaskill Study, 2002 and McEwin Study, 2007**
****nasdtec.org, NASDTEC (National Association of State Directors of Teacher Education and Certification) Knowledgebase Clearinghouse (subject matter endorsements listed on teacher certificate and specific state subject endorsement requirements).**

Table 15 shows the middle-school grade span for each state in the 2002 study by Gaskill and the 2007 study by McEwin. It also indicates whether or not a middle level credential was offered by the time each of these studies were complete. In 2002, there were 44 states plus the District of Columbia with a middle level license/certificate or endorsement. In 2007 there were 46 states plus the District of Columbia, which is a positive increase of two. In 2002, there were 26 states with a middle level license and in 2007 there were 28 states plus the District of Columbia, again, an increase of two. And finally, there were 17 states plus the District of Columbia with middle level endorsements. This total number was maintained because there were 18 states with middle level endorsements in 2007.

Specifically, after NCLB, twenty-eight states changed the grade span on their middle level classification. Four states *added* a middle level credential after NCLB: LA, MD, MS, and NJ. Three states, CA, ID, and MT, did not offer a middle level credential even after NCLB.

Table 15
2002 and 2007 Middle Level Teacher Certification/Licensure Patterns by State

State	License Type 2002 Study	License Type 2007 Study	Credential Required 2002	Grade Span 2002 Study	Grade Span 2007 Study	Middle Level Credential Offered X=both, X=2007 only
Alabama	License	License	X	4-8	4-8	X
Alaska	Endorsement	Endorsement		5-9	5-8	X
Arizona	Endorsement	Endorsement		N/A	5-9	X
Arkansas	License	License	X	5-9	4-8	X
California	None	none		N/A	none	O
Colorado	Endorsement	none		4-8	none	X
Connecticut	License	License	X	5-9	5-9	X
Delaware	License	License	X	4-8	5-9	X
D.C.	Endorsement	License		5-8	5-8	X
Florida	License	Endorsement	X	4-8	5-9	X
Georgia	License	License	X	5-9	4-8	X
Hawaii	License	License		4-8	5-9	X
Idaho	None	none		N/A	none	O
Illinois	Endorsement	Endorsement	X	6-8	5-8	X
Indiana	License	License	X	5-8	5-8	X
Iowa	Endorsement	Endorsement		5-9	5-8	X
Kansas	Endorsement	License		5-8	5-8	X
Kentucky	License	License	X	5-9	5-9	X
Louisiana	None	Endorsement		N/A	4-8	X
Maine	Endorsement	Endorsement		5-9	5-8	X
Maryland	None	License		N/A	4-9	X
Massachusetts	License	License	X	5-9	5-9	X
Michigan	Endorsement	Endorsement		5-9	5-9	X
Minnesota	License	License		5-9	5-8	X
Mississippi	None	Endorsement		N/A	4-8	X
Missouri	License	Endorsement	X	5-9	5-8	X
Montana	None	none		N/A	none	O
Nebraska	Endorsement	Endorsement		4-9	4-9	X
Nevada	Endorsement	License		5-8	7-9	X
New Hampshire	Endorsement	License		5-9	5-8	X
New Jersey	None	Endorsement		N/A	5-8	X
New Mexico	License	Endorsement		5-9	5-8	X
New York (2003)	License	Endorsement		5-9	5-9	X
North Carolina	License	License	X	6-9	6-9	X
North Dakota	License	License	X	5-8	5-8	X
Ohio	License	License		4-9	4-9	X

Table 15

2002 and 2007 Middle Level Teacher Certification/Licensure Patterns by State

State	License Type 2002 Study	License Type 2007 Study	Credential Required 2002	Grade Span 2002 Study	Grade Span 2007 Study	Middle Level Credential Offered X=both, X=2007 only
Oregon	License	License	X	5-10	5-9	X
Pennsylvania	License	License		6-9	4-8	X
Rhode Island	Endorsement	Endorsement	X	5-8	5-8	X
South Carolina	License	License	X	5-9	5-8	X
South Dakota	License	License	X	5-8	5-8	X
Tennessee	Endorsement	License		5-8	5-8	X
Texas (2001)	License	License	X	4-8	4-8	X
Utah	Endorsement	License		4-8	5-9	X
Vermont	License	License		5-8	5-8	X
Virginia	Endorsement	License	X	4-8	6-8	X
Washington	Endorsement	Endorsement		5-9	5-9	X
West Virginia	Endorsement	License	X	5-9	5-9	X
Wisconsin	License	License		5-9	5-9	X
Wyoming	License	License	X	5-8	5-8	X

2002 Number of states with middle level license/certificate or endorsement: 44 + D.C.
2007 Number of states with middle level license/certificate or endorsement: 46 + D.C.

2002 Number of states with middle level license: 26
2007 Number of states with middle level license: 28 + D.C.

2002 Number of states with middle level endorsements: 17 + D.C.
2007 Number of states with middle level endorsements: 18

"License" means that a separate middle level license is available.
"Endorsement" means that the middle level teaching license is available only as an add-on credential for those also qualifying for a different license. For example, adding a grades 5 through 8 mathematics middle level endorsement to an elementary teaching license.

2002 data taken from Middle School Journal
Gaskill, Peggy E. (2002, May). Progress in the Certification of Middle Level Personnel. *Middle School Journal, 33*(5): 33-40.

2007 data taken from Middle School Journal
McEwin, C. Kenneth (2007, January). Middle level teacher preparation certification and/or licensure patterns by state.
http://www.nmsa.org/ProfessionalPreparation/CertificationLicensurebyState/tabid/1235/Default.aspx

The results of this study do not show any particular trend in terms of which states tend to increase or decrease in the percent of full certification and major of middle-school math and science teachers from both years of SASS data. It shows that there are particular states that have increased or decreased in their percent of full certification and major but no pattern emerges.

The challenge remains to analyze data that may allow for some logical conclusion. At this point it makes sense to compare an increase or decrease in certification and majors in math and science in particular states to licensure requirement changes made after NCLB. Minnesota, North Dakota, and New Hampshire increased in both percent certification and majors from 1999-2000 to 2003-2004 among both math and science teachers. Neither Minnesota nor New Hampshire required teachers to take specific subjects after NCLB. North Dakota made no change in content prep requirements after NCLB. These examples of weakening or maintaining the requirements for certification and major *could* account for these states gaining in percent certification and majors. Vermont, D.C., Michigan, and Ohio decreased in percent certification and majors from 1999-00 to 2003-04 among both math and science teachers. Vermont and Michigan made no changes in certification requirements, and D.C. and Ohio increased content prep requirements. No cause-effect trend can be made with these four states. Indiana was the only state that increased in percent majors in both math and science, but not in certification. They added an endorsement yet they had an *increase* in majors. It seems that this should have caused a *decrease*. There were greater numbers of states with increased percent science majors only (17) as compared to increased percent in math majors only (5) from 1999-00 to 2003-04. This overall increase in majors may be due to the fact that after NCLB several states added content requirements in math and science (improving their chances of obtaining a major).

Nebraska and Alabama were in the top 30% in majors for both years in both content areas (math and science). This may be because neither state required their teachers to take specific subjects and did not change the content prep requirements from prior to NCLB thus perhaps lessening the stringency of certification requirements. Kentucky was the bottom state in percent math major and science major. This state actually decreased content preparation requirements. There is no logical explanation for this from these data but it may be due to an underlying reason such as quality of schools.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.01 Introduction

According to research, there are high percentages of middle-school math and science teachers teaching out of their fields. Based on the definition established by NCLB Act of 2001, out-of-field teachers are not highly qualified. The degree of content expertise affects teacher quality. Since research links quality of teachers to student success, those teachers that do not teach in their fields lack an important teacher quality indicator and may be less effective in teaching their students.

This study builds on this premise of the importance of putting high quality teachers in middle-school classrooms. First, highly qualified was defined as having a major in the field taught and full certification. Since, for this study, highly qualified requires that teachers have majors in their fields with full certification, the percent of middle-school math and science teachers with majors in their fields and full certification were compared in each state, before and after NCLB. In addition, states that were consistently high or low in percent highly qualified (major and full certification) were compared as were those states that increased or decreased in percent highly qualified from before to after NCLB. The teacher demographic and background factors that affected whether or not teachers were matched were also analyzed in this study. And, finally, licensure requirements for each state were compiled in order to compare certification policy before and after NCLB.

5.02 Discussion of Findings by Research Question

Research Question One:

During school years 1999-00 and 2003-04, what percent of middle-school teachers in each state who teach math and science are fully certified, and what percent of these teachers who teach math and science have majors in math and science?

States use the determination of whether or not the teacher is highly qualified to measure teacher quality. *Highly qualified* for this study is full certification and a major in the field taught. Results from the analyses of the 1999-2000 and 2003-2004 Schools and Staffing Survey show that overall the percent of fully certified middle-school science teachers decreased from 1999-00 to 2003-04 but the percent of science teachers with science majors increased. The percent of fully certified middle-school math teachers decreased as did the percent of math teachers with math majors. In three of the four categories, overall percentage of highly qualified decreased from 1999-00 to 2003-04. No trends within individual states stood out until Research Question 2 was addressed.

This study showed that during 1999-2000, 87% of middle-school math teachers were fully certified and only 29% of these teachers had math majors. During 2003-2004, fully certified math teachers dropped *slightly* to 85% (-2%) and math teachers with math majors dropped to 21% (-8%). It also showed that during 1999-2000, 88% of middle-school science teachers were fully certified and only 28% had science majors. During 2003-2004 fully certified science teachers also dropped *slightly* to 84% (-4%). However, science teachers with science majors did increase to 40% (+12%). Despite the fact that the percentage of math and science teachers who were fully certified decreased, this percentage of full certification was still considerably high. On the other hand, the percentage of math and science majors was still low in 2003-2004 (after NCLB).

So what does this *say*? Why did certification drop but remain high? This could possibly be due to some states simply putting certification requirements in place for the first time, or some states making certification requirements stricter. Or, perhaps the data were not honestly reported because of the pressure put on administrators to *have* their teachers highly qualified, or provide staff development for them to *become* highly qualified.

The percentage of teachers who had math majors may have decreased because about the time of the inception of NCLB many states were requiring potential teachers to pass a Praxis test to become certified. Some states accepted the passing of this test as evidence that the teachers had content knowledge, i.e. they allowed teachers to become highly qualified in the content knowledge component by passing a Praxis test. In other words, a major was not mandatory to show content knowledge.

During the time span of this study, math teachers could be classified as highly qualified through math education majors and/or math endorsements. Math teachers were considered highly qualified and could teach math if they had a math education degree so did not need a math major. Also, to meet this content-knowledge piece, some states added subject-matter endorsements, rather than having teachers go back to school and major in math.

In addition, veteran teachers were able because of NCLB to become highly qualified through a HOUSSE rubric. This may have happened with elementary certified teachers who did not have much math content coursework but met the highly qualified piece by gaining points on the rubric through years experience and staff development hours.

But why did the percentage of science majors go up? Perhaps the increase in science teachers with science majors increased due to the push to get people who were in science-related fields into to the classroom because of middle-school science teacher shortages. These people very likely had science majors. Or perhaps universities were doing a better job emphasizing that those planning to teach science at the middle or high school level should major in a particular science field (physics, Biology, chemistry, etc.).

It is difficult to say based on these results whether or not NCLB impacted the percentage of highly qualified teachers, as there is no definite pattern. Maybe an increase in science majors was due to something other than NCLB. Further research is needed.

Research shows that teachers' content knowledge is important to students' academic success. Teachers must be knowledgeable about the subjects they teach in order to help students achieve high academic standards (Craig, 2002, August). The results of this study show that not only were 79% of middle-school math teachers teaching math without math majors during 2003-2004, but that percent had *increased* (from about 71%) from 1999-2000. Middle-school science teachers fared a little better in that the overall percent of middle-school science teachers without science majors decreased. Even though the percent of science teachers with*out* science majors *decreased* (from 72%) in 1999-2000 to 60% in 2003-2004, it is still high.

The results of this study are somewhat supported by a study done in by Blank and Toye in 2007. Their study determined the percentage of grades 7-12 math and science teachers with majors. Blank and Toye (2007) found the percent of math teachers with math majors in secondary school math classroom to be 61%, (as compared to 21% of *middle-school* math teachers from this study during 2003-2004), while science teachers with science majors was 77%, (as compared to 40% of *middle-school* science teachers from this study during 2003-2004). These studies are similar in that both show that the percentage of math teachers with majors was lower than the percentage of science teachers with majors.

According to NCLB, students need to be taught by highly qualified teachers. NCLB recognized the key to student learning is access to highly qualified teachers. By NCLB's definition of highly qualified, teachers must be fully certified. In 1999-2000 13% or our nation's middle-school math classrooms and 12% of middle-school science classrooms were staffed with teachers without full state certification. The percent of math teachers and the percent of science teachers was even higher (15% and 16% respectively) in 2003-2004.

