Middle School Mathematics Teacher Certification, Degree Level, And Experience, And The Effects On Teacher Attrition And Student Mathematics Achievement in a Large Urban District

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MIDDLE SCHOOL MATHEMATICS TEACHER CERTIFICATION, DEGREE LEVEL, AND EXPERIENCE, AND THE EFFECTS ON TEACHER ATTRITION AND STUDENT MATHEMATICS ACHIEVEMENT IN A LARGE URBAN DISTRICT

by

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ABSTRACT

The purpose of this study was to examine the backgrounds and experiences of middle school mathematics teachers that often distinguish "quality" teachers, including certification, experience, degree type, and degree level and how those demographics and others vary for different types of schools. The emphasis was on profiling teachers in a large urban district by describing their basic features and distributions, as well as how middle school mathematics teachers, according to those differences, relate to student mathematics achievement, teacher attrition and teacher mobility. Student achievement was measured by test results from the Norm Reference Test-Normal Curve Equivalent (NRT-NCE) mathematics portion of the Florida Comprehensive Assessment Test (FCAT) for two school years (2003-04 and 2004-05).

A variety of analytic approaches and methods were used to examine how different teacher characteristics relate to teacher employment patterns and student achievement, including chi-square, Kruskal-Wallace, Mann-Whitney U, ANOVA, and t tests, together with simple descriptives and graphical analysis. Standard multiple regression was used to evaluate whether students' previous test scores and teacher- and school-level predictors could affect the results of students' mathematics achievement. A short survey was administered, which provided some insight to ascertain whether and why teachers choose among schools when seeking employment. A total of 282 teachers and 24,766 students were included for the final analysis.

This research revealed high rates of teacher turnover and deficient numbers of well-qualified mathematics teachers for this particular demographic. For example, one in three middle school mathematics teachers was in their first year, and over half (55%) had less than three years seniority. It was also apparent that, because of a shortage of well-qualified mathematics teachers,

many new teachers were being hired out-of-field—of those first-year teachers, only about half had certification in their content area and most (67%) did not have a degree in mathematics or mathematics education.

Middle schools in this district had lost 29% of the mathematics teacher workforce employed the previous year due to mathematics teacher attrition. Of those many resigned, some came back to teach another subject at the same or different middle school, and others transferred to high schools. An additional 5% transferred to other middle schools within the same district bringing the total turnover to 34%. Findings revealed no significant differences in turnover rates in high-poverty versus low-poverty schools, but there were significant differences in the proportions of *movers, leavers*, and *stayers* in schools according to whether or not a school was achieving high-standards in mathematics. Although inequities did exist in favor of schools with less at-risk students, in this district—for the most part—teachers were fairly distributed according to the "quality" of their backgrounds and experiences. The only significant gap was in that students in wealthier schools were more likely to have a mathematics teacher with a higher degree.

This study also offers results that further understanding on the debate about which attributes of teachers are most likely to translate into effective-classroom performance. When analysis was performed at the student level, the findings revealed that students of middle school mathematics teachers with higher seniority, advanced degrees, or certification in the content area that they taught, performed significantly higher than students in other classrooms. Yet the magnitude of those differences was either modest or very small. When controlling for students' socio-economics status at the classroom level, differences were not significant for seniority or advanced degrees but the results were significant for certification.

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LIST OF ACRONYMS/ABBREVIATIONS

ABCTE	American Board for Certification of Teacher Excellence
AERA	American Educational Research Association
ANOVA	Analysis of Variance between Groups
AYP	Adequate Yearly Progress
CRT	Criterion-Referenced Test
DOE	Department of Education
EDF	Office of Economic and Demographic Research
ESE	Exceptional Student Education
ETS	Educational Testing Service
FCAT	Florida Comprehensive Assessment Test
FLDOE	Florida Department of Education
FY	Fiscal Year
GAO	Government Accounting Office
IRB	Instructional Review Board
LEP	Limited English Proficiency
MURMSI	Multi-University Reading, Mathematics and Science Initiative
NAEP	National Assessment of Educational Progress
NAGB	National Assessment Governing Board
NBPTS	National Board for Professional Teaching Standards
NCE	Normal Curved Equivalent
NCES	National Center for Educational Statistics

NCLB	No Child Left Behind Act
NCTAF	National Commission on Teaching and America's Future
NCTM	National Council of Teachers of Mathematics
NEA	National Education Association
NELS88	National Education Longitudinal Study of 1988
NRT	Norm-Referenced Test
PISA	Program for International Student Assessment
SASS	Schools and Staffing Survey
SAT I	Scholastic Aptitude Test (formally known as)
SSS	Florida Sunshine State Standards
TFS	Teacher Follow-up Survey
TIMMS	Trends in International Mathematics and Science Study
USDOE	U.S. Department of Education

CHAPTER ONE: INTRODUCTION

Many decisions about educational reform center on the question of how much schools and teachers really matter when it comes to improving student achievement (Weglinsky, 2000). Since *A Nation at Risk* in 1983, which cited poor test performance and a concern for the need for more remedial courses in colleges and businesses, much of the focus of reform has been on school level factors (Marzano, 1996, 1997). This contrasts sharply with an earlier perspective: that regardless of teacher and school level factors, it is the background of students, themselves, which determines how much they are able to learn (Coleman et al., 1966; Jencks et al., 1972).

The landmark study, *Equality of Educational Opportunity,* better known as the "Coleman Report," was put forth by sociologist James Coleman in 1966. He and a team of researchers analyzed data describing attributes of a large number of teachers, schools, and students, and showed that equalizing input factors such as curriculum, teacher quality, and facilities was not the answer: "Schools bring little to bear on a child's achievement that is independent of his background and general social context" (Coleman et al., p. 325). A few years later, distinguished sociologist Christopher Jencks (1972) and a team of researchers from Harvard confirmed Coleman's findings with analysis documented in the influential book, *Inequality: A Reassessment of the Effect of Family and Schooling in America,* which concluded:

> Our research suggests...that the character of a school's output depends largely on a single input, namely the characteristics of the entering children. Everything else—the school budget, its policies, the characteristics of the teachers—is either secondary or completely irrelevant. (p. 255-56)

Since then, Coleman's and other similar works have been scrutinized for not taking into account important factors, including students' prior achievement. Some more recent studies show a broader picture of this function, mainly because of the use of more advanced statistical techniques, and the availability of larger data sets. For example Scheerens and Bosker (1997), in a review of multi-level studies relating to teacher quality and student achievement, found differences in student achievement are associated with school (20%) and classroom or teacher factors (20%), with the remaining difference (60%) at the student level (including socioeconomic status and prior achievement). Other powerful value-added models (Jordan, Mendor, & Weerasinghe, 1997; Sanders & Rivers, 1996), that track students' gains over more than one year, have brought about a rethinking among researchers regarding the relative importance of the role of the teacher. Sanders and Rivers' (1996) ground-breaking Tennessee value-added study showed that fifth-grade mathematics students matched in performance assigned to ineffective teachers for three years performed dramatically worse (separated by 50 percentile points on comparable assessments) than children assigned to more effective teachers. Similarly, Jordan et al. (1997), who isolated the effects of Texas teachers on student achievement, found differences of 34 percentile points in reading and 49 percentile points in mathematics achievement, when comparing students assigned to ineffective teachers for three consecutive years to students assigned to three years with effective teachers (defined by how much their students improved).

Now, with the mandates and philosophies of the *No Child Left Behind Act* (NCLB), much of what is driving educational reform centers on the premise that teachers matter. For example, by the end of the 2005-06 school year, states were required, for the first time, to have data-collection and reporting mechanisms in place to ensure the ability to publish reports disclosing whether they meet the goal of ensuring all teachers are "highly qualified." Meeting these standards basically means that teachers must 1) hold an acceptable bachelor's or higher degree, 2) have state licensure or certification, and 3) demonstrate subject competency of the subject(s) and grade level(s) taught.

Attaining this goal of assurance—that all teachers are highly qualified—has and will continue to be difficult for schools already challenged with high-teacher attrition rates and an ongoing short supply of qualified teachers. The U.S. Department of Education (USDOE), Office of Policy Planning and Innovation (2003), estimates that during the 1999-2000 school year, about half of the nation's secondary core-subject teachers would have fallen short of the government's basic definition of highly qualified. Research has shown this need for qualified teachers is particularly great in lower-performing schools with higher numbers of low-income and minority students (Allen, 2005; Betts, Rueben, & Danenberg, 2000; Hanushek, Kain, & Rivkin, 2004; Lankford, Loeb, & Wyckoff, 2002; Sanders & Rivers, 1996; Schields et al, 2003; U.S. DOE, Office of Postsecondary Education, 2005); and the problem is even more pronounced in middle schools (Jerald & Ingersoll, 2002). The Government Accounting Office (GAO, 2003) projects 20% of middle schools will have a difficult time meeting NCLB provisions for "highly qualified" teachers.

Evidence is mounting that better teachers can and do make a difference in student achievement (Allen, 2003; Haycock, 1998; Jordan et al., 1997; Rivkin, Hanusheck, & Kain, 2005; Sanders, 2004; Sanders & Rivers, 1996). Still, substantial disagreement exists among researchers as to which teacher qualifications make a difference (Greenberg, Rhodes, Ye, & Stancavage, 2004), and little has been explored on this topic specific to the middle school classroom. For example, Jennifer King Rice (2003) found a serious gap in the knowledge base that still needs to be explored regarding middle school (and elementary) teachers' effectiveness that is used to guide important teacher policy decisions. Her award-winning review of a wide range of empirical studies, titled *Teacher Quality: Understanding the Effectiveness of Teacher Attributes*, examines the impact of teacher characteristics on teacher effectiveness.

Weglinsky's (2002) research explored the link between teacher quality and eighth-grade students' mathematics achievement, using data from the 1996 National Assessment of Educational Progress (NAEP) which measures American students' current performance and trends over time in key subject areas. The study found that the effects of classroom practices, when added to those of other teacher characteristics, are comparable in size to those of student backgrounds, suggesting that teachers can contribute as much to student learning as the students themselves.