If teacher quality *does* matter in student academic success, then based on the results of this study, the Schools and Staffing Survey data from school years 1999-2000 and 2003-2004, where little or no improvement in the percent of highly qualified teachers (fully certified with majors in their fields) was shown, much still needs to be done. The National Assessment of Educational Progress (NAEP) did a study analyzing standardized math test scores for 13 year olds. This 2008 study showed a slight improvement in academic progress in math for 13 year-olds from 1973 to 2008 (an increase of 15 points in NAEP math test results), but claimed that student progress during the NCLB era was not very impressive (National Center for Education Statistics, 2009, April). Perhaps this is due to the lack of improvement in percent of highly qualified middle-school math teachers.

Research claims (Thornton, 2004, March) that if middle-school math and science students are taught by teachers who have majors (as opposed to being taught by those out-of-field) with full certification, having math and science teachers who are of high quality (i.e. are effective, knowledgeable, skilled, in-field and certified) and are highly qualified as per the NCLB definition, these students will more likely than not succeed academically. Further research to support the claim made by this study and the results of the NAEP study must be done to determine if highly qualified teachers will indeed have more successful students than those who are not highly qualified.

<u>Research Question Two – Part A</u>:

Which states are consistently ranked high or low in percent of middle-school math and science teachers with math and science majors?

Two particular U.S. states were consistently represented as top 30% percent of middle-school math and science teachers with math and science majors. Nebraska and Alabama were in the top in all four categories (1999 math teachers with math majors, 2003 math teachers with math majors, 1999 science teachers with science majors, and 2003 science teachers with science majors). Only Kentucky was in the bottom percent in both subjects and both years (math, science, 1999, 2003).

Certain states either ranked high or low in both subjects in each year. Several states, NE, AL, NY, and NJ remained the top states in math teachers with math majors from 1999-00 to 2003-04. DC, AL, and NE were top states in percent science teachers with science majors from both years. Only Nebraska and Alabama were top states from both years for both math and science majors. Two states, AZ and KY, remained the bottom states in math teachers with math majors. KY, NC, TN, and GA were bottom states in science teachers with science majors from both 1999-00 and 2003-04. Kentucky was the only state that was in the bottom third of both math and science majors from both years.

In comparing states consistently in the top in percent major in 1999-00 to those states that were consistently in the top in 2003-04, there were overall more (four) consistently top states in 2003-04 as compared to fewer (three) in 1999-00. The District of Columbia was in both top categories in 1999-00, but only top in science during 2003-04. New York and New Jersey were top in two groups in 2003 but only in one group during 1999. Nebraska and Alabama were in both top categories for both years.

In comparing bottom states in 1999-00 to bottom states in 2003-04, there was the same number (three) of consistently *bottom* states in both 2003-04 and in 1999-00. In science, North Carolina, Kentucky, and Georgia are on the bottom during both years. In math, Kentucky and Arizona are in the bottom 30% during both years. There were three consistently *bottom* states in both 2003-04 and in 1999-00. In science, North Carolina, Kentucky, and Georgia are on the bottom during both years. In math, Kentucky and Arizona are in the bottom 30% during both years.

NCLB may have influenced the top states to continue this trend. And, perhaps NCLB encouraged the bottom states to strengthen certification requirements and increase their staff development opportunities in order to improve teacher quality. It seems, though, that regardless of the efforts some of these bottom, mostly southern, states may have made to improve teacher quality, there still remains a high percentage of these states remaining on the bottom. The fact that some states were in the top or bottom and remained there may have happened without NCLB.

***Research Question Two – Part B*:**

Which states show an increase or decrease in percent middle-school teachers with full certification and major in math or science in their teaching field?

There are three states, Minnesota, North Dakota and New Hampshire, with an increase in percent of *both* science and math certification *and* percent of science and math majors. Perhaps Minnesota's improvement in percent certification and majors was its creating clear and demanding academic standards (Cavanaugh, 2009). There are more states in which science teachers showed an increase percent both in full certification and major than states that had math teachers that showed this same increase.

There were four states, Vermont, District of Columbia, Michigan and Ohio, that had a decrease in percent of *both* science and math teachers with full certification *and* percent of science and math teachers with science and math majors. There are more states that have math teachers that showed a decrease in both percent certification and major than states that showed an increase in science teachers who are fully certified and have majors.

Indiana was the only state that *increased* in percent majors *only* from 1999-00 to 2003-04 among both science and math middle-school teachers. According to Table 11C, from 1999-2000 to 2003-2004, there were a greater number of states (17) with increased percent science majors only among middle-school teachers as compared to the number of states (5) with an increased percent in math majors only. There were no states that increased in percent certification only from 1999-00 to 2003-04 among both science and math middle-school teachers. According to Table 11D, there were a greater number of states with increased percent in math certification only (15) as compared to five states increased percent in science certification only from 1999-00 to 2003-04, among middle-school teachers.

It is important to discuss here the possible reasons why many of the states that were consistently on the bottom (KY, NC, TN, and GA) are from a particular southern region in the United States. The Southern Regional Education Board (SREB) is a region of 16 southern states that includes: Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. This pattern of decline could be due to the strictness of the requirements to become licensed in these states. The SREB created a set of goals in their "Challenge to Lead – Goals for

Education" (Cornett, 2004). Two of their goals are significant to this study. The first of these goals, Goal 10, states that every student must be taught by qualified teachers, which necessitates having teachers with content preparation in every classroom, and continued reform of teacher licensure (SREB, 2009). The second of the SREB goals that is relevant to this study is Goal 3, which states that the "achievement in the middle grades for all groups of students is to exceed achievement levels on the NAEP" (Southern Regional Education Board, 2009, p. 15). The results show that student achievement in the middle grades is rising in most SREB states, but ***not quickly enough*** to meet the requirements of the federal *No Child Left Behind Act.* Despite the fact that these states had strict requirements for teachers, their students still had a consistent pattern of poor performance on the NAEP tests.

SREB states have been national leaders in setting higher standards for teacher-preparation programs. Most of the states in this region also require teachers to pass performance tests for licensure and to have on-the-job evaluations. According to a report by U.S. Department of Education (2006) in 2005, Georgia, Tennessee, Florida, Delaware, Kentucky, Louisiana, South Carolina, Oklahoma, Mississippi, Alabama, Virginia and Texas, all of which belong to the SREB, required content-specific degree for initial certificates, showing again that these states altered standards for their teachers by strengthening licensure requirements. Based on the results from the SASS from 1999-2000 and 2003-2004, these states, Georgia, Tennessee, Florida, Kentucky and Louisiana, started on the bottom and remained on the bottom. South Carolina in math started (in 1999-00) on the top and moved to the bottom (in 2003-04), and in science started on the top and moved to the middle. Virginia moved from the middle in math and top in science to bottom in both. Oklahoma moved from middle to bottom in science and stayed in middle in math. Mississippi stayed in bottom middle in both math and science. Delaware moved to top in science but remained in bottom in math. Texas moved from bottom to top in both math and science, and Alabama was top in both math and science in both years. Despite the fact that *some* of these states do match the assumption that if standards are raised percent highly qualified will decrease, due to the inconsistencies within this group of states, it is difficult to see any pattern. Perhaps the reason some of the states from this region have decreased in percent majors and/or percent fully certified is that they *raised* their certification standards, actually having made the licensure certification more stringent due to NCLB. It is possible, though, that the changes in certification had no impact.

There were also four states that are not members of the SREB, Alaska, Arizona, District of Columbia and Nebraska, which were consistently high in percent majors with full certification. These states required *no* uniform content-specific requirement for initial certification, supporting the assumption that lowering standards would make majoring in science or math easier, thus causing an increase in percent majors.

Research Question Two – Part C:

Which particular states, when compared to Kansas, are more likely to have math and science teachers who have math and science majors (have teachers who are "matched") during school years 1999-00 and 2003-04?

States vary in their degree of likelihood of their teachers being matched. Minnesota teachers were likely to be matched during both 1999-00 (3.4 times more likely than Kansas) and 2003-04 (4.6 times more likely). A goal of state departments of education could be to match Minnesota's likelihood of having "matched" math and science teachers in our middle schools. All highly qualified teachers could teach in all states if the certification of middle-school math and science teachers was standardized, stringent and available at all state universities.

With the trend of some states consistently top or bottom during 1999-00 and 2003-04, certain states increasing or decreasing in percent majors and/or certification, and states likelihood of being matched when compared to a middle-of-the-road state like Kansas, a closer look at the characteristics of these states is needed. Research claims (Ingersoll, 2001, May) that middle schools are difficult to staff with highly qualified math and science teachers. But, in addition to this middle school difficulty, poor urban school classrooms are also difficult to staff. Could the variation among states possibly be due to economic status, or urban vs. rural vs. suburban, or geography, or increasing stringency/leniency of licensure requirements be factors? A closer look at these factors must be considered. This discussion is found later in the study following the analysis of Research Questions 3 & 4.

Research Question Three:

What demographic and background factors affect whether or not a math or science teacher has a math or science major (what variables predict if teachers are "matched"), during school years 1999-00 and 2003-04?

According to the answer of Research Questions 3, during school year 1999-2000, a middle-school teacher who teaches in a middle school building as opposed to teaching in an elementary building is almost twice as likely to be "matched". This dropped off to *about* as likely in 2003-04. These data also showed that 1999-00 middle-school teachers in high school buildings were 5 times *more likely* than middle-school teachers in elementary school buildings to have content majors. This dropped to about 1.5 times more likely in 2003-04. There was a tighter connection to the timing of NCLB however, between full regular certification and "matched" in 2003-04 (O.R. = 8.74) than in 1999-00 (O.R. = 2.32) (the likelihood in 2003-04 was greater than in 1999-00). In addition, in 1999-00, male teachers were 1.4 times more likely to be matched than female teachers and, in 2003-04, minority teachers are 2.1 times more likely to be matched than non-minority teachers. The other variables tested (years experience, years since Bachelor's degree, suburban vs. urban, and rural vs. urban) seemed to have no effect on teachers being matched.

Policymakers, school administrators, teaching institutions, and middle-school teachers must make note of the fact that there has been no apparent increase in math and science middle-school teachers being matched from 1999-00 to 2003-04, that there are still more matched teachers in high school buildings than middle school buildings, and the likelihood of fully certified teachers being matched increased from 1999-00 to 2003-04. These results imply that there is a need for middle-school teacher education programs to become more of a focus so that teachers can obtain middle-level certification. Assuming that having a major affects the quality of teaching, these programs might consider requiring middle-school math and science teachers to obtain majors in the subjects they teach (or will teach) so that there are just as many matched teachers in middle schools as there are in high schools. Education institutions should offer, and school districts should require, middle level licensure with a major in core subjects taught. School administrators should hire only teachers who are highly qualified and that match subject and grade level taught. The results of the answer to this question seem to say that NCLB had some impact on fully certified but no apparent impact on whether or not teachers were matched. It could be said though that NCLB *indirectly* affected matched because teachers were more likely matched if they were fully certified.

Research Question Four:

How did state licensure requirements for middle-school math and science teachers change between 1999 and 2003?

There have been changes among states of licensure requirements, middle-level credential offered, grade span offered, and endorsements and content preparation requirements added from before to after NCLB. Much of this information was obtained from two separate studies, one done in 2002 and the other in 2007.

This information was compiled to see if there is a relationship between licensure requirements from before to after NCLB to the following variables:

- the percent of highly qualified teachers in a particular state;
- the trends in typically top or bottom states in percent math and science teachers with math and science majors;
- the trends in increasing or decreasing status of having a major and being fully certified;
- the variables that determine the likelihood if a teacher being highly qualified; and,
- the likelihood of a middle-school math and science teacher being highly qualified in a particular state.

The policy implementation in states that were consistently high or low must be analyzed. Did policy changes match with the states that were consistently top or bottom or with those that moved to the top or bottom? Did policy changes match with those states that increased or decreased in major and/or certification? And is there a connection between policy changes and the trend to be consistently bottom or top or move to the bottom or top, or to increase or decrease percent major and/or certification? Through further thorough analysis of this study's data (the collective results of all four Research Questions) *these* questions may be answered.

Perhaps the variation among states was due to things other than the impact of NCLB, such as the state's schools' socio-economic status, or whether or not the majority of the schools within the states were urban, rural or suburban. Maybe per pupil federal funding or geographical location had a greater influence on trends of staying on, or moving to, the top or bottom. Or perhaps NCLB caused a change in some states' stringency/leniency of licensure requirements, thus affecting states' high or low status or moving from high to low. A closer look at these factors must be considered.

During 1999-2000, when Kansas was compared to all other states in odds of being matched, 17 states were less likely to be matched than teachers in Kansas. Most of these were southern states which included Mississippi, Florida, Arkansas, Arizona, Kentucky, Louisiana, Georgia, Texas, North Carolina, and Tennessee. During 2003-2004, ten states were less likely to be matched than Kansas. Of those states, Mississippi, Kentucky, South Carolina, Arkansas, Tennessee and Georgia were southern states. On the other hand, some southern states, Alabama, Delaware, Florida, Maryland, Louisiana, North Carolina and Texas were *more* likely than KS to be matched. In addition, six of these states, DE, FL, MD, LA, NC, & TX, made huge jumps from less to more likely to be matched than Kansas (especially Texas, from 0.5 times *less* likely to 3 times *more* likely).

According to Education Week's Quality Counts 2010 report on NAEP math progress, Kansas is just above the average for math progress score (Education Week, 2010, January 14). Many of these southern states are more likely than Kansas to have teachers that are matched (teach math/science have a major in math/science). In 2009, only 51% of Kansas 8th grade math students had teachers with "a major or minor in math" (p. 15) which was 13th from the bottom (which was better than only six southern state). However, even though some of the southern states have attempted to improve their teacher quality, the fact that they are matched does not seem to have helped their math progress index score. Of these southern states, only KY and FL had higher index scores on 8th grade math NAEP tests than Kansas. So it seems that NCLB affected certification requirement changes but not the percentage of matched teachers. Whether or not teachers in particular states have majors in the subjects taught seemed to have been affected more so by their geographic location than by NCLB.

The purpose of Table 16 was to compile data that would compare states' certification requirement changes to changes in stringency or leniency and/or opportunity. Table 16 compared states that were in the top percentage of math/science majors and math/science teachers that were fully certified during both years of the study, states that were on the bottom, and states that moved up or down in percentage, to changes in certification requirements. This chart includes only the states that made certification changes *or* were southern states and were on the bottom during both years of the study. Some southern states did not change certification requirements from 1999-2000 to 2003-2004 and were included on the bottom of the chart. It is possible that NCLB affected states adding endorsements and/or content preparation in individual states, but again no common thread was revealed. Perhaps certification changes and geographical location *together* reveal a trend. Because there may have been an effect of schools being in southern states, these were all included and highlighted on the chart.

Table 16:
Analysis of trends among states that made certification changes after NCLB: Checking for “Wow” States.

State	Increasing stringency or leniency and/or opportunity	Geography	% Majors (top, middle or bottom)	Moved up or down (from 1999 to 2003)	Increase percent major and/or certification	Decrease percent major and/or certification	Added endorsements (increase opportunity to become HQ)	Increased + or decreased o content prep	No subjects required	Added middle level credential (x) or none (o)	Less likely to have matched teachers when compared to KS (x=’99, o=’03)
AR	+	south	Mid math, bottom science	Down (math) Up (science cert)	X	X	X				xo
CT	+							+			
ID	+							+			x
IN	+						X				
LA	+	south	Mid math, bottom science	Down (math)		X	X			x	x
MD	+	south	Bottom math, mid science	Up (math cert) Up (science)	X		X			x	
ME	+							+			
MI	+			Down all		X					
MO	+						X				x
MS	+	south	Mid math, bottom science	Up (math cert & science)	X			+		x	xo
ND	+			Up all	X						
NJ	+		Top					+		x	
NM	+						X				
OR	+						X				
PA	+						X				
SC	+	south	Bottom math, mid science	Up (science major) Up (math cert)	X		X				o
VT	+			Down all		X					
GA	++	south	Bottom	Up (science) Down (math)	X	X	X	+			xo
MA	++						X	+			
NY	++		Top				X	+			
OH	++			Down all		X	X	+			
WI	++						X	+			
AK	+O							+	o		
CA	+O						X			o	
DC	+O		Top	Down all		X		+			
ID	+O						X			o	
KY	+O	south	Bottom	Up (math cert & science)	X		X	o			xo
MN	+O			Up all	X				o		
MT	+O						X		o		
NH	+O			Up all	X				o		
AL	O	south	Top	Down (math) Up (science)	X	X			o		
AZ	O	south	Bottom	Up (science) Down (math cert)	X	X		o			x
HI	O							o			
IA	O							o			
IL	O								o		xo
KS	O								o		
NE	O		Top						o		
WA	O								o		o
NC	N/A	south	Bottom	Up (science major)	X						x
TN	N/A	south	Bottom	Up (math) Down (science)	X	X					xo
WV	N/A	south	Bottom math, mid science	Down (math) Up (science major)	X	X					xo
FL	N/A	south	Bottom math, mid science	Up (science major) Down (math)	X	X					x

TX	N/A	south	Mid math, top science	Up (math) Up (science major)	X						x
DE	N/A	south	Mid math, top science	Up (science major) Up (math cert)	X						x
VA	N/A	south	Bottom math, bottom science	Down (science) Up (math cert)	X	X					
NH	N/A										x
OK	N/A										o

Column one in Table 16 shows increased opportunity (endorsements and credentials) vs. increased stringency (through added subject area requirements), combining positive and negative factors that may or may not have been affected by NCLB. The certification changes that might improve teacher quality are the addition of content preparation required, and added endorsement and credential. “+” means a positive change toward highly qualified which would include adding an endorsement, a credential and more content preparation. “0” indicates a negative change (away from being highly qualified. So, a “+” means an addition of opportunity *or* an increase in content requirement, a “0” means a decrease in content requirements. “++” means *both* positives were added after NCLB, and “+0” means either opportunity or content prep were added, and no content required. The two “+” variables, added endorsements and/or credentials and content requirements, could, however, have had a countering effect. While adding endorsements and credentials increased teachers’ opportunities to become highly qualified, adding content prep requirements made it more difficult. Adding credentials could either make it easier or, if before NCLB no credentials were required, tougher. Thus, added opportunities to become highly qualified through added endorsements and/or credentials may *increase* the teachers’ likelihood to become highly qualified, whereas increasing content preparation requirements may *decrease* the likelihood to become highly qualified.

Georgia, Louisiana, Maryland, Mississippi and Kentucky are all southern states which changed their certification requirements and were in the bottom 30% during both years of the study. Georgia added endorsements and content prep requirements after NCLB, so opportunity *and* stringency were increased. Georgia went up in percent science teachers with science majors and certification but down in percent math majors and certification. This state remained in the bottom 30% in math and science majors after NCLB. In 1999-00 and 2003-04 Georgia was less likely than Kansas to have teachers who were matched.

Louisiana and Maryland added endorsements and credentials, increasing opportunity to become highly qualified. LA went down in math major and certification causing it to move to the middle. Louisiana stayed in the bottom 30% in science. LA was less likely than Kansas to have matched teachers in 1999-00, but more likely in 2003-04. MD went up in math certification and science certification and major, but remained in the bottom in math majors and moved to the middle in science majors. It was more likely than Kansas to have matched teachers in both years of the study.

Mississippi added endorsements but decreased content prep requirements, increasing opportunity but decreasing rigor. Mississippi went up in math certification, and up in science majors and certification. This state remained in the middle in math majors, but was still on the bottom in science majors. MS was less likely than Kansas to have matched teachers during both years of the study.

Minnesota and North Dakota increased in certification and major perhaps because they either weakened their subject requirements (MN took away the specific subjects required after NCLB) or maintained their subject requirements (ND did not change their subject requirements after NCLB). Both Nebraska and Alabama dropped in percent math majors and improved in percent science majors after NCLB. Both states remained in the top 30%, Nebraska possibly because they *maintained* their content preparation requirement, and Alabama perhaps due to *dropping* specific subjects required. Once again, it is difficult to link being on the bottom, changing certification requirements, and becoming more or less stringent, on the movement (increasing or decreasing) of majors and certification and whether or not these states are *now* on top, in the middle, or on the bottom. Further studies and further interpretation of the data from this study are needed to link the change (increase or decrease stringency) of licensure requirements to these variables: movement from top to middle to bottom in percent majors, increase or decrease in percent majors and/or certification, and likelihood of teachers being matched. More important, deciphering any relationship among these factors to improve teaching performance is needed. Further research should examine the stringency, leniency, and opportunity factors to determine effects of such policy changes on teaching effectiveness.

5.03 Findings and Conclusions

This study did several things in order to determine if NCLB caused schools to put highly qualified teachers in their classrooms. First, the possible impact of NCLB's definition of highly qualified on states' definition was analyzed. Second, this study attempted to determine the impact NCLB had on the percent of middle-school math and science teachers with full certification, and the percent of middle-school math and science teachers with majors. Third, NCLB's impact on middle-school licensure requirements was examined. Finally, its impact on administrators' behavior was examined.

Recall that for this study, teachers had to be "matched" and fully certified to be classified as highly qualified. "Matched" meant a major in the field taught, i.e., a math teacher must have a math major. These more stringent requirements of highly qualified used in this study may have in and of itself caused the drop in percent of fully certified.

So, *did* NCLB make a difference?

NCLB's definition of highly qualified impact

NCLB's defining of highly qualified impacted education by requiring states to do the same, using state certification, bachelor's degree and content knowledge as requirements. How states determined content knowledge was left to each state's discretion. This research used stricter requirements for highly qualified since some research argues that NCLB's definition requires that a teacher be only minimally qualified with the potential to *become* highly qualified (Erb, 2004). However, despite the stricter definition, as some states adopted these more stringent harsher requirements, this added stringency did not seem to make a difference on national test scores. Some of the SREB states tightened their highly qualified teacher requirements, yet these states still have not improved their NAEP scores. Overall, the percent of highly qualified teachers decreased from 1999-2000 to 2003-2004. This decrease in percent fully certified middle-school math and science teachers might imply that NCLB caused state legislators to strengthen licensure requirements. So NCLB may, in a sense, have affected certification. It may have caused policymakers to strengthen certification requirements, thus decreasing the percent of fully certified middle-school math and science teachers. Or, NCLB could possibly have had no impact.

Since there still remains a fairly high percent of out-of-field (non-highly qualified) middle-school science (72% in 1999-2000 to 60% in 2003-2004) and math teachers (71% in 1999-2000 to 79% in 2003-2004), from before to after NCLB, there is a need for policymakers to find a solution to help teachers become highly qualified. So, NCLB may not necessarily have affected the percent of highly qualified teachers among states, as no overall increase or decrease in percent of highly qualified middle-school math and science teachers was apparent from the results of this study.

NCLB impact on percent majors and percent fully certified

First, in order to see if NCLB impacted the percentage of teachers with majors and the percentage of fully certified teachers, the results of Research Questions 1-3 were analyzed. The percent and whereabouts of non-highly qualified teachers (as per this study's definition) in the nation's middle schools were determined. The results of this study supported claims made by research that the type of classrooms where the problem of non-highly qualified (not fully certified and no major in field taught) teachers is greatest is middle-school math and science classrooms (Ingersoll, 2002, January & Craig, 2002, August). This study showed that only 28% of these science teachers had science majors in 1999-2000 and 40% in 2003-2004, and only 29% of math teachers had math majors in 1999-2000 and 21% in 2003-2004. An attempt to identify trends in decreasing and/or increasing percent fully certified with majors was made. The percent fully certified math and science teachers decreased (from 87% to 85% and 88% to 84% respectively). No trends were found as some states increased in percent certified with majors in both math and science (MN, ND, NH) and some decreased (VT, MI, OH, and DC).

In determining the status of highly qualified for this study, all four components (fully certified math, fully certified science, have major in math, and have major in science) were considered together. The analysis showed that highly qualified *decreased* in three of the four categories. According to the results of Research Questions 1, 2, and 3 there was no overall change in percent major after NCLB, as there was a decrease in math and an increase in science, thus indicating that NCLB had no apparent effect on percent major. There was a *decrease* in fully certified in both middle-school math and science teachers. So, perhaps, full certification was affected by NCLB. NCLB may have influenced states to strengthen their certification requirements. Finally, as shown in the compilation and analysis of middle school certification among U.S. states, some licensure requirements *did* change. Some states made licensure requirements stricter while others made them more lenient. For example, Alaska, Connecticut, Idaho, Maine, Massachusetts, Mississippi, New Jersey, and Ohio all increased content preparation requirements. On the other hand, Arizona, Hawaii, Iowa, and Kentucky decreased these requirements. So, despite strengthening or weakening of certification requirements, the overall percentage of fully certified did not change, i.e. there is no overall increase or decrease in certification requirements by the states. It appears that NCLB may have encouraged some states to change certification requirements but this may have solely been the result of states' need to simply *have* or *create* definitions that include these requirements.