This study took place in a large urban district in Florida, where in response to NCLB, the characteristics that constitute a highly qualified teacher have been defined; and it is now a requirement, as of the end of the 2005-06 school year, that all teachers who teach core academic areas be highly qualified. Core subjects in Florida include English, reading, language arts, math, science, foreign languages, civics, government, economics, history, geography and most arts. This research examined competencies and skill sets of middle school mathematics teachers that often distinguish quality teachers, including certification, experience, degree type, and degree level, and how those demographics and others vary for different types of schools. The emphasis was on profiling teachers in a large urban district by describing their basic features and distributions, as well as how middle school mathematics teachers, according to those differences, relate to student mathematics achievement, teacher attrition, and teacher mobility. In addition to describing the workforce, determining whether those critically needed mathematics teachers were distributed equitably among schools and providing insight about their transition patterns, was a central focus of this work.

Purpose of the Study

The over-arching purpose of this study was to examine the *backgrounds and experiences of middle school mathematics teachers and how these aspects of qualifications relate to student achievement, mathematics-teacher mobility, and mathematics-teacher attrition.* The following research questions were explored:

1. How are middle school mathematics teachers, according to four aspects of their qualifications (certification, experience, degree type, and degree level), distributed among different types of schools (considering socio-economic status and student mathematics achievement)?
2. What is the degree to which middle school mathematics teachers, according to certain demographics (teacher certification, experience, degree type, degree level, and school level student mathematics achievement and socio-economic status), are mobile within the school system, leave teaching, or remain teaching at the same school?
3. How do different aspects of middle school mathematics teachers' qualifications (certification, experience, and degree level) relate to student achievement in mathematics at the classroom level, when accounting for students' socio-economic status or past mathematics achievement status?

By profiling a workforce of middle school mathematics teachers in a large urban district, and examining how different teacher characteristics relate to teacher-employment patterns and student achievement, a rich picture emerged. The intent of this analysis was to both gain new insights into understanding the teacher-labor supply, and to add to the existing literature that guides important district, state, and national policy decisions intended to address improvements in this area.

Significance of the Study

In the United States, there are millions of middle and high school students at a significant risk of dropping out of school. This is evident from a recent report, released by the Educational Testing Service (ETS), showing that about a third of our students are leaving high schools without obtaining a diploma (Barton, 2005). The resulting social and economic costs of the low educational attainment of these dropouts are staggering. Most would agree that a) being able to provide an equitable education to all children, and b) preparing teachers well and keeping them, are the best ways to improve student achievement levels. This is true especially in poorer and higher-minority schools, where there is an even more desperate need for high-quality and more-experienced teachers (Fetler, 2001; USDOE, Office of Postsecondary Education, 2005). For example, one report on California teacher preparation (Shields et al., 2003) revealed under-prepared teachers were disproportionately concentrated in schools serving poor, minority, and low-performing students. For the 2002-03 school year, about half of the novice teachers (first or second year) employed at high-poverty schools were under-prepared compared with 30% in low-poverty schools.

Unfortunately, inequities, including how teachers are distributed across schools, are becoming more of a concern within the education system. According to Michael Allen, Commissioner of the States, who participated in talks convened by the Economic Policy Institute, (20 August, 2003), it is no longer just a matter of the kind of buildings or the number of teachers a school employs that is being judged:

> It's really now become a matter of how qualified the teachers are. Are the teachers getting adequate professional training? We've seen that most prominently in New York City, but we also see related concerns and lawsuits in as disparate states as Wyoming, Alabama, Nebraska, and Montana. So it seems like this whole focus on teacher quality is now becoming an entrenched part of everyone's thinking about what needs to happen in order to improve education. (p. 13-14)

High teacher-attrition rates contribute to the paucity of high-quality teachers for *all* schools, and this problem has progressively worsened since the early 1990s. The National Commission on Teaching and America's Future (NCTAF, 2003) showed that in the 1999-2000 school year, a staggering statistic of 24% more teachers left the system than entered it; that it is estimated that almost one-third of all new teachers leave the field in the first three years; and after five years schools about half are gone. Enormous turnover, recently up to about 15% nationwide annually, is the major factor driving the need for new teachers, as compared to about ten years earlier when there was only a 3% difference (NCTAF, 2003, also see Ingersoll, 2001). It is no wonder education is dubbed "the profession that eats its young" (Halford, 1998, p.33).

It is becoming more evident that providing a better picture of which teacher backgrounds and experiences make a difference in employment patterns is important to guiding policy decisions related to improving the teacher workforce. According to Hanushek et al. (2004), "The lack of comprehensive understanding of the determinants of teacher-labor supply is a basic impediment to the development of effective teacher-labor-market policies" (p. 326). Hanusheck is a leading expert on educational policy specializing in the economics and finance of schools. Part of this lack of understanding stems from the need for better data; and unfortunately data that track changes in teacher assignments from school to school, between districts, and between states, are very difficult to find (Allen, 2003, Guarino, Santibanez, Dale, & Brewer, 2004; Voorhees & Barnes, 2003).

This study adds to the existing body of literature that relates to the teacher-labor supply. It is organized into five chapters. This chapter provides an introduction, the research question, and significance of this study. Chapter 2 contains a comprehensive review of the related literature. Chapter 3 addresses the context, subjects, procedures, instrumentation, data analysis, and limitations and Chapter 4 provides details about the data analysis. The final chapter reports the summary of the findings, discussion, recommendations, and conclusions of this study.

CHAPTER TWO: LITERATURE REVIEW

According to a National Center for Educational Statistics (NCES) report, examining the need for additional teachers by using information from several nationwide *Schools and Staffing Surveys* (SASS), each year more than 150,000 public school teachers are hired to meet an ongoing demand to fill teaching positions. Those jobs are created in several ways, including rising student enrollment, meeting new requirements, and teacher attrition caused by retirements and teachers leaving for other reasons. The report estimated that this demand would translate to a need to produce an estimated 2.4 million new and highly qualified public school teachers for the period from 1998-99 to 2008-09 (Hussar, 1999).

This review of literature focuses on characteristics of the teacher-labor supply, and the factors that impact its demand. The first section centers on concerns with teacher employment patterns—where some backgrounds and the dynamics of teacher turnover are provided, along with some discussion on current and projected demand. Attention is brought to both the national level and to the state of Florida, where this study takes place. Next begins a review of research related to middle school students' mathematics achievement. Lastly, because much of what is driving current educational reform centers on the premise that teachers matter, a description of the literature focusing on competencies and skill sets of teachers that often are associated in both policy and practice with "quality teachers," including certification, experience, degree type, and degree level, is provided.

Teacher Employment Patterns

Teacher mobility and attrition can be costly for schools and districts that must recruit and train new teachers year after year. A recent policy brief from the Alliance for Excellent Education (2005) estimates that, nationally, costs of replacing public-school teachers who drop out of the profession prior to retirement costs $2.2 billion a year (using the U.S. Department of Labor's figure that attrition costs an employer 30% of the leaving employee's salary). Furthermore, the policy brief projected costs of replacing teachers who transfer at an additional $2.5 billion. Another cost often pointed out by researchers is the value foregone by students who miss an opportunity to be taught by a well-qualified and experienced teacher. Understanding the dynamics of teachers—described as *movers, leavers,* and *stayers*—is important for making teacher-policy decisions affecting teacher quality and the institutional stability of schools.

The National Council of Education Statistics (NCES) revealed that, in the 1999-2000 school year: a) fully 17% of teachers were new hires, and about half of those had transferred (*movers*) between schools; b) the same percent of new hires worked in both low- and high-poverty schools; c) most movers involved beginning teachers with three or fewer years' experience, and; d) teachers in high-poverty schools were twice as apt to move as teachers in low-poverty schools (10% versus 5%) (Provasnik & Dorfman, 2005). Other research tracking patterns of movers has found that teachers often move to schools with fewer minority students (Carroll, Reichardt, & Guarino, 2000; Scafidi, Sjoquist, & Stinebrickner, 2002). Educational researcher Richard Ingersoll, who specializes in measuring teacher qualifications and distribution, conducted an analysis of results from the NCES Schools and Staffing Survey (SASS) and its supplement, the *Teacher Follow-up Survey* (TFS). The data, from a large representative sample of 6,733 teachers, revealed that roughly half of total teacher turnover is due to migrants who move to other schools (2001). As a result of the findings, Ingersoll suggested that since movers do not decrease the overall supply of teachers, they do not contribute to the overall problem of staffing schools.

Not all researchers agree with Ingersoll's lack of concern for movers. Though Provasnik and Dorfman (2005) could not trace from available NCES data where movers went—or whether transition rates were higher for teachers whose students performed worse academically—they highlighted this concern and pointed to another study, by Hanushek, Kain, and Rivkin (2004). Those researchers described statewide Texas public school and district enrollment patterns of 375,000 teachers, where more than 6% of teachers moved between schools each year, 5% moved between districts, and 7% left altogether (Hanushek et al., 2004; see also Hanushek et al., 2004b). Additionally, they also found that teachers who switched between schools tended to move to schools with higher-test scores and smaller percentages of poor students, and confirmed the difficulties that schools serving academically disadvantaged students have with retaining teachers, especially novice teachers (Hanushek et al., 2004). More recent work by Hanushek, Kain, O'Brien and Rivkin (2005), examining the distribution of teacher quality in a large urban district, showed transition rates higher for less-experienced teachers. It was also revealed that teachers who switched schools had the lowest achievement in their classes compared to movers between districts, and teachers who left Texas schools altogether.

For research on leavers, it was found that there is a growing body of evidence indicating that attrition is higher for those with little initial preparation (Darling-Hammond & Sykes, 2003). For example, analysis of SASS data for 1999-2000 showed that there were large differences in teachers' *plans to stay in teaching* between first-year teachers (who felt well prepared) versus first-year teachers (who felt poorly prepared). For actual attrition, TFS results showed that teachers who had training in certain aspects of teaching—for example, training in child psychology and learning theory, practice-teaching experience, and training in how to select instructional materials—were half as likely to leave the profession as teachers who did not receive that initial preparation (NCTAF, 2003). Furthermore, another report, which continues to follow 1992-1993 college graduates' progress through the teacher pipeline, revealed that uncertified teachers were three times more likely to leave (49%) than certified entrants (14%) (Henke et al., 2000). Other research showed novice teachers much more likely to quit than their experienced counterparts (Ingersoll, 2003); and attrition about 50% higher in poorer schools than in wealthy ones (NCTAF, 2003).

A Florida Department of Education (FLDOE, 2004) report on enrollment provided information about its workforce, and the challenges related to finding teachers to fill school classrooms through the 2020 school year. Enrollment projections showed it is likely that over the next decade (from 2004), the state will face a 26% increase of 213,600 teachers needed to fill Florida classroom positions—nearly one-and-a half the size of the number of all teachers employed in 2002 alone. Growth over the past decade had shown similar increases of 33%. Figure 1 displays the trend of teachers needed to fill positions from 1994 projected to 2020.

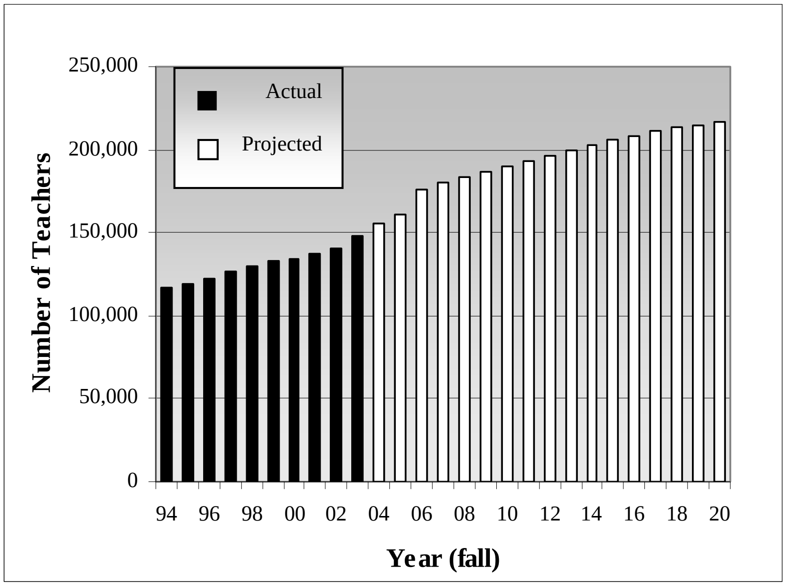

Figure 1. *The Trend of Actual and Projected Florida Classroom Teachers Needed to Fill Positions by School Year (1994-2020).*

Note. Adapted from "Projected Number of Teachers Needed Florida Public Schools," Florida Department of Education (2004).

Meeting the critical need for hiring these additional teachers is not likely to be met, especially by Florida's public and private colleges and universities, which produce only about 6,000 teacher candidates annually—a figure not likely to grow substantially. Even worse, with regard to meeting the need for new mathematics teachers, only about 2% of teacher-education graduates have majored in mathematics education historically (FLDOE, 2003a).

As in many other states, Florida has high rates of teacher turnover. Enrollment reports revealed that only 60.5% of teachers remained for ten years in Florida classrooms during the fall of 1992—an attrition rate of 39.5% (FLDOE, 2004). By both the 2002-03 and 2003-04 school years, one in every ten teachers left the classroom—more leavers than ever before (FLDOE, 2005a). According to another report on Florida Teacher Retention (FLDOE, 2003b), although some of these teachers do transfer to other districts within Florida, that figure is only about 1%

each year. It is no wonder that reducing turnover rates is a vital component of Florida's strategy to enlarge the supply of qualified teachers.

In order to understand the importance of the teacher-labor supply, one needs an adequate understanding of the facets of its demand. The following three sections of this literature review briefly describe the projected number of total classroom positions open(ed), which can be categorized by components such as: a) estimated teachers needed due to *terminations* caused either by resignation short of retirement or an aging-teaching workforce; b) estimated teachers needed due to *enrollment growth*; or c) estimated teachers needed due to *classroom-size adjustments*.

Figure 2 illustrates those components of actual and projected Florida classroom teachers needed to fill positions (2004-20). Clearly, Florida's school staffing problem, for the most part, is due to the growing number of teachers needed to replace those resigning year after year. For example, using this data, it is estimated that after 2006 (projected to 2020), an average number of 86% of the new hires will be replacing resigning teachers. In 2006-07, a spike in projections occurs when new legislation regarding class-size-average requirements were first applied at the school level. This is explained further under the subheading *Enrollment Growth* later in this section.

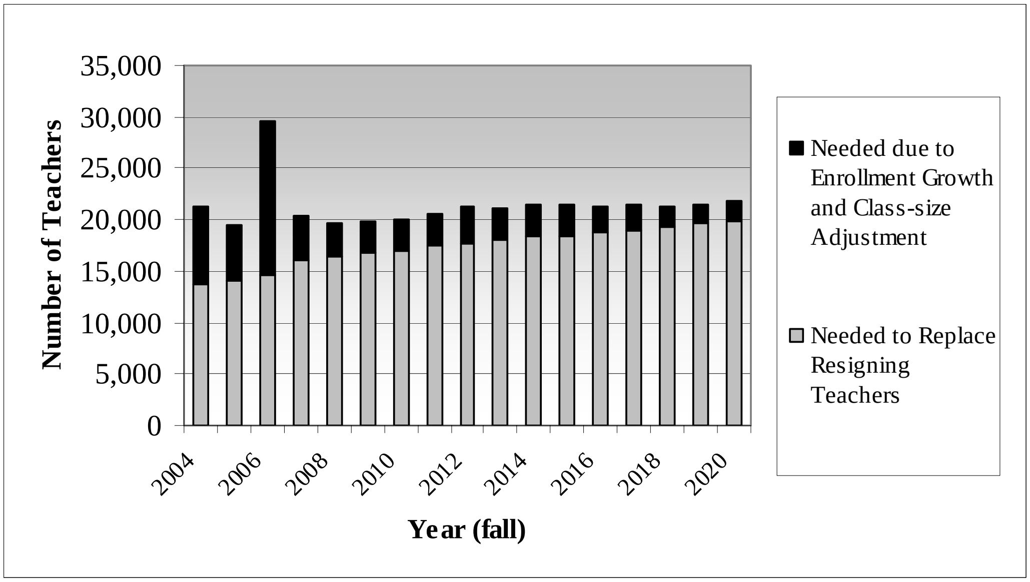

Figure 2. *The Components of Actual and Projected Florida Classroom Teachers Needed to Fill Positions by School Year (2004-20).*

Note. Adapted from "Projected Number of Teachers Needed Florida Public Schools," Florida Department of Education (2004).

Terminations

The inability of schools to adequately staff classrooms with qualified teachers, according to Ingersoll (2001a, 2001b, 2001c), who has done extensive research on teacher shortages and underqualified teachers, is mostly due to the excess demand which results from a *revolving door,* whereby teachers quit for reasons such as job dissatisfaction and a desire to pursue other careers.

To investigate *why* teachers were dissatisfied at the national level, Provasnik and Dorfman (2005), analyzed results from two surveys, including the 1999-2000 SASS and the related 2000-01 Teacher Follow-Up Survey (TFS). While the 1999-2000 SASS was administered to a nationally representative sample of more than 50,000 teachers about their work environment, classroom teaching, teaching qualifications, and other individual characteristics, the TFS was administered to a representative sample of about 5,000 teachers. The questionnaire was comprised of follow-up questions about job changes over the previous year. Participants included both teachers who continued teaching the year after completing the *Schools and Staffing Survey* (SASS), and those who left the profession. To determine what factors influenced those to leave teaching, the top five reasons for teachers' dissatisfaction were a lack of planning time (60%), too many students in a class (48%), salary was too low (48%), too much work (44%), and problems with student behavior (44%). Ingersoll's (2001c) analysis of data from the 1991-92 TFS—after he controlled for the characteristics of both teachers and schools—linked with data from the 1990-91 SASS teachers and administrator questionnaires, showed low salaries, problems with student discipline, inadequate support from school administration, and a limited ability of faculty to provide input into school decision making. Another earlier study, by Berry, Noblit, and Hare (1985), who interviewed 180 administrators and school principals, revealed the primary reasons for teacher dissatisfaction to be handling disadvantaged students and discipline problems.

Another important finding about teacher turnover, relevant to the current study, was that the number of movers and leavers who pass through the *revolving door* vary greatly among different kinds of teachers and schools. One study, for example, found middle school teaching assignments to be less desirable than those in the higher grades (Carter & Carter, 2000). Others show strong evidence that middle and high school teachers are more likely to leave their jobs than elementary teachers (Allen, 2005), and that turnover is strongly influenced by academic field—specifically with special education, mathematics, and science teachers having the highest degrees of turnover (for examples see Boe, Bobbitt, Cook, Whitener, &Weber; 1997; Grissmer & Kirby, 1992; and Murnane, Singer, Willett, Kemple, & Olsen, 1991).

In the state of Florida, by the end of the 2002-03 school year, 10% of the teacher labor supply (13,751 classroom teachers) left classrooms—more than any previous year. See Figure 3 and Table 1 which both display percentages of teacher terminations over time (1997-2002). This is somewhat higher than the percent of teachers who left classrooms nationwide, which is also increasing, up from 6% in 1987-1988 to 8% in 1999-2000 (Provasnik & Dorfman, 2005).