The variable that combines major *with* full certification is called "matched." To determine if NCLB impacted whether or not middle-school math and science teachers were matched (fully certified with a major in the field taught), Research Question 3 was analyzed. According to the answer to Question 3, math and science teachers who taught in high schools were more likely to have majors (be "matched") than math and science teachers who taught in middle schools. This study revealed that fully certified male teachers who taught in high schools had the greatest likelihood of being matched.   After NCLB middle school teachers who taught in middle schools were less likely to be matched than before NCLB. The likelihood of middle school teachers having majors also dropped after NCLB. However, if fully certified, middle school teachers' likelihood of being matched *increased* after NCLB. So, once again, NCLB seems to have possibly affected the percentage of fully certified but not percentage of middle school teachers with majors. Thus, it can be said that NCLB *indirectly* affected matched because teachers were more likely matched *if they were fully certified*!

NCLB impact on middle-school certification

According to the results obtained from Research Question 4, some states did change licensure requirements. Many middle-school math and science teachers are still elementary and secondary certified, even though most states offer middle level certification. And, in spite of NCLB, certification requirements are still extremely varied. But, NCLB required all middle-school teachers be highly qualified. The minimum requirements for highly qualified are full state certification, content knowledge in the subject taught, and at least a bachelor's degree. The measure of content knowledge, though, can vary from obtaining a major in the field taught, getting an endorsement, passing the Praxis test, or fulfilling the HOUSSE requirements. The requirements to obtain teacher certification also vary among states. Some states require several college hours or a major, while some require only a few courses.

Many middle-school teachers obtain a K-9 license but the majority of these teachers do not teach in K-9 facilities (Gaskill, 2002, May). Historically, teaching institutions offered either an elementary or secondary license that included overlaps with middle level grades. This led to most teachers teaching middle level with either an elementary license, which may be lacking in content emphasis, or a secondary license, which may be lacking in age-specific pedagogy training. Recently, though, according to the data compiled for this study (from Gaskill's 2002 study and McEwin's 2007 study), education programs have begun offering a middle-school license. But, despite the fact that 43 states and the District of Columbia have established a middle-level teacher credential, only 21 of those states *required* a middle-level teacher license to teach in the middle grades (Gaskill, 2002, May).

Certification requirements for middle-school math and science teachers often vary from state to state. At the time of this study, several states (CA, CO, DC, KS, MD, NE, NH, ND, TX, VA, and WA) did not require hours of content preparation in math or science and/or specific subjects in math or science. According to the U.S. Department of Education (2004), some states provided for a general science certification, while others required subject-specific certification. Some states allowed teachers to be highly qualified in a broad field science or individual disciplines of science such as chemistry, physics or biology. The stricter definition devised for this study that, in order to truly have content knowledge, the teacher should have a major in the field taught, allowed for this disparity to be eliminated, thus ensuring that teachers have strong content knowledge in the subject taught. To solve this issue, teaching institutions could standardize certification, testing and degree requirements to teach middle-school math or science. They could offer a license specifically for middle-school math and science teachers. In addition, state departments of education could standardize certification requirements across all states so that teachers can teach in all states. Middle school certification could be standardized by grades levels (*all* 6-9, or 5-8, etc.).

According to the results of Question Four, middle school certification remains varied. The data compiled in Tables 14 and 15 show that most states (46 plus D.C.) offer either a middle level licensure or endorsement. Despite this fact, most middle-school math and science teachers are still elementary and secondary certified. In this study it was difficult to define a middle school teacher because of the confusion due to the varying grade spans identified as middle school, and whether or not certification was offered by a particular state. For example, according to Tables 14 and 15, 13 states' middle school grade spans were 5-8, nine states had 5-9, others designated grades 4-8, 4-9, 7-9 (Nevada), and some did not designate a grade span for middle schools in their states. This leads to the question of where did they classify those schools that are still junior highs (grades 7-9)? Was Nevada the only state with junior high schools? There are a few states that do not offer a middle level credential. In spite of NCLB, then, middle school licensure requirements are still "all over the place."

This study showed that after NCLB several states offered a middle level licensure and/or endorsements in math and science. According to research, having middle level licensure and/or endorsements available is important for middle school teachers. Research supports the need for colleges and universities to make middle-level teacher licensure available. This will help middle-school teachers become knowledgeable about, and skilled in teaching, early adolescents. This is critical to the success of middle grades education (Jackson and Davis, 2001). The rationale for *this* study was that middle-school math and science teachers should have a major in the fields they teach. However, there remains a lack of quality research on effective teacher preparation in middle school math and science (Cavanaugh, 2008, March 21).

This study also showed that, after NCLB, four more states (Louisiana, Maryland, Mississippi and New Jersey) added a middle level credential and at the time of this study only three states (California, Idaho and Montana) still did not have such a credential. This is supported by the study done by National Association of Secondary Principals (NASSP) in 2004 (Petzko, 2004). It showed that progress has been made in the area of certification specific to the middle level, but there is still much work to be done. Many states offered a middle level credential after NCLB. The sad fact remains that the majority of teachers throughout the history of the middle school movement have not been educated to teach at this level (Dickinson and Butler, 2001). Their study revealed that approximately half of middle schools still employ a majority of teachers with secondary certification. Thirty percent employed a majority of teachers with elementary certification. However, the percentage of schools with a majority of teachers who hold middle level certification had increased from 11% in 1992 to 18% in 2000. Also, those schools classified as highly successful had 25% with middle level certification by 2000 (Petzko, 2004). The compilation of data from these studies and others indicates that NCLB positively affected an increase in middle level certification programs among certain states, but the results here suggest the changes are not having much impact.

NCLB impact on administrators' behavior

Whether or not NCLB impacted school administrators' behavior is purely speculative. However, NCLB seems to have affected the behavior of school administrators at the state and district level in two ways. First, because it dictated that they only hire highly qualified teacher per NCLB's definition, school administrators are no longer allowed to hire teachers unless they have at least a bachelor's degree, full state certification and content knowledge, which could add to the problem of shortages of middle-school math and science teachers. Second, states may be inclined to change certification requirements to fit their teachers into the definition of highly qualified, thus lowering the standards. This study may support this claim because math and science certification percent had decreased from 1999-2000 to 2003-2004. According to the results from Research Question 4, some states did change licensure requirements. Since NCLB required states to define and hire highly qualified teachers, some states may have chosen to weaken requirements while some strengthened requirements. Because there is no pattern, it is difficult to determine if NCLB affected the percent certified middle-school math and science teachers. Because of the requirement of all teachers being highly qualified, at least 12 states have loosened teacher certification requirements, in some cases lowering test score minimums (Au, 2004). The net effect is an actual lowering of teacher certification standards, while at the same time meeting the requirements of highly qualified.

If policy implementation has indeed impacted state and district administrators to see the necessity of improving the quality of teachers, and to help them *become* highly qualified, then they may be encouraged to continue to come up with ways to fill middle schools with highly qualified teachers. Since NCLB's impact on administrators was not directly measured by the results of this study, much future research must be done.

5.04 Summary

Based on the results of this study the following conclusions can be drawn. It is still unclear exactly what NCLB did, as it seems to not have had an effect on the percent of highly qualified teachers. Collectively the states decreased in percent math certification and math major after NCLB. Individually some states increased. Overall the states increased in science major but decreased in percent science certification. Again, some states did improve in these categories. If nothing else NLCB has forced the issue of states looking more closely at certification requirements. As indicated by the inconsistency of middle-school teacher certification requirements states need more guidance in determining what these policies should be. Policymakers should ensure that their teachers are highly qualified through requiring appropriately stringent standards.

The states in the south appear to be on the bottom of percent highly qualified as per this study's definition despite the fact that, according to SREB, they have been working to improve teacher quality by offering professional development opportunities. Even though many of these states (TX, AL, DE, NC, MD, DC, FL, LA, & AZ) are more likely to be matched than Kansas after NCLB, many southern states (GA, NC, AR, AL, SC, TN, WV, DC, AZ, MS, and LA) ranked lower than Kansas on the NAEP math progress index score. DE, TX and AL were the only southern states that were not on the bottom in percent major during 2003-04. Despite these southern states' efforts to improve teacher quality (which may or may not have been due to NCLB), their students still had lower academic achievement than even the students in some states whose teachers had a low likelihood of being "matched." They may have simply been victims of their geography.

A stricter definition for highly qualified is needed to capture the "quality" component. There has been much discussion as to what makes a teacher a quality teacher. This study required a more stringent definition in hopes that highly qualified could be better characterized. Perhaps states can work together to follow the belief that certification requirements for middle-school math and science teachers should be held strict and high.

5.05 <u>Recommendations for Future Research</u>

More studies are needed to examine the inconsistencies in the results of this study that showed the percent of science teachers with science majors *increased* after NCLB while percent of fully certified science teachers, percent of math teachers with math majors, and fully certified math teachers *decreased*. In addition, more research must be done to determine if a major in the field taught is a necessary component of being a quality teacher. And if it is, what needs to be done to increase these percents?

This study also showed that "matched" middle-school math and science teachers are more likely to be teaching in high schools as opposed to middle schools, are more likely to be male than female, are more likely to be fully certified than not and more likely to be a minority. Future research should examine why these characteristics matter in the likelihood of being matched and if being matched really makes a difference in student achievement.

This study provides a stricter definition of highly qualified specifically that a teacher must have full certification and have a major in the field taught. More studies need to be done to determine if this stricter definition results in quality teachers in the classrooms or negatively affects the chances of getting our classrooms staffed with highly qualified, quality teachers. It is possible that stricter requirements will discourage college students from becoming teachers, thus defeating the intent of toughening these requirements.

In this study, middle-school certification requirements from before and after NCLB have been compiled and analyzed. Some states added endorsements and credentials after NCLB. Other states added content preparation requirements. Some decreased requirements. It is probable that some of these changes that were made were likely due to this policy implementation but it is also apparent that these requirements are changing and will continue to be modified. It is important that these changes continue to be observed and monitored to see the direction middle-school certification is going.

Studies have shown that being taught by a quality teacher can positively affect student learning. The results of this study showed that there still remained a high percentage of middle-school math (79%) and science (60%) teachers without majors in their content taught and that the percent of fully certified middle-school math (from 87% to 85%) and science (from 88% to 84%) teachers dropped after NCLB. Further research should be done to see if out-of-field teachers negatively affect student learning and to determine the long-term effects of students being taught by out-of-field (teachers who lack credentials and/or are mis-assigned) vs. teachers with majors and/or full certification. More studies need to be done to determine if it really does matter that teachers are quality as defined here – are effective, knowledgeable, skilled, in-field, and certified. More studies have to be done to answer the question, what is the significance of a highly qualified teacher, as defined by NCLB.

Why particular states (like Nebraska, Alabama, New Jersey, New York, and DC) were consistently represented in the top 30% of middle-school math and science teachers with full certification and math and science majors, while other states (like Arizona, Kentucky, North

Carolina, Tennessee and Georgia) were consistently represented in the bottom 30%, and why certain states made such drastic changes, should receive further study. For example, NY was in the top 30% in math in both 1999-2000 (at 45%) and 2003-2004 (at 39%) but was in the bottom in science in 1999-2000 (at 15%) then jumped to the top in 2003-2004 (at 61%). MN moved from the middle to the top in both math (38 to 55%) and science (23 to 61%) majors. More research also needs to be done to determine why certain states (Minnesota, North Dakota, and New Hampshire) increased in both the percent of middle-school math and science teachers with full certification and math and science majors, while other states (Vermont, DC, Ohio, and Michigan) decreased in both categories. The reason this study attempted to determine the high to low and increase to decrease in percent "matched" was to search for relationships between these trends within certain states and policy (certification requirements) changes, and geographical location and socio-economic status. But it remains unclear why states actually increased or decreased.

In attempting to answer Research Question 3, certain teacher characteristics emerged as components that impacted teachers being "matched." More research needs to be done to understand this. Why were middle-school math and science teachers who taught in high schools and middle schools more likely to be matched than middle-school teachers who taught in elementary schools? Why did the likelihood of being matched drop off during 2003-04? Why were fully certified middle-school math and science teachers more likely to be matched during 2003-04 than 1999-00? Why were male teachers more likely to be matched than female teachers in 1999-00? Why were minority teachers more likely to be matched than non-minority teachers in 2003-04? NCLB seems to not be impacting a variety of what it argued were keys for student success. Reasons for these changes need to be further examined.

One of the components of this study was to determine the middle-school licensure requirements for middle-school math and science teachers from 1999 to 2003. In general, some states increased the content preparation requirement, some changed grade level span on license, while some states increased the opportunity to gain a middle-level license or endorsement. Further research should be done to determine *why* these changes were made. Perhaps these changes represent the effort to improve teacher quality while at the same time continue to get (or keep) teachers highly qualified.

This study did not examine any differences between traditional and alternative certification routes. Further research might examine the impact of alternative routes on the variables of interest in this study – lack of credentials and mis-assignment of middle-school math and science teachers and the shortage of middle-school math and science teachers.