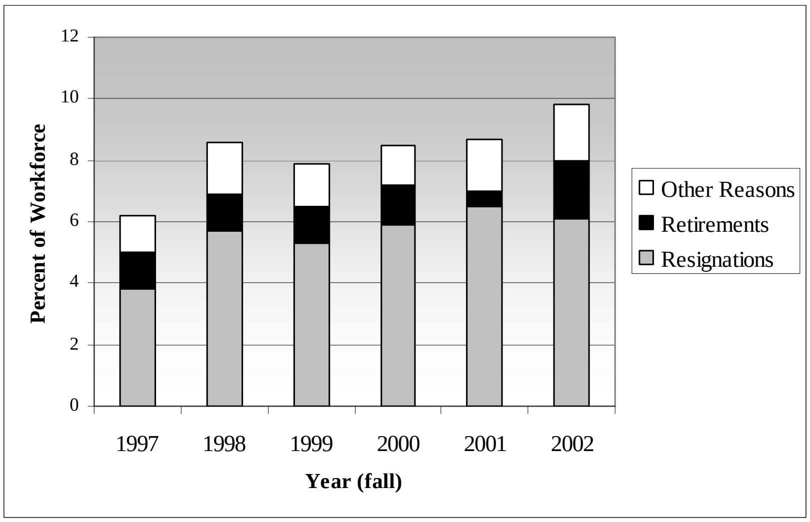

Figure 3. *Teacher Terminations as a Percent of the Teacher Workforce—Florida Public Schools (1997-2002).*

Note. Adapted from "Projected Number of Teachers Needed Florida Public Schools," Florida Department of Education (2004).

Table 1.

Florida Public School Teacher Terminations as a Percent of the Teacher Workforce (1997-2002)

	1997	1998	1999	2000	2001	2002
Resignations	3.8	5.7	5.3	5.9	6.5	6.1
Retirements	1.2	1.2	1.2	1.3	0.5	1.9
Other Reasons	1.2	1.7	1.4	1.3	1.7	1.8
Total	6.2	8.6	7.9	8.5	8.7	9.8

Note. Adapted from "Projected Number of Teachers Needed Florida Public Schools," Florida Department of Education (2004).

The Florida Department of Education attributes a substantial portion of those terminations to retirement, a problem apt to continue as projections show it is “likely that teacher retirements will reach unprecedented heights in the decade following 2006” (Florida DOE, 2004 p. 2). Unfortunately, at the same time Florida is struggling because of an aging teacher workforce, more teachers are resigning for other reasons.

The Office of Economic and Demographic Research (EDR), whose primary mission is to provide the Florida Legislature with an independent forecasting capability, performed an investigation into why Florida teachers resign. In the spring of 2000, surveys were mailed to over 10,000 individuals holding current certification(s) in the critical shortage areas of mathematics, computer science, science, exceptional education, or foreign language who no longer taught in Florida schools. One of the most revealing questions on the *Survey Sent to Former Teachers* (Office of Economic and Demographic Research, 2000) asked, “What was your main reason for leaving the teaching profession?” Teachers chose from 10 reasons, including an “other family or personal” category. The most common reason chosen was pregnancy or child rearing (29%). Other common responses included leaving for a better salary or benefits (14%), retirement (10%), and many reported being dissatisfied with teaching as a career (20%). Overall, almost half of the leavers reported that they quit because of factors related to the teaching profession rather than for personal reasons. The same teachers were asked to mark up to five out of eighteen items that would encourage them to return to teaching. The item most marked was “increased pay” (72%). Many teachers chose “smaller class size” (63%), “fewer disruptive students” (53%), “less paperwork” (42%), and “more support from school administration” (35%).

Enrollment Growth

The problem of filling classrooms with skilled teachers, is exacerbated by a growth in overall enrollment, which will likely continue until at least 2014 at the national level, according to the *2004 NCES Digest of Educational Statistics* (USDOE NCES, 2004). Another NCES report, released in September 2005, showed school enrollment nationwide reached an all-time high in 2002 at 55 million, a 19% increase since 1989 (Hussar, 2005). Historically, enrollment in public K-12 schools grew quickly during the 1950s and 1960s, and peaked in 1971 at 51 million because of the "baby boom." After 1971, as displayed in Figure 4, it dropped until 1984 to 45 million, and then began to rise again, reaching new highs every year over the last decade since 1996. Total public K-12 enrollment is now at an estimated 55 million (Hussar, 2005). This enrollment increase is expected to continue until 2004, with grades 9-12 rising through 2007 and then declining slightly.

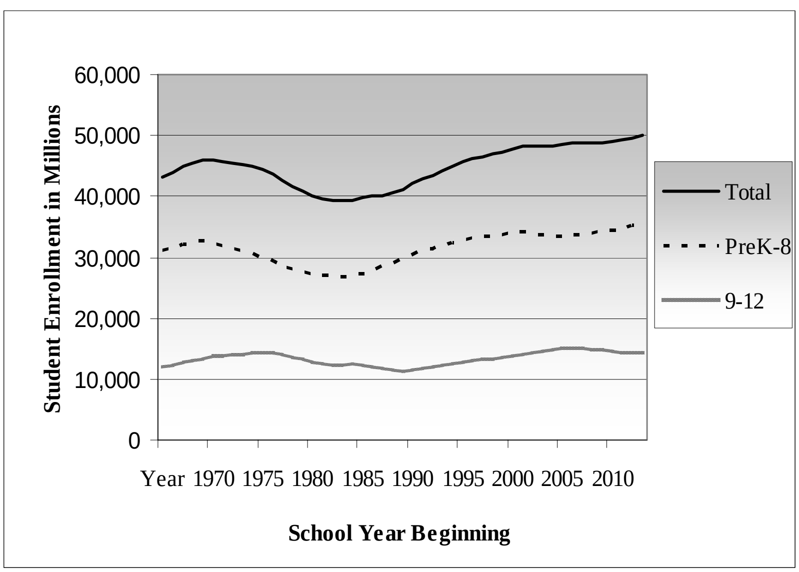

Figure 4. *U.S. Public Elementary and Secondary Teacher Enrollment (1965 to 2020).*

Note. Data from 2002 on are estimates. Adapted from "Digest of Education Statistics, 2004" U.S. Department of Education, National Center for Education Statistics (2004). (NCES 2006 005.) Washington, DC: U.S. Department of Education, NCES.

The enrollment trend in Florida is similar. According to the U.S. Census Bureau American Fact Finder (revised 2005), data show Florida ranked third out of the nation's fastest-growing states and—along with Texas and California combined—accounted for 42% of the nation's population increase from 2002 to 2003. Yet, while the rate of Florida school-enrollment growth has continually increased, from 2.6% to 3.6% each school year from 1985 to 1996, that rate of increase is beginning to slow down. Projections show enrollment will continue to increase but eventually to less than 1% in 2019-20 (FLDOE, 2004). Another concern, which heightens with Florida's growth in enrollment, is this: as the need for additional classrooms develops, the projected need for teachers will continue to vary across different subjects and grade levels, causing even larger demands for teachers to teach in subject areas of critical need. For example, it is estimated that the largest growth will be in elementary and core subjects because, within five years, about 84% of the current workforce will need to be replaced for mathematics, language arts, science, elementary and foreign languages classrooms, 75% to 83% for social studies and reading, and 67% for exceptional student education (FLDOE, 2004).

Class-Size Adjustments

Large-scale adjustments in class size can further exacerbate teacher shortages. In Florida, the 2002 *Class Size Reduction Amendment* was made to the State Constitution. This amendment, highly debated and passed by a margin of just 52 to 48 percent by Florida voters, requires the state to provide funds sufficient to lower the average number of students per core-curricula classroom, by the 2010-11 school year, to a maximum of 18 students per teacher for pre-kindergarten through third grade, 22 students for grades 4-8, and a maximum of 25 students for grades 9-12. As displayed in the previous section (see Figure 2), in the fall of 2006 when class-size average requirements will first be applied at the school level, meeting the challenge of finding enough teachers will be especially difficult. That year the estimated number of additional teachers needed (due to terminations, enrollment growth, and class-size adjustments) is predicted to grow to 29,604—a 51% increase from the 19,559 needed the year before. Although the economically disadvantaged students and younger children who tend to achieve better when class sizes are reduced will likely benefit (certainly a goal of the amendment), many will be looking to Florida over the next few years to see what happens as a result of this new legislation.

In California, across-the-board class-size reductions, implemented more quickly than those now being undergone in Florida, contributed severely to teacher shortages and appeared to have led to a decline in teacher quality for economically disadvantaged and minority students. This was studied by Jepsen and Rivkin (2002), who found that a creation of jobs in middle-class communities moved experienced teachers out of the lower-SES schools. These researchers recommended that when manipulating class size in an effort to positively affect student achievement, smaller ratios should be targeted carefully, and directed more towards disadvantaged children who would benefit the most. The concern again is—at least in the short term—that the supply of good quality teachers is not so elastic as to avoid the potential tradeoff between teacher quality and class size, especially in poorer schools. (Rivkin et al., 2005).

For an example of how class size affects students' achievement according to grade level, see Rivkin, Hanushek, and Kain's more recent work. They studied the impact of schools and teachers in influencing student achievement, also using data from Texas schools. Those results revealed statistically significant effects of class size on both fourth and fifth grade mathematics and reading-achievement gains; rather small effects for sixth grade; and little systematic effect on seventh grade achievement (Rivkin et al., 2005). Although most research shows that class-size reduction increases student achievement in the lower grades, Rice (1999), in her study of the impact of class size on instructional strategies and the use of time in high school mathematics and science courses, found high school mathematics teachers engaged with individual students and small groups more often when class sizes were smaller. Furthermore, researchers and others who guide educational policy decisions have emphasized that teachers, students, and parents all report positive effects on the quality of classroom activities (see for example Greenwald, Hedges, & Laine, 1996; and NCTAF, 1996, 2003).

Student Mathematics Achievement

During World War II, in the midst of the largest and deadliest war of all history, it was realized that the United States needed to increase the mathematical and technical skills of students if they were going to be successful in competing in the development of new technologies. Then with the launch of Sputnik in 1957, even more heightened concerns led to the passing of the *National Defense Education Act,* which provided funding to improve mathematics and science education through the National Science Foundation (NSF). In 1983 the report *A Nation at Risk* recommended higher academic standards, better teacher preparation, and greater accountability of schools, among other ways of improving student achievement (National Commission on Excellence in Education, 1984). Yet, even with increased efforts and actions to improve education, in 2000, another national commission concluded that U.S. students were still behind their peers in other countries (National Commission on Mathematics and Science Teaching for the 21st Century, 2000).

Measuring student progress is essential to ensuring that children receive a quality education and the *act* has been around long before the passing of NCLB. Teachers have, of course, been measuring the progress of their students all along, but it was not until 1963 that the idea of measuring student achievement at the national level was realized. That was when Francis Keppel, U.S. Commissioner of Education first formally decided to collect a higher level of detailed information on the state of the nation's schools and appoint a committee to investigate options to assess the condition and progress of education (Pellegrino, Jones, & Mitchell, 1998). Those committee members soon agreed that there was a strong need for a system supporting information to better aid public officials to make decisions about education; and by 1966 it was determined, that a set of instruments be developed to periodically assess how well students were doing nationally. Soon after that, *The National Assessment of Educational Progress* (NAEP) was founded.

Congress authorized NAEP—commonly known as *The Nations Report Card*, beginning in 1969; to periodically administer a set of exams on different subjects to a sample of students across the country, maintain the data, and monitor the nation's progress with regards to education (USDOE NCES, 1974). Beginning in 1988, Congress created the *National Assessment Governing Board* (NAGB) to oversee and set NAEP policy. This 26-member Governing Board, works independent of the U.S. Department of Education, and is responsible for developing the framework for testing. Currently, no measure of students' academic achievement is more widely respected or consulted in the United States than NAEP, which continues as a project of NCES, within the *Institute of Education Sciences* of the U.S. Department of Education.

NAEP tests continue to be administered periodically to a nationally representative sample of public and private students' with the goal to objectively assess their progress in mathematics, reading, science, writing, U.S. history, civics, geography and the arts. For example, students from over 17,600 schools participated in the 2005 mathematics assessment, with about 172,000 fourth graders, 162,000 eighth graders, and 6,000 twelfth graders participating. Those particular results (for fourth and eighth graders) were reported at both the state and national level recently (Perie, Grigg, & Dion, 2005). Every two years, mathematics and reading are assessed at both the national level (grades four, eight, and twelve) and the state level (grades four and eight) and the other subjects are assessed periodically.

Over the last three decades, the importance of standardized assessments continues to increase with new legislation—for example, with the *Secondary School Improvements Amendments* of 1988, and also with the passage of NCLB. According to one report, generally 40 to 45 states had elected to participate in state NAEP, but beginning in 2003 with NCLB, *all* states and school districts receiving Title I money were required to participate in the biennial NAEP reading and mathematics assessments for fourth and eighth graders (USDOE NCES, 2005b).

Mathematics Achievement at the State and National Level

The most recent results (USDOE, NCES, n.d.) show improvement for the nation and for a majority of states, including Florida, and also for many student groups. Selected results are presented in Table 2.

Table 2.

NAEP Average Mathematics Scale Scores and Percentages of Students within each Achievement Level, Grades 4 and 8: At the National and/or State Level

		Scale Score Average[b]		Achievement Level Percent at or Above, Florida		
Grade	Year	National	Florida	Basic	Proficient	Advanced
Fourth[a]	1990	212				
	1992	219	214	51	13	1
	1996	222	216	55	15	1
	2003	234	234	76	31	4
	2005	237	239	82	37	5
Eighth	1990	263	255	43	12	1
	1992	268	260	49	15	1
	1996	272	264	54	17	2
	2003	278	271	62	23	4
	2005	279	274	65	26	5

Note. [a]Some scores were not available for Florida for 1990. [b]Scale scores range from 0 to 500.
Source: U.S. Department of Education, Institute of Educational Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2005 Mathematics Assessment.

According to NAEP results on mathematics (USDOE, NCES, n.d.), on a scale from zero to 500, at the national level for public schools—fourth and eighth graders improved and averaged three and one point higher in 2005 than two years prior (respectively). Average scores increased since 1990 by 25 points in fourth grade and 16 points for grade eight. Achievement levels continued to increase, at the national level with the percent of students achieving “proficient or above” at 35% for fourth and 28% for eighth in 2005 (for Florida it was 37% and 26%). At the state level, grade four average scores increased in 31 states, and for grade eight they increased in seven states, both from 2003 to 2005. Since the current study uses FCAT test results as a measure of student achievement, it should be mentioned that those results indicate a higher number of students on-or-above grade level in mathematics at 64% for fourth and 59% for 2005.

Other indicators also show improvements at the national level. The SAT I, formerly known as the *Scholastic Aptitude Test*, is a general test of verbal and quantitative reasoning accepted for U.S. college admissions. Those results also show students are continuing to make gains in mathematics over time. For example, for the class of 2005, the average mathematics scores were reported at an all-time high and gains are attributed to the fact that more students are taking demanding courses. Since 1995, there has been an 11% increase in the number of students taking pre-calculus and a 5% increase in students taking calculus and physics (College Board, 2005).

Gaps in Achievement

It is generally thought that students from poor backgrounds—who often live in poorer neighborhoods—are more likely to attend schools where the curriculum is weak; and that by the time they get to middle school they are tracked into lower-level classes than their peers. It is commonly agreed that there are indeed many factors both within and outside the control of the educational system that can have an impact on the degree to which a child achieves. For example, numerous studies have demonstrated the effect of the self-fulfilling prophecy that when students are expected to perform well or badly, they do [American Educational Research Association (AERA), 2004]; and the need for peer approval has also been found to play a role in student achievement (Fetler, 2001; Steinberg, 1996).

Other research identifies that a variety of factors can hinder academic achievement before children even enter school. For example, Hart and Risley (2003) showed from their study of 42

Kansas families, that children of upper-class families, by age four, had vocabularies twice as large as those of welfare children and 50% larger than children whose parents were middle class.

While overall improvements continue to be made at the national level, there still remain achievement gaps between certain demographic groups. This gap, even though there have been improvements in some recent years, shows there continues to remain an unsettling phenomenon—that children in some demographic groups continue to score lower than others on standardized tests. This was found from NAEP reports which reveal average-score gaps continue to remain between selected groups including gender, ethnicity, levels of poverty, and by how well they have scored on previous tests.

According to NCES State Profile reports (USDOE NCES, n.d.), for the state of Florida, data indicate that for 2005—similar for all states combined—most of the measured gaps in achievement had not improved over the previous fifteen year period. For example, comparing 1990 to 2005, males continued to outperformed females slightly and at the same rate; and the gaps between whites and blacks and between whites and Hispanics narrowed slightly. For students qualifying for free or reduced priced lunch (a measure of poverty) the gap was also reduced but only slightly, and gaps between students in the 75th percentile and those in the 25th percentile remained constant for both 2005 and 1990.

An International Perspective of Students' Mathematics Achievement

Turning to the international level with regard to measuring students' mathematics achievement, TIMMS represents the continuation of a long series of mathematics and science achievement studies conducted by the *International Association for the Evaluation of*

Educational Achievement. Results from *The Trends in International Mathematics and Science Study* (TIMSS), indicate that U.S. students at grades seven, eight, and twelve, achieve lower, relative to their peers in many countries. The results may also suggest that U.S. mathematics curriculum and instruction are not as challenging as they should be (Silver, 1998; see also Ginsburg, Cooke, Leinwand, Noell, & Pollock, 2005).

Recent results from TIMSS 2003, outlined in the report, *Highlights From the Trends in International Mathematics and Science Study (TIMSS) 2003* (Gonzalez et al., 2003) showed, among other things that—although U.S. eighth graders a) scores exceeded the international average (in 25 out of 44 other participating countries), and b) were outperformed by students in five Asian countries and four European countries—the net effect resulted in a higher-relative standing (from 1995 to 2003). This was not the case with fourth graders who showed no measurable change over the same period whose relative standard was lower.

TIMSS also measures the relative performance of population groups over time. It seems from that perspective, that there was a narrowing of some gaps between 1995 and 2003 for U.S. students. According to the same report (Gonzalez et al., 2003), at the national level for both fourth and eighth grade, the gap narrowed between whites and blacks but not between whites and Hispanics, and boys continued to score higher than girls but both boys and girls improved the same amount.

Another study, published by the *American Institutes for Research*, examined among other things, the mathematics rigor, instructional background factors, and areas within mathematics content, with regard to TIMSS and the *Program for International Student Assessment* (PISA). The report bared that "U.S. students' scores and ranks are uniformly lodged in the bottom half of the distribution on both TIMSS assessments [grades four and eight] and for both the high and low ends of the range in cognitive skills” suggesting that U.S. students need improvements in “both the their ability to apply facts and procedures and their ability to reason through more-complicated multistep problems” (Ginsberg et al., 2005, p. 12). The study also showed that U.S. performance was significantly weakest in the areas of measurement in grades four and eight, and in geometry in grade eight, but scores consistently strongest in the area of data and statistics. In addition, they found that elementary classrooms in the United States spend proportionally less time on geometry in grade eight and consistently more time on data and statistics, especially in earlier grades.

Teacher Characteristics

This section examines the competencies and skill sets of middle school mathematics teachers that often distinguish “quality” teachers, including certification, experience, degree type, and degree level; and how those demographics and others vary for different types of schools (i.e., high versus low percentage of at-risk students). These are the teacher attributes that are most associated in both policy and practice with teacher quality (Greenberg et al., 2004; Rice, 2003; and others).

Certification

The main purpose of teacher certification, or licensure, is to ensure to the public that teachers meet certain standards as determined by the state education system. While state certification offices require existing teachers to continue to meet state certification regulations and renewal requirements, the process of certification should also confirm the quality of teachers' competence in a subject area, teaching skills and methodology, and classroom management potential (Roth & Mastain, 1984). Section 207 in Title II Reports of the Higher Education Act, as amended, requires each state receiving federal funding to report on the quality of teacher preparation annually. For 2004, Title II reports show Florida was one of 43 states that had implemented policy that connected teacher certification to student content standards. Nationally, states reporting showed an average 3.5% of secondary mathematics teachers holding emergency certification waivers compared to just 0.7% in Florida. For teachers from all subject areas on waivers, figures were almost the same for all states (3.6%) compared to Florida (3.5%) (USDOE, Office of Postsecondary Education 2005). These figures are displayed in Table 3.

Table 3.