This study revealed that the following teacher factors and credentials lead to math and science teachers being matched: Years experience, degree (major in field taught), certification type, undergraduate institution competitiveness attended, gender, and race. More studies need to be done to find the connection between these middle-school teacher factors and credentials. In addition, this study did not examine the impact of these variables on student achievement. Such research is necessary to determine if the components of highly qualified make any difference. What is the significance of a highly qualified teacher? And, how can educators be sure that "highly qualified teachers" are indeed *highly qualified* – how can we standardize its operational definition? More studies need to be done to answer these questions.

This study did not reveal the essential attributes for quality teachers. Since these qualities are still unknown, more research must be done to determine them. It must be decided where to go next to improve teacher quality. One study suggested that since there is such uncertainty about *which* math teaching skills demonstrate whether or not a teacher is effective in the classroom, this is where the action has to come next (Cavanaugh, 2008, April). Having a math major to teach math may not be enough. The percent of fully certified math teachers remained fairly high after NCLB, but the percent with math majors decreased. More studies will have to be done to evaluate the impact of having a major has on student achievement in math. Perhaps it is simply the teacher's attitude regarding math that positively or negatively affects the math student's success.

This study assumes that a major is an important component of being a highly qualified and an effective teacher. According to parents, politicians and school board members, having a college major would be high on the list (Cavanaugh, 2009, January). Recent results from the NAEP show that, when looking at the necessity of a major to teach math, results are mixed. On average 8th graders taught by a teacher with a math major scored 9 points higher than their peers taught by a non-major. In Kansas however, students taught by math majors and non-majors scored at about the same level (Cavanaugh, 2009, January). More research must be done on the importance of a major in teaching middle-school math or science.

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Appendix A

SASS Questions Used in this Study

I. Questions from Public School Teacher Questionnaire (PSTQ) and Public School Questionnaire (PSQ) Schools and Staffing Survey 1999-2000 School Year.

General information regarding your teaching assignment (PSTQ)

1a. How would you classify your main assignment at THIS school, that is, the activity at which you spend most of your time during this school year? Mark only one box.

4a. What was your MAIN activity LAST school year?

6a. How many years have you worked as a FULL-TIME elementary or secondary teacher in PUBLIC schools?

6b. How many years have you worked as a PART-TIME elementary or secondary teacher in PUBLIC school?

Teaching Assignment ("Out-of-field") (PSTQ)

12. THIS school year, what is your MAIN teaching assignment field at this school, that is, the field in which you teach most classes?

15a. This school year are you assigned to teach classes in OTHER fields at this school in addition to your MAIN teaching assignment field?

38. For each class (or section) that you taught during your MOST RECENT FULL WEEK of teaching at this school

38b.What subject did you teach?

Training (PSTQ)

8a. Do you have a bachelor's degree?

8b. In what year did you receive your bachelor's degree?

8c. What was your major field of study?

8d. Did you have a second major field of study?

8e. What was your second major field of study?

10a. Do you have a master's degree?

10b. What was your major field of study?

Certification (PSTQ)

13a. Do you have a teaching certificate in this state in your MAIN teaching assignment field?

13b. What type of certificate do you hold in this field? (If yes, mark only one box).

16a. Do you have a teaching certificate in this state in your OTHER teaching assignment field at this school?

16b. What type of teaching certificate do you hold in this field? (If yes, mark only one box).

Organization of classes in which you teach (PSTQ)

33. In which grades are the students in the classes you currently teach at THIS school? Mark all that apply

34a. Which category best describes the way YOUR classes at this school are organized?

38. For each class (or section) that you taught during your MOST RECENT FULL WEEK of teaching at this school – (complete a line of the table for each class that you taught).

38b. What subject did you teach? (Record the subject matter code and the name of subject)

General information regarding your school (PSQ)

6. What grades are offered in this school? Mark all that apply.

Admission, programs and performance (PSQ)

13. What type of school is this? **Mark X the box that best describes this school.**

Students and class organization (PSQ)

21. Does this school use the following methods to organize classes or student groups?

Staffing (PSQ)

35a. Were there teaching vacancies in this school for this school year – that is, teaching positions for which teachers were recruited and interviewed?

35b. Did this school use the following methods to fill these vacancies? (Answer yes or no)

37. How difficult or easy was it to fill the vacancies for this school year in each of the following fields? (Choose from: not applicable in this school; no vacancy in that field; easy; somewhat difficult; very difficult; couldn't fill the vacancy)

- Mathematics
- Biology or life sciences
- Physical science

II. Questions from Public School Teacher Questionnaire (PSTQ) and Public School Questionnaire (PSQ) Schools and Staffing Survey 2003-2004 School Year

General information (PSTQ)

1. How do you classify your position at THIS school, that is, the activity at which you spend most of your time during this school year? Mark only one box.

5. What was your MAIN activity LAST school year (2002-03)? Mark only one box.

6a. How many years have you worked as a FULL-TIME elementary or secondary teacher in PUBLIC, CHARTER and/or INDIAN schools?

Teaching Assignment ("Out-of-field") (PSTQ)

17. This school year, what is your MAIN teaching assignment field at this school?

19. For each class (or section) that you currently teach at THIS school, complete a row/line of information.

Training (PSTQ)

20a. Do you have a bachelor's degree?

20b. In what year did you receive your bachelor's degree?

20d. What was your major field of study?

20e. Did you have a second major field of study?

20f. What was your second major field of study?

22a. Do you have a master's degree?

22d. What was your major field of study?

Certification (PSTQ)

30a. Which of the following describes the teaching certificate you currently hold in this state? (Mark only one box).

30b. Some certificates may allow you to teach multiple content areas. In what content area(s) does the teaching certificate marked above allow you to teach in this state? Which of the following grade ranges does this certificate apply to? Mark all that apply.

30c. If there is an additional content area that the certificate described above allows you to teach, please list it below. Record content area code from Table 3. **Which of the following grade ranges does this certificate apply to?** Mark all that apply.

Class organization (PSTQ)

11. In which grades are the STUDENTS you currently teach at THIS school? Mark all that apply.

12. Which statement best describes the way YOUR classes at this school are organized?

19. For each class (or section) that you currently teach at THIS school, complete a row/line of information.

General information about this school (PSQ)

7. Which of the following grades are offered in this school? Mark all that apply.

Admission, programs and performance (PSQ)

14. Which of the following best describes this school? Mark only one box.

Student and class organization (PSQ)

27. THIS school year (2003-04), does this school use the following methods to organize classes or student groups? (Answer yes or no)

Staffing (PSQ)

38a. For THIS school year (2003-04) were there teaching vacancies in this school, that is, teaching positions for which teachers were recruited and interviewed?

38b. How easy or difficult was it to fill the vacancies in each of the following fields? (Choose from: no positions in this school; no vacancy in this field; easy; somewhat difficult; very difficult; could not fill the vacancy)

- Mathematics
- Biology or life sciences
- Physical sciences

39. For THIS school year (2003-04), did this school use the following methods to cover the vacancies? (Answer yes or no)

Appendix B

Codes for use with STATA data analysis program

Weightings codes:
Teacher Final Weight = svyset[pw=tfnlwgt] for 99-00 SASS, or svyset[pw=TFNLWGT] for 03-04 SASS.
Teacher Repeated Weight = brrweight(trepwt1-trepwt88) for 99-00 SASS, or brrweight(TREPWT1-TREPWT88) for 03-04 SASS.

Data Sets and Variables codes:
99-00 codes:
c:\sass\ms9900b.dta = SASS Middle Schools 99-00 data set
c:\sass\all9900b.dta = SASS All Schools 99-00 data set
mathmajor = has math major
sciencemajor = has science major
tchmath = teaches math
tchscience = teaches science
state = state
certification type = t0103

03-04 codes:
c:\sass\ms0304b.dta = SASS Middle Schools 03-04 data set
c:\sass\all9900b.dta = SASS All Schools 03-04 data set
mathmajor = has math major
sciencemajor = has science major
tchmath = teaches math
tchscience = teaches science
STAT_ABB = state
certification type = T0166

Tabulation codes examples:
```
c:\sass\ms9900b.dta
svyset [pw=tfnlwgt], brrweight(trepwt1-trepwt88)
tab mathmajor tchmath, col
tab  state mathmajor
tab state tchmath
```

```
c:\sass\all0304b.dta
svyset [pw=TFNLWGT], brrweight(TREPWT1-TREPWT88)
tab sciencemajor tchscience, col
tab STAT_ABB sciencemajor
tab STAT_ABB tchscience
```

Multiple Variables codes:
state vs. math/science major vs. teaches math/science vs. certification type

```
c:\sass\ms9900b.dta
tab state t0103 if tchmath==1 [iwei=tfnlwgt], row
tab state mathmajor if tchmath==1 [iwei=tfnlwgt], row

c:\sass\ms0304b.dta
tab STAT_ABB T0166 if tchscience==1 [iwei=TFNLWGT], row
tab STAT_ABB sciencemajor if tchscience==1 [iwei=TFNLWGT], row

c:\sass\all9900b.dta
tab state t0103 if tchscience==1 [iwei=tfnlwgt], row
tab state sciencemajor if tchscience==1 [iwei=tfnlwgt], row

c:\sass\all0304b.dta
tab STAT_ABB T0166 if tchmath==1 [iwei=TFNLWGT], row
tab STAT_ABB mathmajor if tchmath==1 [iwei=TFNLWGT], row
```

Logistical Regression code:
predictors of whether science teachers have science majors & math teachers have math majors

```
xi: svy:logit matched middle_school high certified ln_exper ba_year minority
male suburb rural i.state i.schsize if tchscience==1| tchmath==1, or vce(brr)
```

Appendix C

Characteristics of Schools and Staffing Survey 1999-00 and 2003-04

1999-00 and 2003-04 Questionnaire Design
The 1999-00 and 2003-04 SASS questionnaires were revised in preparation for each year's upcoming survey distribution. The newly designed questionnaires continue to measure the same five major policy issues: teacher shortage and demand; characteristics of elementary and secondary teachers; teacher workplace conditions; characteristics of school principals; and school programs and policies. New items for the 1999-00 questionnaires included school and district performance reports, standards for home-schooled students, charter schools, migrant students and availability and use of computers and the Internet. New items about teachers' career paths, parental involvement, and school safety, have been added to the 2003-04 questionnaires.

1999-00 and 2003-04 Sampling Frame
CCD is a universe file that includes all elementary and secondary schools in the United States. In the table below are the strata for public school teachers in both years.

Public School Teacher Strata 1999-00 and 2003-04

Year Survey Given	1999-2000	2003-2004
Total teachers	56,860	53,188
Asian/Pacific Islander	1,216	1,466
Native American	1,420	1,435
ELL	2,040	
New	7,012	8,032
Experienced	45,172	42,255

1999-00 and 2003-04 Sample Design
Both the 1999-00 and 2003-04 use stratified probability sample design. ***Stratified sampling*** is commonly used probability method that is superior to random sampling because it reduces sampling error. A stratum is a subset of the population that shares at least one common characteristic. The researcher first identifies the relevant stratums and their actual representation in the population. Random sampling is then used to select a *sufficient* number of subjects from each stratum. "*Sufficient*" refers to a sample size large enough to be reasonably confident that the stratum represents the population. Stratified sampling is often used when one or more of the stratums in the population have a low incidence relative to the other stratums.

Reliability and validity tests have already been done on SASS. Because stratified random sampling was used it has external validity. This ensures variability in the population. External validity relies on methods of sampling (probability sampling method used in SASS) and population size. The larger the population, the greater the external validity.

To produce a broad cross-section of schools and their staffs, NCES sorted schools into categories based on state, type of community, size of enrollment, and grade levels served. The sampling frame for the 1999-2000 public school sample was the 1997-98 Common Core of Data (CCD) school file. The frame used for the 2003-2004 public school sample was the 2001–02 CCD school file. The NCES collects these data annually from all state education agencies (NCES, 2002). Within the public group, the NCES randomly selected schools to be in the samples for each survey. Each selected school was asked to provide a list of all its teachers along with teacher characteristics**.** Teachers with certain characteristics such as new teachers and (English Language Learners (ELL) teachers were chosen at a greater rate to ensure that these samples were large enough to be considered reliable.

1999-00 Data Collection

For the 1999-00 data collection, the U.S. Census Bureau performed the data collection and began by sending advance letters to the sampled LEA's in August, and schools, in September 1999. Questionnaires were mailed in October of 1999 and a reminder postcard was sent several weeks later. Follow-up for non-responding teachers was conducted using Computer-Assisted Telephone Interviewing (CATI). Data collection was completed by May of 2000 (NCES, 2002).