Number and Percent of Classroom Teachers on Waivers (Nationally and in Florida)

Certification Status	Nationally		Florida	
	Number	Percent	Number	Percent
Classroom teachers of all subjects on waivers	114,626	3.6%	6,926	4.6%
Secondary mathematics teachers holding emergency certification waivers	8,431	3.5%	52	0.7%

Note. Adapted from "Projected Number of Teachers Needed Florida Public Schools," Florida Department of Education (2004).

Note that these waivers have frequently allowed teachers to begin their careers while they continue to track toward meeting professional-certification requirements for subject(s) outside of the field(s) for which they are appropriately trained. For the 2004 data-reporting cycle, the definition of a waiver was aligned with the NCLB provisions for highly qualified teachers to *exclude* "both teachers participating in alternative routes who are considered fully certified for purposes of NCLB, and those teachers who are short- or long-term substitutes (as defined by the state)” (p. 39).

In Florida, certification requirements are met on the basis of (a) an undergraduate or graduate academic major, (b) subject content courses equivalent to a major, (c) a passing score on the appropriate Florida subject-area test, and (d) either a valid standard certificate in the subject area issued by another state, or a valid advanced national certificate in the subject area issued by the *National Board for Professional Teaching Standards* (NBPTS) or *American Board for Certification of Teacher Excellence* (ABCTE). In addition, all K-12 teachers who are not new teachers of core subjects must meet one of the following criteria: 1) passed the appropriate subject area test; 2) had a satisfactory or better performance evaluation in the area assigned; or 3) for middle and secondary teachers only: have a major or equivalent courses in the subject area assigned (Florida DOE, 2005b).

Although most states clearly place a value on certification as a teacher attribute that relates to student achievement, the relationship between these two factors is highly debated in the literature. Grover “Russ" Whitehurst (2002), Assistant Secretary in the Office of Educational Research and Improvement, at a *White House Conference on Preparing Tomorrow’s Teachers*, presented research on teacher quality, and said, “The issue of certification has drawn more heat than light. You would think it would be simple to compare student achievement for certified versus uncertified teachers, but it is not…. The value for certification in general is equivocal at best” (Characteristics of Teachers section, ¶ 19). What we do know is that certification alone does not guarantee that a teacher will be or will remain successful at teaching.

Overall, it is difficult to generalize the effects of certification on student achievement. There are several well-documented reasons. Whitehurst gave four: 1) since teachers without certification are often inexperienced beginners, comparisons are biased by differences in their age and years of experience; 2) alternative-route certification, which allows teachers to bypass some of the coursework of teachers from traditional paths, is frequently confused with certification; 3) issues concerning out-of-field teaching are often confused with certification, e.g., a math teacher teaching reading might be considered out-of-field but can also be considered certified; and 4) difficulties that arise in making comparisons across states and different districts, where requirements for certification and licensure have historically varied. To further complicate disentangling these issues, another reason not mentioned by Whitehurst is a human element. Administrators, whose experiences vary, do not always agree on what kinds of certification really make a difference when it comes to classroom teaching. This could very well influence their hiring practices: for example, where middle schools are defined as grades 6-8, the decision of whether to hire an elementary (K-6) certified teacher to teach mathematics in a sixth-grade classroom rather than a mathematics (5-9) content certified teacher. Administrators often make this choice in Florida 6-8 schools, because elementary-certified teachers are "in-field" for all K-6 subject areas; therefore, they are versatile employees in a position where attrition and growth often affect demand for specific kinds of teachers.

Because there are several controversies related to certification, the subsets described below were created to describe the literature, including *Alternative-Routes to Certification*, *Level of Certification,* and *Subject-Area Certification*.

Alternative Routes to Certification

By 2004, 43 states plus the District of Columbia reported having some type of alternative route for certifying teachers (U.S. DOE, Office of Innovation and Improvement, 2004) with 1,323 state-approved programs in the United States (National Association of State Directors of Teacher Education and Certification, 2004). *Alternative-route certification*, for the purposes of this paper, is defined as any certification earned through a program that is not a university state-approved teacher education program for middle school mathematics teachers. This includes temporary certification where teachers may be teaching out-of-field while they complete training to qualify for a Professional Certificate.

Alternative-route certification is characterized as a *method* rather than a specific type of certification one would earn. For example, mathematics (5-9) certification could be considered alternative-route certification if it has been earned by an individual without a background in mathematics or mathematics education. The fact that many of these teachers are highly qualified and have already earned their certification in the subject they teach is precisely why it is so difficult for researchers to distinguish them. Furthermore, districts and states do not ordinarily house data on degree types or career backgrounds that can be tied to specific teachers who have been hired.

The route to obtaining alternative certification is an auxiliary and well-beaten path taken mostly by those who want to pursue a career in teaching and who do not come from education backgrounds. Most of these individuals would not have become teachers if they had been required to take a more traditional route. One survey, conducted by the *National Center for Educational Information*, showed that about 35,000 individuals entered teaching through alternative routes in the prior year. The survey showed less than one in four (22%) respondents would have gone back to college to get a teaching certificate; just fewer than half (47%) would not have become a teacher if an alternative route was not available; one out of four (25%) were not sure; and others would have found a job in a private school or in a setting in which they did not have to be certified (Feistritzer, 2005). The alternative-route category also includes teachers who were previously certified in other subjects or grade levels, and for whatever reason are switching to jobs to where they are no longer certified; for example a science teacher may be asked to teach mathematics (even for part of a work day).

Alternative-route programs first began as a short-term solution to deal with teacher shortages, and are now an institutionalized alternative to the more traditional teacher education programs (Stoddart & Floden, 1995; U.S. DOE, Office of Innovation and Improvement, 2004). Several studies showed that individuals from this pool of potential teachers are not only valued for their subject-area knowledge, but can bring with them positive dispositions and real-world experiences that may help them relate to even the most challenging students (Eifler & Potthoff, 1998; Haberman, 1991; Stoddart,1993). Still, one of the common questions surrounding the teacher-quality debate is whether teachers from these alternative routes are prepared well enough to teach effectively. Rice (2003), in her empirical review, specified "[S]tudies have shown little clear impact (either positive or negative) of emergency or alternative-route certification teachers on student performance in mathematics and science relative to teachers acquiring certification through standard channels" (p.33). The question is frequently being investigated as these alternative-route programs continue to be developed.

Goldhaber and Brewer (2000), who analyzed base-line data collected in 1988 for the National Educational Longitudinal Study (NELS88 data) to examine the relationship of high school mathematics-gain scores and teacher certification, revealed that although students of teachers certified in mathematics did better than teachers who were not, whether or not a teacher had emergency certification in subjects made no difference in high school mathematics achievement. Other researchers found that students of teachers prepared in an alternative-certification program in Houston achieved as well as those taught by other teachers, but the research did not control for students' prior test scores or teachers' experience (Goebel, Ronacher, & Sanchez, 1989). Lutz and Hutton (1989), in their evaluation of the Dallas Independent School District's alternative-certification program, found that principals scored those teachers either the same or higher than other teachers on a measure of teacher performance. Similarly, in another evaluation, Florida teachers participating in the state's alternative-certification program were shown to perform similar to (71%) or better than (28%) other first-year teachers, with very few (less than 2%) performing worse (Milton, Rollin, Shin, Nilles, & Hodgins, 2003). Other researchers found no difference in *National Teacher Exam* results between North Carolina alternatively certified teachers enrolled in their program and other more traditionally prepared teachers (Hawk & Schmidt, 1989). The Georgia alternative-certification program participants were also successful (Guyton, 1991). For an overview of several successful alternative-route programs see the report *Innovations in Education: Alternative Routes to Teacher Education* (USDOE, Office of Innovation and Improvement, 2004).

In response to increasing attention to the issues of teacher attrition, teacher quality, and *NCLB*, the number of alternative-route programs, such as Florida's alternative-certification program (see FLDOE, n.d.), are increasing rapidly as a way to attract and support new teachers. Feistritzer and Chester (1991) indicate that, during the period between 1985 and 1990, more than 200,000 teachers were licensed nationwide through alternative-certification programs. These programs attract qualified and experienced individuals to the profession, especially in subject areas where critical shortages exist (Lutz & Hutton, 1989). There are many differences among these programs, and education requirements for teachers from alternative routes can vary widely from state to state. For example, Feistritzer's (1990) report, *Alternative Teacher Certification: A State-by-State Analysis* (as cited in Darling-Hammond, Berry, & Thorenson, 2000) showed coursework required beyond a liberal arts degree has varied from 45 credit hours for a master's degree in Alabama and Maryland, as compared to just nine hours required in Virginia.

Alternative-route programs are likely to continue due to a number of factors, including the relatively low cost, and the continuing high demand for teachers (Hawley, 1990). The state of Florida, like many others across the country, has a large number of teachers coming from alternative routes. According to a report presented at the meeting of the Board of Governors of the State University System of Florida (2005, September 15), of the 20,521 first-time certificates issued in Florida during the 2002-03 school year, only 23% came from approved Florida university-based teacher education programs. That figure is not likely to increase anytime soon based on recent trends (Florida DOE, 2003b). Another 14% came from Florida teacher-education programs (not approved), 20% through reciprocity agreements, and a total of 43% or 8,813 teachers had other alternative-route certification. A chart of initial certification routes of Florida public school teachers is displayed in Figure 5.

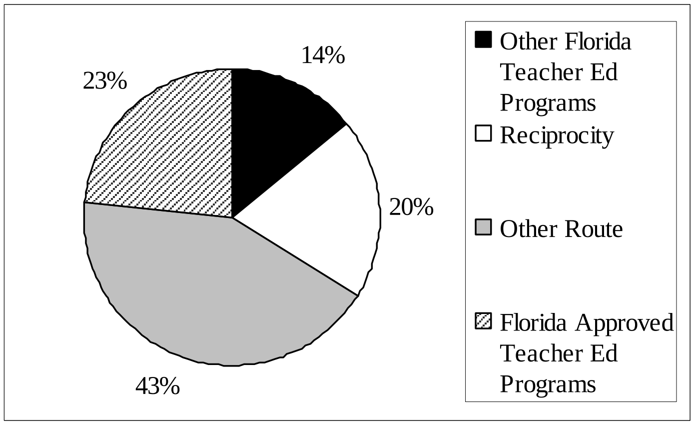

Figure 5. *Initial Certification Routes in Florida Public Schools (2003-04)*

Note. Adapted from a *Teacher Shortage Crisis,* a report presented at the meeting of the Board of Governors of the State University System of Florida (2005, September 15).

For Florida, where mathematics has been defined as a critical shortage area, finding enough certified teachers has been a problem historically. For example, according to an evaluation report on Critical Teacher Shortage Areas (FLDOE, 2005a) in the fall of 2004, fully 12% of the newly hired mathematics teachers did not hold an in-field certificate. The same year the proportion of new-hires not certified in the appropriate field for all classroom teaching positions across the state was down to 10.7% from 15.8% two years before (from 2002) due in large part from actions taken as a result of *No Child Left Behind*. See Table 4.

Table 4.

Percentage of New Hires Not Certified in the Appropriate Field in Florida Public Schools

	1996	1998	2000	2002	2004
Basic Fields	8.4	10.2	10.2	12.3	8.9
Exceptional Student Education	22.2	27.1	30.0	29.9	19.8
Vocational	9.0	11.6	15.3	9.9	10.0
Total Classroom	11.3	13.5	14.2	15.8	10.7

Note. Adapted from “Critical Teacher Shortage Areas 2006-2007,” Florida Department of Education (2005a).

Level of Certification

Difficulties arise in making comparisons across geographic locations where requirements for certification have historically varied. For example, as mentioned in the previous section, middle school teachers of sixth-grade students, in places where grades are defined 6-8, can meet government highly qualified middle school requirements with elementary (K-6) certification. However, in middle schools, with grade levels designated as 7-9 or 8-9, those same teachers would not be considered as highly qualified. These differences exist across states and districts, and even within districts.

Some would argue that meeting the minimum mathematics-content requirement of an elementary (K-6) certification, such as the one teachers can earn in Florida, does not prepare them with a strong enough mathematics background to teach middle school students effectively. It seems even teachers certified as K-8, who have met certification requirements, may fall short on content knowledge. Johnny Lott, former president of the National Council of Teachers of Mathematics (NCTM), asserts that middle school teachers of K-8 certification programs may be ill equipped, finding it challenging to teach the assigned middle-grades content (Conference Board of the Mathematical Sciences, 2001). Lott and others have been pushing for higher content-level requirements for mathematics certification as higher mathematics content is being pushed down in grade levels. In Florida Mathematics (5-9) certified teachers must have taken 18 hours of mathematics, including calculus, pre-calculus or trigonometry; geometry; and probability or statistics, compared to Mathematics (6-12) teachers who are required to take 30 semester hours of mathematics. Typically, Elementary (K-6) teachers in Florida have taken the equivalent of college algebra.

Subject-Area Certification

Teachers who lack full certification are not evenly distributed across subject areas, ranging nationwide from about 8% for special education and career or technical-education teachers to 4% for elementary-education teachers (USDOE, Office of Postsecondary Education, 2003). In a review of literature, little research was found specific to the effects of subject-specific certification in middle-grades mathematics achievement and findings were mixed for high school. This is consistent with Rice's (2003) analysis of more than 80 research studies that focused on certification and other teacher variables related to teacher effectiveness. She made no mention of middle-grades certification, but did "reveal a positive effect of subject-specific teacher certification on high school mathematics achievement and *no* statistically significant effect for elementary mathematics or reading" (p. 29).

Darling-Hammond (2000), found that certification status was significantly and positively related to student achievement when aggregated at the state level for fourth- and eighth-grade-mathematics assessments; and Goldhaber and Brewer (2000) found evidence that twelfth-grade students of teachers with standard certification in mathematics did better than students of teachers who were uncertified. However, as mentioned earlier, Goldhaber and Brewer found no difference due to teachers holding emergency teaching credentials. They even went so far as to conclude that certification should not be required of teachers. Darling Hammond et al. (2000) argued, in an article entitled *Does Teachers' Certification Matter? Evaluating the Evidence* critiqued Goldhaber and Brewer's methodology. They argued that Goldhaber and Brewer's claim had created a "straw man argument about the views of 'educational establishment' that reduces the complex issues of teacher licensure to a set of simplistic claims" (p. 2), suggesting that there is a critical need for additional research in this area:

> A responsible research and policy agenda that builds on the evidence currently available about teacher education and certification should aim to illuminate more fully the specific aspects of teachers' knowledge and skills that make a difference for student learning and how the features of different teacher education models—the ways in which they organize the acquisition of content and teaching knowledge and build knowledge about practice as it is applied—are related to different teaching outcomes. (p. 31)

Subject-Specific Degrees

In order to be highly qualified under NCLB, teachers must demonstrate content mastery in the subject(s) that they teach. This is important because many researchers have shown that content knowledge of teachers has an impact on student achievement (Goldhaber & Anthony, 2003; Sanders & Rivers, 1996; Wright, Horn, & Sanders, 1997). The problem comes with attracting and keeping *enough* highly qualified teachers. One way that mastery of subject area can be measured, is to consider the type of scholastic degree an individual has attained—at least the minimum of subject-matter expertise. But it should be pointed out that it is common for teachers to avail themselves of additional coursework or other professional development, which, of course, can add to their overall and pedagogical-content knowledge.

In secondary studies related to mathematics and science, subject-specific degrees were found to impact student test scores positively (Rice, 2003). For example, Hawkins, Stancavage, and Dossey (1998), in their NCES report on *School Policies and Practices Affecting Instruction* *in Mathematics*, considered the subject of the degrees that teachers had earned. They showed that students who had teachers with either an undergraduate or advanced degree in mathematics outperformed students taught by education majors or other majors; and also found differences between different grade levels. For example, grade-four students whose teachers had college majors in mathematics education or education, outperformed students whose teachers had majors in other fields; at grade eight, students of teachers with college majors in mathematics outperformed students whose teachers had other majors including education and mathematics education (Hawkins et al., 1998). Other analysis of NELS88 data, by Goldhaber and Brewer (2000) and Rowan, Chiang, and Miller (1997), suggests that secondary students who had teachers with majors in fields related to mathematics and science did better than students with teachers with majors in other fields.

An NCES report on teacher qualifications and the prevalence of out-of-field teaching revealed that in 1999-2000, 70% of middle-grade (5-8) teachers did not have majors and certification in mathematics, compared to 31% of secondary mathematics teachers (Seastrom, Gruber, Henke, McGrath, & Cohen, 2002). Many of these teachers were teaching out-of-field, which, according to Ingersoll (1999), occurs more often in middle schools compared to high schools and also occurs more frequently for classrooms of lower-income students. There are also other issues specific to middle school, where, for example, many sixth-grade middle school mathematics teachers hold only elementary teaching credentials, and so lack adequate subject-area expertise (Kleiman, 2004).

For Florida, as mentioned earlier, there is a shortage of teacher candidates being produced by Florida's public and private colleges and universities—approximately 6,000 of about 20,000 needed each year. Approximately 95% of those candidates complete teacher education degrees in subject fields and the rest in other instructional areas (guidance counselors, media specialists, and school psychologists). According to a Florida Department of Education report (FLDOE, 2003b), more than half of those (54%) major in elementary education where only one-third of the teachers hired by school districts are for elementary; and “although math accounts for 8% of the fall vacancies and science accounts for 6%, only 2% of the graduates major in math education and 1.7% in science education” (p. 2).

Degree Level

At the *White House Conference on Preparing Tomorrow’s Teachers*, Dr. Russell Whitehurst, the Assistant Secretary in the Office of Educational Research and Improvement, said, “The bulk of evidence on this policy is that there are no differential gains across classes taught by teachers with Masters' degree or other advanced degree in education compared to classes taught by teachers who lack such degrees” (Whitehurst, 2002). Even though teachers in many districts across the nation are provided higher salaries or other incentives for obtaining higher degrees, such as the teacher-qualification issue of certification, little empirical evidence has been found to support a strong relationship between teachers’ degree level and student achievement. While Ballou and Padgursky (2000) argue that evidence is weak, others claim there is no difference at all.

Hanushek and Rivkin (2004), who aggregated results across studies, found it remarkable that “a master’s degree has no systematic relationship to teacher quality as measured by student outcomes” (p. 8). In his earlier work (Hanushek, 1997), analyzing studies published through 1994 to assess the effect of school resources on student performance, Hanushek had found that fewer than 10% of the studies could show significant relationships between student achievement and teachers' education level. It should be mentioned that his work, although highly regarded by some, has been sharply criticized by others (Greenwald et al., 1996) for its unsophisticated "vote counting" method. Greenwald et al. (1996) argued that Hanushek's method of tabulating results did not convincingly indicate the strength of magnitude of effects (see also Hedges, Laine, & Greenwald, 1994). Darling Hammond (2000), found some positive effects in her analysis of assessment data from 1990, 1992, 1994, and 1996 tests administered by the *National Assessment of Educational Progress* (NAEP), and data available from the 1993-1994 *Schools and Staffing Surveys* (SASS). She revealed teachers' levels of education were less influential than other variables, including certification status and the type of degree that teachers held, but when the degree was in the subject taught, there was a significant and positive correlation.

Researchers, including Goldhaber and Brewer (1997), are concerned that studies often attempting to measure the effects of degree level on student achievement are inconclusive because they do not consider the subject of the degree. Their analysis of NELS88 data revealed that, when controlling for other factors, high school students' mathematics achievements were positively associated with teachers holding advanced-mathematics degrees; however, they also found that when the advanced degree was in a field other than mathematics, there was no effect (Goldhaber & Brewer, 2000). This was also found by Chaney (1995), who had similar results when analyzing NELS88 data for 24,599 eighth-grade students. Still, those findings did not indicate whether there was an advantage of having a graduate degree over having an undergraduate degree in a subject taught. Another popular analysis by Monk (1994), using results from achievement data from nearly 3,000 tenth graders reported that teacher-degree level was either unrelated or negatively related, although coursework was important. He found a threshold effect on math and science courses, and concluded that additional coursework over five mathematics classes in college had little effect. Similarly, Eisenberg (1977) found no benefit in algebra students' achievements, when teachers took college mathematics classes beyond calculus. Eisenberg and others, like Rowan, Correnti, and Miller (2002) who examined data from large-scale survey research, found that elementary students who were taught by a teacher with an advanced mathematics degree performed substantially worse than other students. This adds to the concern that the effect of whether or not a teacher has an advanced degree may depend on the grade level or subject matter that is being taught.