2003-04 Data Collection

For the 2003-04 data collection, the U.S. Census Bureau performed the data collection and began by performing an address verification operation in June 2003 to verify school names and addresses. Advance letters were sent to the sampled LEA's in September and advance postcards requesting appointments with Census Bureau field representatives were sent to sampled schools in September and October 2003. Verification of school data was conducted by telephone and using computer-assisted personal interviewing (CAPI). Collection of teacher lists by field representatives and distribution of school questionnaires began in October 2003. Field representatives distributed teacher questionnaires after school questionnaires were collected. Respondents were asked to complete the questionnaire and mail it back to the U.S. Census Bureau. Follow-up for non-responding teachers was conducted by in-person pickups or by verifying that the respondent had sent the questionnaires in by mail. Data collection was completed by February 2004 (NCES, 2007).

Data Collection Time Schedule 1999-00 and 2003-04

Activity	**Month and year for 1999-00 SASS**	**Month and year for 2003-04 SASS**
Sent advance letters to district	August 1999	September 2003
Census Bureau contacted schools for list of teachers	September 1999	October 2003
Questionnaires were distributed	December 1999 – March 2000	October 2003 – May 2004
Completion of data collection	May 2000	February 2004

1999-00 and 2003-04 SASS Weighting

Weighting of the sample units was carried out to produce national, regional, and state estimates for public schools, districts, principals, teachers, and school libraries. Private schools, principals, and teachers were weighted to produce national, regional, and affiliation estimates. The weighting procedures used in the Schools and Staffing Survey have three purposes: to take into account the school's selection probability; to reduce biases that may result from unit non-response; and to make use of available information from external sources to improve the precision of sample estimates.

1999-00 and 2003-04 SASS Response Rate

The response rates were weighted using the inverse of the probability of selection. Weighted response rates are defined as the number of in-scope responding questionnaires divided by the number of in-scope sample cases, using the basic weight (inverse of the probability of selection) of the record. There are two sampling stages for teachers; first, the school-level collection of the teacher listing form, and then, the teacher level. When both stages are multiplied together, that is the overall weighted response rate. For example, from the 1999-00 data, (83.1 times 92.2 = 76.6), is the overall weighted response rate for 1999-00. From the 2003-04 data, (84.8 X 89.3 = 75.7), is the overall weighted response rate for 2003-04. Unweighted = number of interviewed sampled units (teachers) divided by the number of eligible (in-scope) units teachers.

Sample size, weighted and unweighted response rates and weighted overall response rates in percent, by public school survey population: 1999-00

Survey Population	Sample size	Unweighted response rate	Weighted response rate
Teacher	56,860	81.2	83.1
Teacher Listing Form		93.1	92.2
School	9,374	88.5	88.5
District	5,465	87.1	88.6

Response rates were weighted using the inverse of the probability of selection. Taken from: 1999-00 SASS Data File Users Manual, November 2004.

Sample size, weighted and unweighted response rates and weighted overall response rates in percent, by public school survey population: 2003-04

Survey Population	Sample size	Unweighted response rate	Weighted response rate
Teacher	53,188	84.0	84.8
Teacher Listing Form	10,202	89.4	89.3
School	10,202	80.5	80.8
District	5,437	81.9	82.9

Response rates were weighted using the inverse of the probability of selection. Taken from: Documentation for the 2003-04 Schools and Staffing Survey, January 2007.

Appendix D
Figures and Tables of Descriptive Data Compiled for Study

Figure 12
Middle School Math Fully Certified & Teach Math 99-00

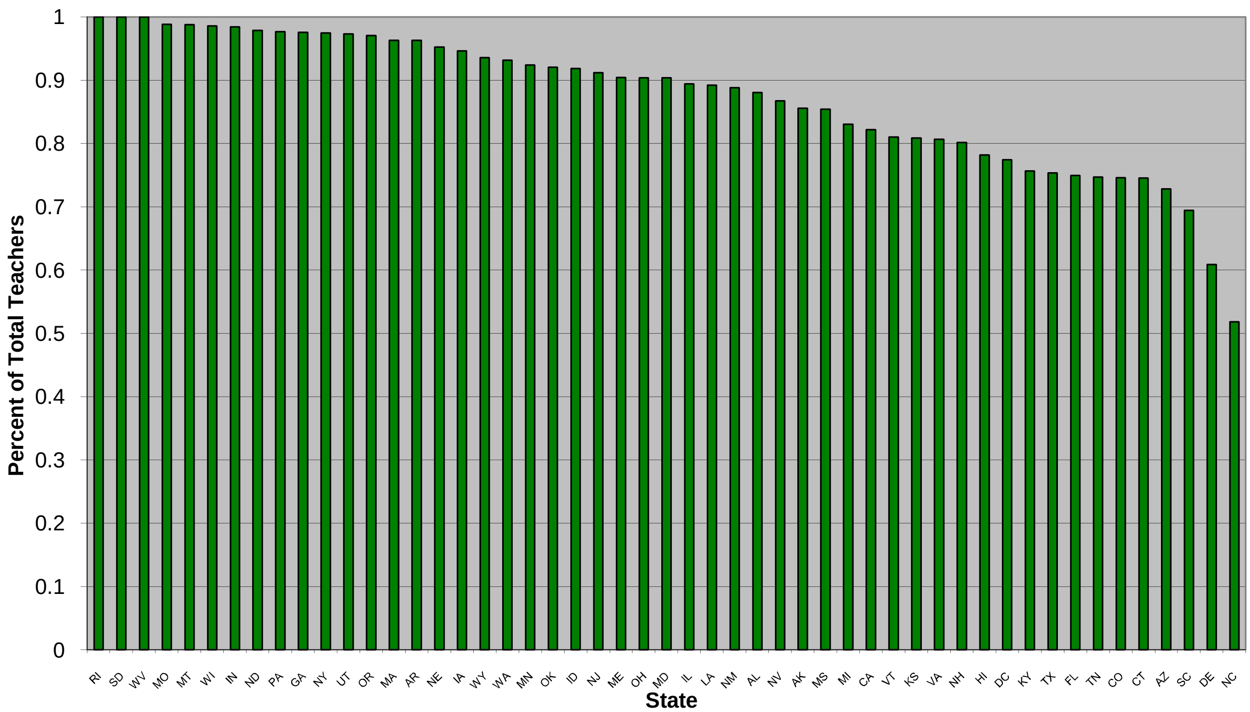


Figure 13
Middle School Math Fully Certified & Teach Math 03-04

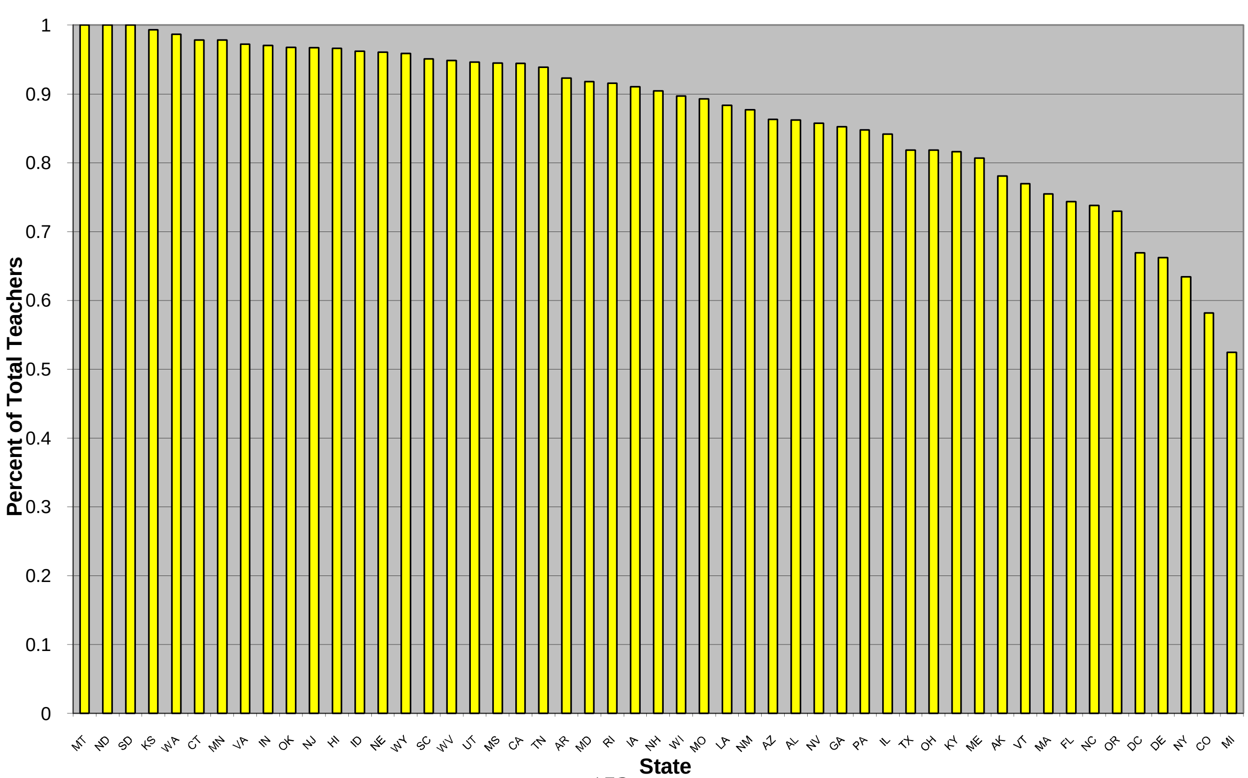


Figure 14
Middle School Science Fully Certified & Teach Science 99-00

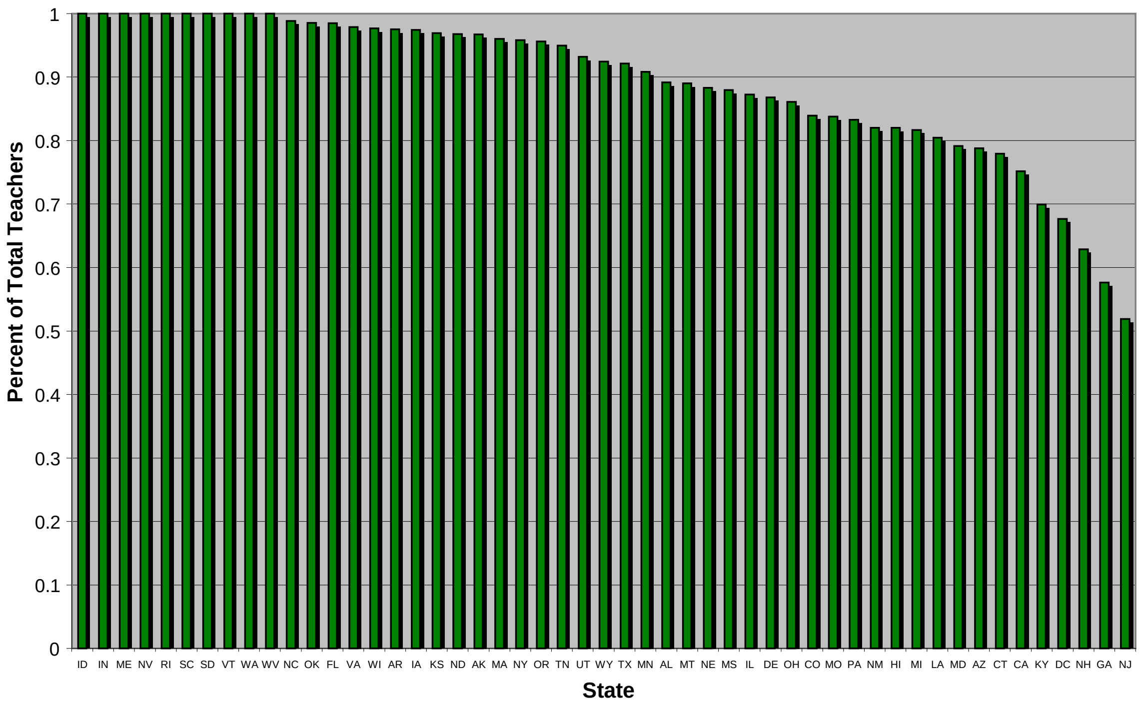


Figure 15
Middle School Science Fully Certified & Teach Science 03-04

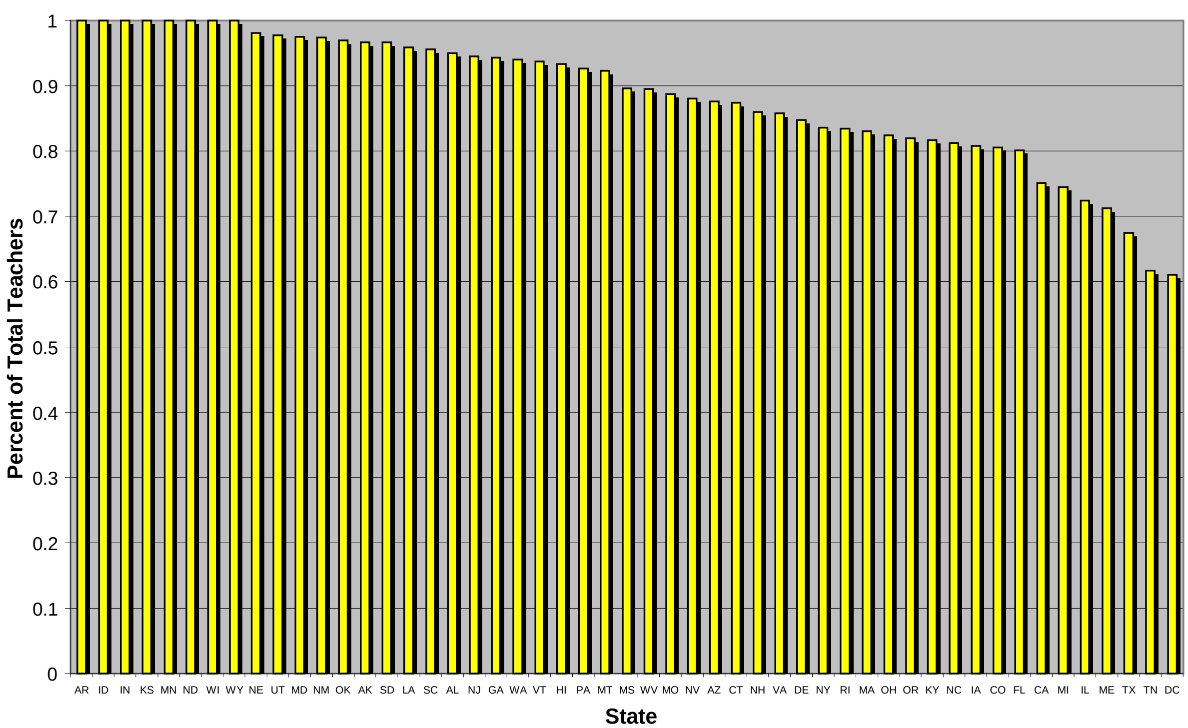


Figure 16
Middle School Math Have Math Majors & Teach Math 99-00

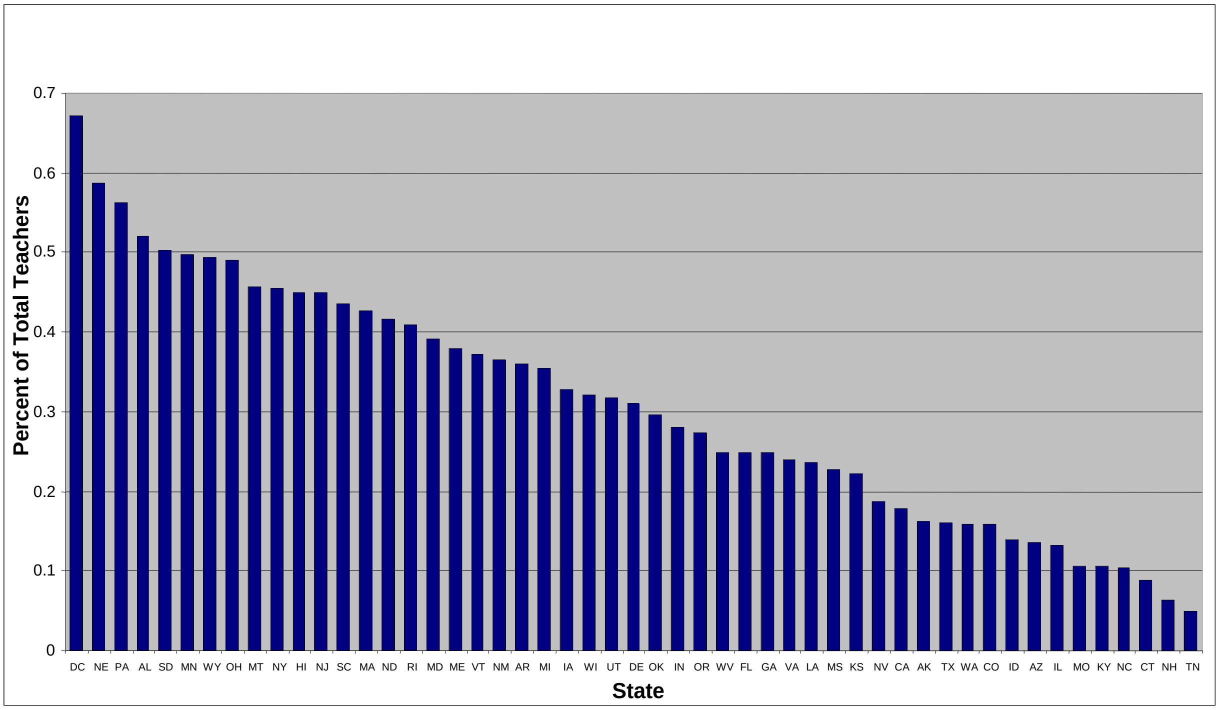


Figure 17
Middle School Math with Math Majors & Teach Math 03-04

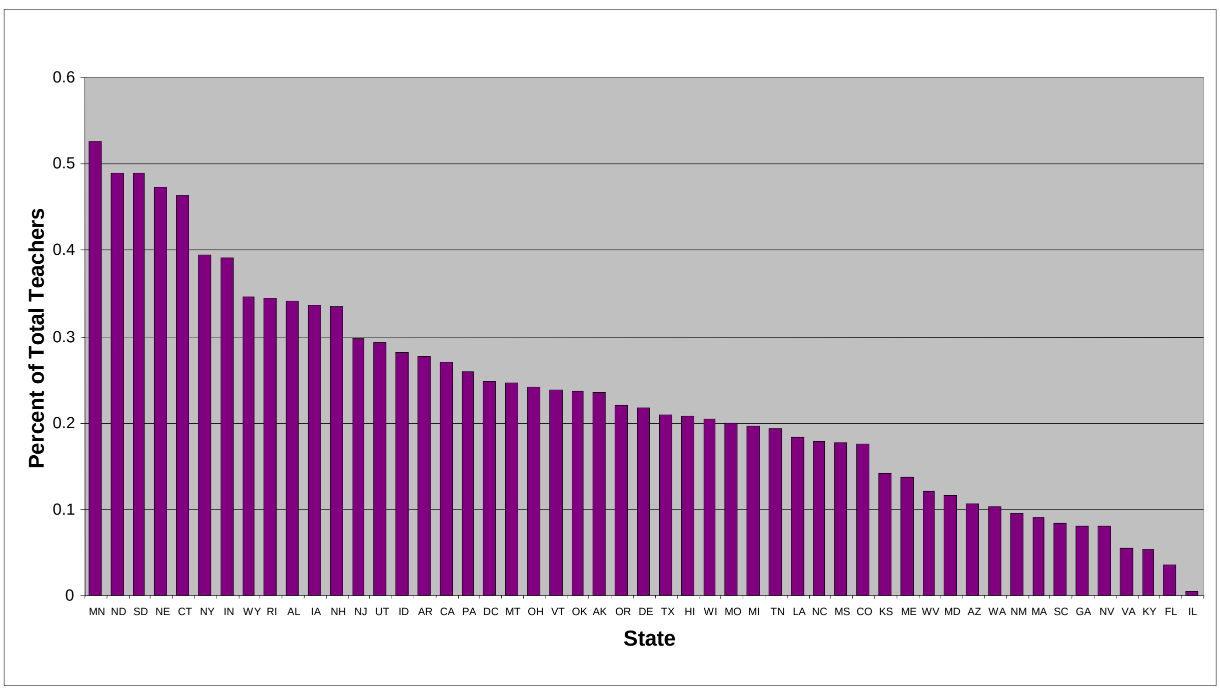


Figure 18
Middle School Science Have Science Majors & Teach Science 99-00

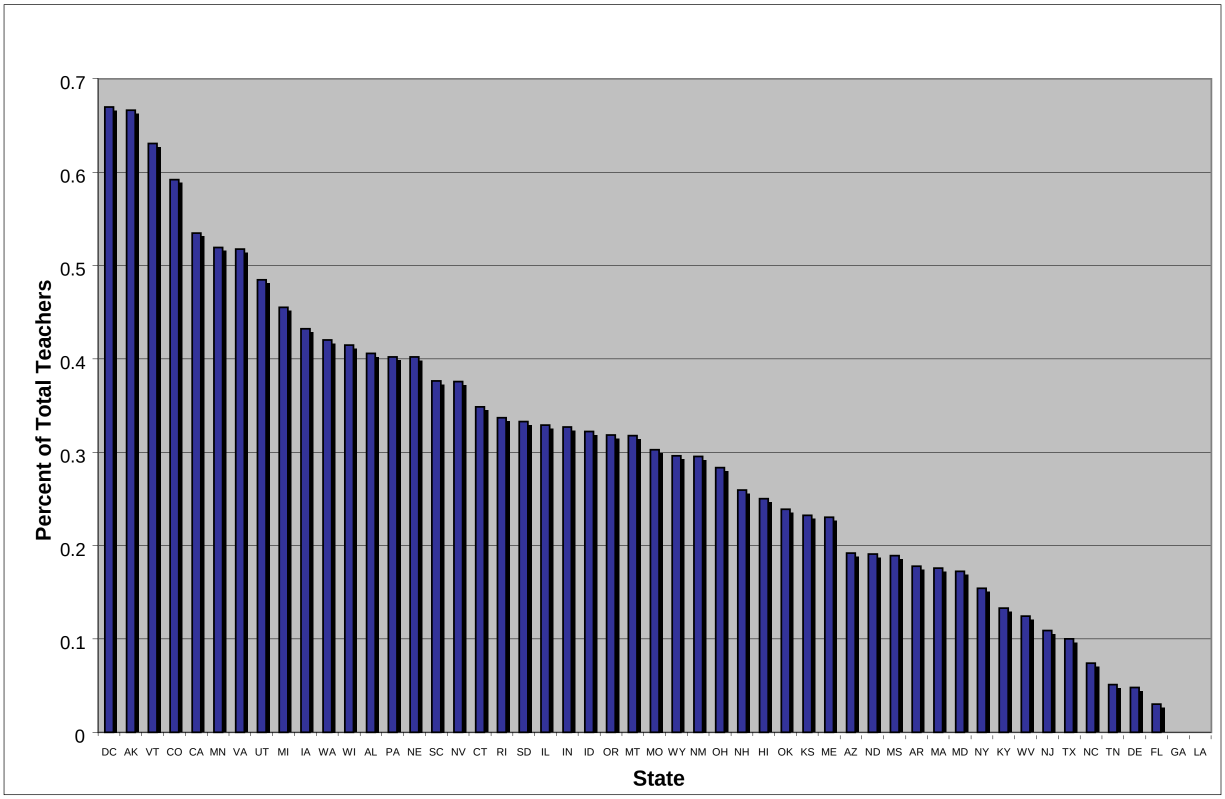


Figure 19
Middle School Science Teachers with Science Majors & Teach Science 03-04

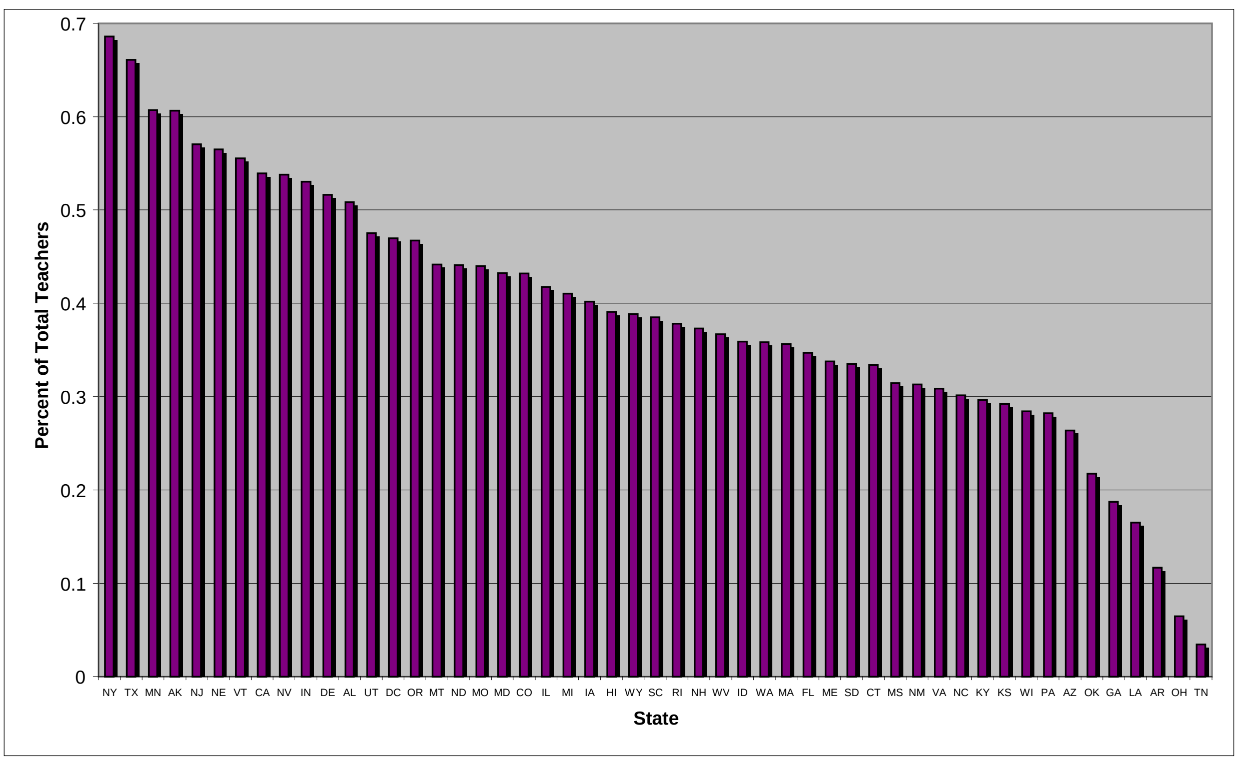


Figure 20
Overall Percent Fully Certified MS Math Teachers with Math Majors who Teach Math, 99-00 vs. 03-04

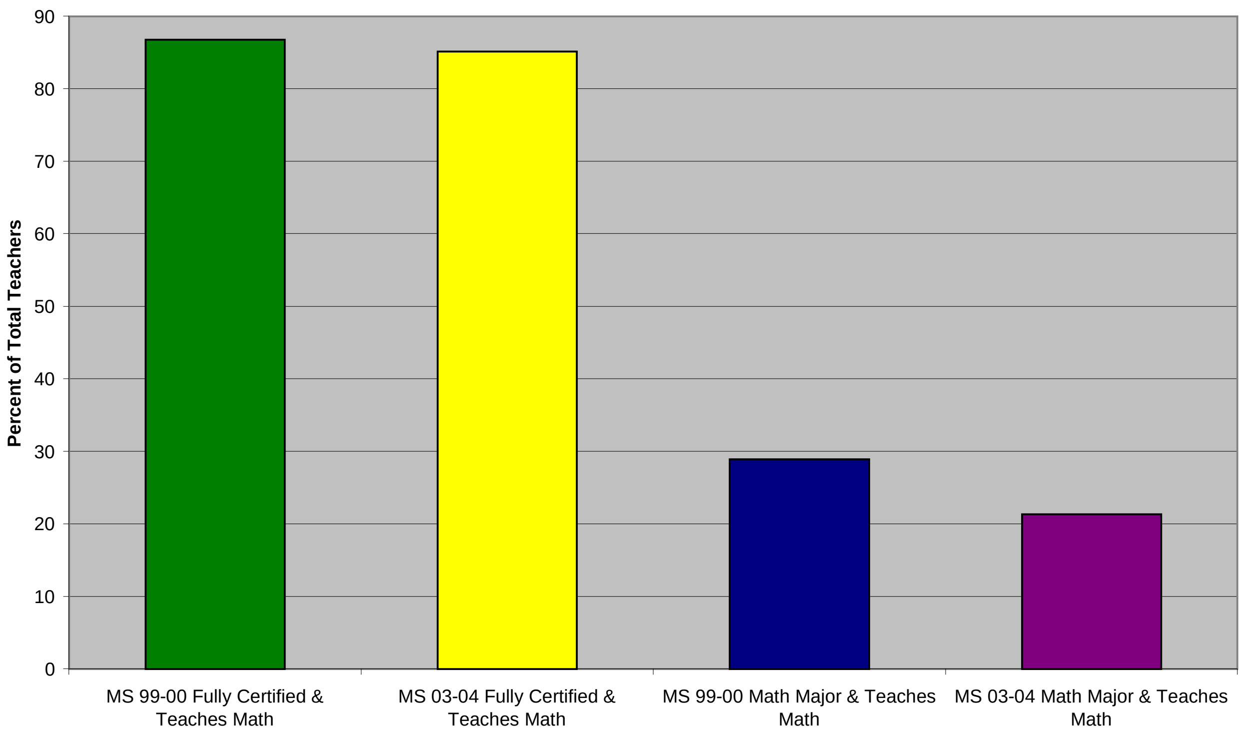
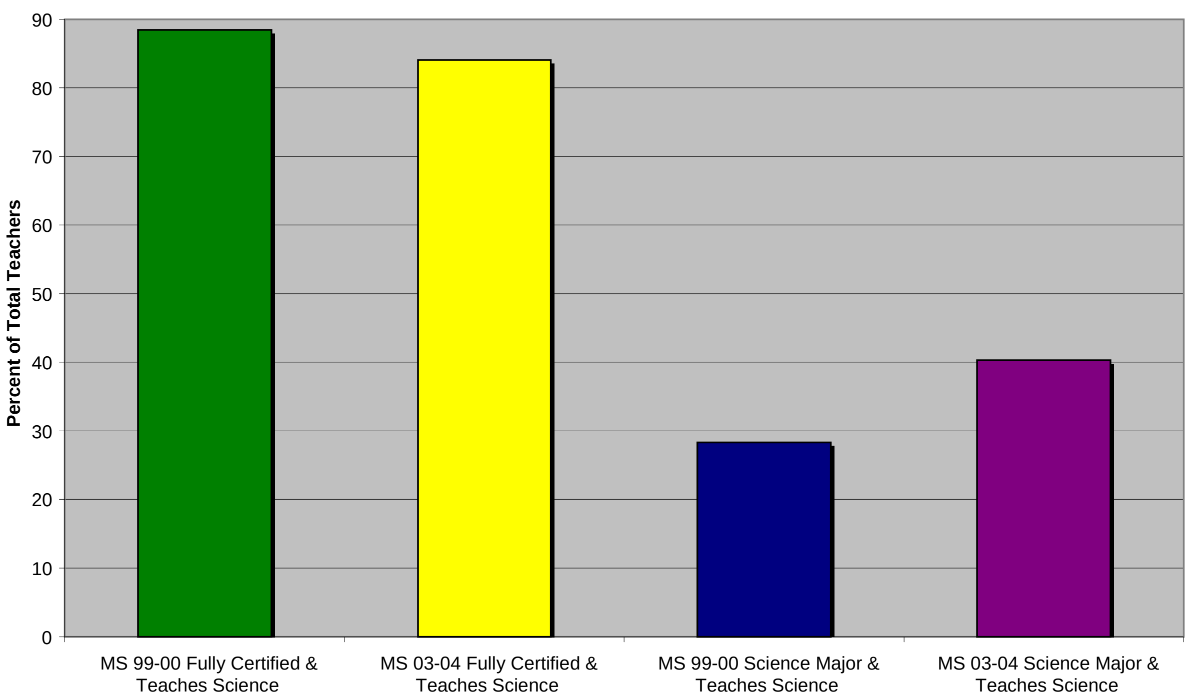


Figure 21
Overall Percent Fully Certified MS Science Teachers with Science Majors who Teach Science, 99-00 vs. 03-04



Tables 17A through 17D

*States that Increased or Decreased in **Both** Percent MS Teachers with Science and/or Math Majors **and** Full Certification from 1999-00 to 2003-04*

Table 17A: *Increase* Percent Middle-School *Science* Teachers with Majors *and* Full Certification

	1999-00 Cert.	2003-04 Cert.	1999-00 Major	2003-04 Major
MN	***90.87***	***100***	***51.94***	***60.74***
NJ	51.87	94.51	10.91	57.05
NE	88.34	98.10	40.20	56.49
AL	89.19	95.00	40.58	50.84
MT	89.01	92.30	31.78	44.17
ND	***96.81***	***100***	***19.08***	***44.11***
MO	83.80	88.72	30.29	44.00
MD	79.18	97.50	17.26	43.25
HI	82.00	93.32	25.01	39.07
WY	92.47	100	29.62	38.88
NH	***62.92***	***85.96***	***25.97***	***37.30***
MS	87.96	89.63	18.94	31.46
NM	82.03	97.41	29.56	31.32
KY	69.92	81.65	13.30	29.63
KS	96.94	100	23.26	29.21
AZ	78.80	87.63	19.20	26.40
GA	57.62	94.30	0	18.73
LA	80.49	95.88	0	16.51

Table 17B: *Increase* Percent Middle-School *Math* Teachers with Majors *and* Full Certification

	1999-00 Cert.	2003-04 Cert.	1999-00 Major	2003-04 Major
MN	***92.42***	***97.83***	***49.65***	***52.66***
ND	***97.85***	***100***	***41.58***	***48.94***
CT	74.54	97.84	8.85	46.31
NH	***80.14***	***90.43***	***6.36***	***33.51***
ID	91.85	96.23	13.93	28.10
CA	82.17	94.46	17.83	27.08
TX	75.33	81.86	16.10	20.96
TN	74.68	93.88	4.99	19.32
NC	51.84	73.79	10.43	17.88

Table 17C: *Decrease* Percent Middle-School *Science* Teachers with Majors *and* Full Certification

	1999-00 Cert.	2003-04 Cert.	1999-00 Major	2003-04 Major
AK	96.77	96.68	66.63	60.63
VT	***100***	***93.70***	***63.05***	***55.55***
DC	***67.68***	***61.08***	***66.98***	***46.96***
CO	83.92	80.57	59.22	43.20
MI	***81.68***	***74.47***	***45.53***	***41.05***
IA	97.47	80.80	43.24	40.18
WA	100	94.02	42.03	35.83
VA	97.88	85.79	51.77	30.88
OK	98.55	96.93	23.91	21.77
OH	***86.12***	***82.41***	***28.35***	***6.47***
TN	94.98	61.68	5.11	3.45

Table 17D: *Decrease* Percent Middle-School Math Teachers with Majors *and* Full Certification

	1999-00 Cert.	2003-04 Cert.	1999-00 Major	2003-04 Major
SD	100	100	50.32	48.87
NY	97.45	63.45	45.53	39.36
RI	100	91.54	40.87	34.50
AL	88.04	86.23	51.98	34.11
UT	97.33	94.62	31.80	29.34
AR	96.29	92.29	35.92	27.67
PA	97.68	84.78	56.32	25.88
DC	***77.45***	***66.91***	***67.17***	***24.84***
OH	***90.40***	***81.85***	***48.94***	***24.08***
VT	***81.03***	***76.94***	***37.15***	***23.74***
OR	97.06	72.97	27.36	22.02
WI	98.57	89.69	32.12	20.46
MI	***83.05***	***52.46***	***35.44***	***19.57***
LA	89.21	88.34	23.68	18.39
ME	90.41	80.67	37.92	13.63
WV	100	94.84	24.81	12.14
NM	88.80	87.71	36.58	9.55
MA	96.31	75.49	42.75	9.00
GA	97.56	85.24	24.80	8.10
NV	86.75	85.77	18.65	8.03
FL	74.95	74.37	24.80	3.47
IL	89.44	84.19	13.22	.54

Bold italic print signifies states that are on both science *and* math teacher lists.

Tables 17E through 17H

States that Increased in Percent Science or Math Major ***only*** *and States that Increased in Percent Certification* ***only*** *from 1999-00 to 2003-04*

Table 17E: Middle-School *Science* Teachers with *Increase* Percent *Majors Only*

	1999-00	2003-04
NY	15.44	68.60
TX	10.04	66.10
CA	53.48	53.94
NV	37.58	53.79
IN	***32.71***	***53.03***
DE	4.81	51.63
OR	31.85	46.73
IL	32.91	41.79
SC	37.62	38.50
RI	33.70	37.83
WV	12.44	36.69
ID	32.24	35.91
MA	17.60	35.64
FL	3.04	34.72
ME	23.06	33.77
SD	33.30	33.50
NC	7.42	30.15

Table 17G: Middle-School *Science* Teachers with *Increase* Percent *Certification Only*

	1999-00	2003-04
UT	93.21	97.75
CT	77.92	87.38
WI	97.52	100
PA	83.3	92.65
AR	97.47	100

Table 17F: Middle-School *Math* Teachers with *Increase* Percent *Majors Only*

	1999-00	2003-04
IN	***28.01***	***39.03***
IA	32.79	33.61
AK	16.21	23.49
MO	10.66	20.02
CO	15.81	17.57

Table 17H: Middle-School *Math* Teachers with *Increase* Percent *Certification Only*

	1999-00	2003-04
MT	98.77	100
KS	80.86	99.31
WA	93.15	98.68
VA	80.65	97.21
OK	92.03	96.79
NJ	91.17	96.71
HI	78.21	96.61
NE	95.22	96.08
WY	93.58	95.87
SC	69.42	95.10
MS	85.42	94.48
MD	90.39	91.77
AZ	72.83	86.30
KY	75.65	81.63
DE	60.88	66.21

Bold italic print signifies states that are on both science *and* math teacher lists.