While Florida law requires all teachers to have a minimum of a bachelor's degree, many teachers hold one or more degrees. Table 5 shows the number and percentage of teachers by degree level for 2002-03 to 2004-05 for Florida public schools. These data, obtained from payroll records for 2005, indicate that most teachers had a bachelor's degree—accounting for 61% of the teachers—and 35% had a master's degree (FLDOE, 2005d). This figure for master's degrees is considerably lower than a nationwide estimate of over half (56%) reported by the National Education Association (NEA, 2003). That NEA report, *Status of the American Public School Teachers 2000-2001*, was the result of survey research where questionnaires were sent to 2,826 of the nation's approximately 2,953,000 public school teachers, where 2,115 questionnaires were returned of which 648 were not usable.

Table 5.

Teacher Degree as a Percent of the Florida Teacher Workforce (2002-03 to 2004-05)

Degree Level	2002-03		2003-04		2004-05	
	Number	Percent	Number	Percent	Number	Percent
Bachelor’s	92,944	60.5	98,485	61.1	104,651	61.2
Master's	54,665	35.6	56,401	35.0	59,863	35.0
Specialist’s	4,296	2.8	4,239	2.6	4,375	2.6
Doctorate	1,825	1.2	1,968	1.2	2,095	1.2
All Degrees	153,730	100.0	161,093	100.0	170,984	100.0

Note. Adapted from “Teacher Salary, Experience, and Degree Level 2004-05,” Florida Department of Education (2005d) report. For this FLDOE report, the average number of years of experience includes both public and private teaching experience from within and outside the state.

The average years of teaching experience by degree varies in Florida, ranging from 10.3 years for teachers with bachelor’s degrees to 18.9 years for teachers with a specialist degree. Teachers with a doctorate degree average 16.2 years of experience, and master’s degree holders average 15. Statewide, for all degrees, teachers average 12.5 years of teaching experience. See Table 6. The following section provides additional information about teacher experience.

Table 6.

Florida Teachers’ Average Years of Experience (Seniority) by Degree Level for 2004-05

Degree Type	Average Years of Experience
Bachelor’s	10.3
Master’s	15.6
Specialist	18.9
Doctorate	16.2
All Degrees	12.5

Note. Adapted from “Teacher Salary, Experience, and Degree Level 2004-05,” Florida Department of Education Report (2005d).

Experience

Teachers' experience or seniority is often used as a factor in determining teachers' pay (Odden & Kelly, 2002). While it would make sense that more experience would allow teachers to gain skills making them more effective, there is some debate about how much difference additional years of service really makes. Part of the debate lies in a concern that the factor of teaching experience is confounded by other factors, such as the socioeconomic makeup of a particular school. For example, more experienced teachers may be attracted to schools in more affluent areas, where the differences in the performance of students might be better explained by socioeconomic status than how well teachers teach. For whatever reason, there is a concern that inequities do exist. For example, Margaret Spelling, Secretary of Education, in her most recent annual report on teacher quality, wrote the following in her opening letter:

> Too often, the least experienced teachers are leading the classrooms of our neediest children…. [A]ll children deserve highly qualified and effective teachers. Over the last decade, there has been too little improvement in educational achievement, and the achievement gaps between minority students' and their non-minority peers remain unacceptably large. (USDOE, Office of Postsecondary Education, 2005, p. iv)

Most research literature indicates a relationship between teacher experience and student achievement. But, like the issue of certification, there exists some debate. For example, in a large meta-analysis on student achievement and school inputs, Greenwald et al. (1996) found a significant relationship between student achievement and teacher experience; however, Hanushek (1997) found in his review of studies related to estimating the effect of teacher experience on student achievement, that most results (66%) revealed no statistically significant relationship, and others (5%) actually estimated a negative relationship. Similar studies, often cited in the literature show that, although a relationship exists, it does not appear to be linear (Ferguson & Ladd, 1996; Grissmer, Flanagan, Kawata, & Williamson, 2000; Murnane & Phillips, 1981).

Rivkin, Hanushek, and Kain's work with Texas school data showed that students of beginning teachers, and even second- and third-year teachers (to a lesser extent), perform significantly worse in mathematics than more experienced teachers (Rivkin et al., 2005), and that since lower-income and minority students faced higher teacher turnover, they were more frequently taught by beginning teachers. They concluded that "because beginning teachers, regardless of their ultimate abilities, tend to perform more poorly, policies should be developed to both keep more senior teachers in the classrooms of disadvantaged students and to mitigate the impact of inexperience" (p. 450).

Summary

This chapter contains a comprehensive review of the related literature which focuses on characteristics of the teacher-labor supply, and the factors that impact its demand. The first section centers on concerns with teacher employment patterns, where some backgrounds and the dynamics of teacher employment are described, along with some discussion on current and projected demand. For research on *leavers*, it was found that there is a growing body of evidence indicating that schools have difficulty keeping teachers with less experience or little initial preparation. Other research showed that novice teachers were much more likely to quit than their experienced counterparts; and attrition was higher in poorer schools than in wealthy ones.

Attention was brought to both the national level and to the state of Florida, where this study took place.

The chapter also describes the projected number of teaching positions open(ed), and categorized by components such as estimated teachers needed due to terminations, enrollment growth, or classroom-size adjustments. It was found that most of the studies reviewed on teacher turnover, were dependent on results from questionnaires; and although they provided rich information about the differences overall, it was found that most researchers made claims about the relative proportions of teacher qualities without exposing strength, or “effect size.”

Next, was a review of research related to middle school students’ mathematics achievement. Some attention was given to the condition of mathematics achievement at the state, national, and international levels and it was clear that over the last three decades, the importance of standardized assessments continues to increase with new legislation. Gaps in achievement for several student subgroups, which had improved slightly over time, were discussed.

Subsequently, because much of what is driving current educational reform centers on the premise that teachers matter, the chapter went on to describe teacher competencies and skill sets that are often associated in both policy and practice with “quality teachers,” including certification, experience, degree type, and advanced degrees; and how those demographics and others vary for different types of schools (i.e., high versus low percentage of at-risk students). It was revealed, that substantial disagreement exists among researchers as to which teacher qualifications make a difference, and little has been explored on this topic specific to the middle school classroom. Overall, it was found that it was difficult to generalize the effects of certification on student achievement—and for degree level—little empirical evidence had been found to support a strong relationship between whether or not a teacher held and advanced degree and student achievement. For teacher experience, it was found that most previous research had indicated a relationship between additional years experience and student achievement. But, like the issue of certification, there existed much debate.

The current research was necessitated by the conflicting findings and conclusions or otherwise lack of findings regarding the need for teacher certification and rewarding teachers based on additional years of experience or advanced degrees. It was also driven by questions surrounding whether and how much these and other factors make a difference in teacher turnover and student achievement.

CHAPTER THREE: METHODOLOGY

This research focuses on middle school teachers who taught regular or advanced mathematics for the 2004-05 school year and their students. The purpose was to examine the backgrounds and experiences of middle school mathematics teachers that often distinguish "quality" teachers, including certification, experience, degree type, and degree level, and how those demographics and others vary for different types of schools. The emphasis was on profiling teachers in a large urban district by describing their basic features and distributions, as well as how middle school mathematics teachers, according to those differences, relate to student mathematics achievement, and teacher turnover. A total of 282 teachers and 24,766 students were used for the final analysis. Student achievement was measured by test results from mathematics portions of the Florida Comprehensive Assessment Test (FCAT). The following research questions were explored:

1. How are middle school mathematics teachers, according to four aspects of their qualifications (certification, experience, degree type, and degree level), distributed among different types of schools (considering socio-economic status and student mathematics achievement)?
2. What is the degree to which middle school mathematics teachers, according to certain demographics (teacher certification, experience, degree type, degree level, and school level student mathematics achievement and socio-economic status), are mobile within the school system, leave teaching, or remain teaching at the same school?

3. How do different aspects of middle school mathematics teachers' qualifications (certification, experience, and degree level) relate to student achievement in mathematics at the classroom level when accounting for students' socio-economic status or past mathematics achievement status?

By profiling a workforce of middle school mathematics teachers in a large urban district, and examining how different teacher characteristics relate to teacher employment patterns and student achievement, a rich picture is expected. The intent of this analysis was to both a) gain new insights into understanding the teacher labor supply; and b) add to the existing literature that guides important state and national policy decisions intended to address issues related to its improvement.

All data were collected after seeking and attaining approval from the University of Central Florida's Institutional Review Board (IRB) as well as approval by the Accountability, Research, and Assessment department of the target school district. See Appendix A. The pilot study for this research (see Swan, Dixon, & Subedi, 2004), which used a two-level hierarchical linear model to examine the effects on student achievement, allowed for some exploration and determination of the capabilities and capacities of the district's data base systems and further refinement of the research questions for the current study. That work was funded by the Multi-University Reading, Mathematics and Science Initiative (MURMSI) from a grant awarded by the Institute of Education Sciences, U.S. Department of Education to the Learning Systems Institute, Office of the Provost, Florida State University, Tallahassee, FL (FY 04 award number U215K040242). This chapter addresses the context, subjects, procedures, instrumentation, data analysis, and limitations of this work.

Design of the Study

This study incorporates several methods, including descriptive analysis, multiple-linear regression, and a short survey administered to all middle school mathematics teachers used to obtain data not available at the district level. The analysis begins with an emphasis on describing this group of teachers as a whole, and then comparing different teacher groups according to aspects of their qualification by school-level student SES and mathematics achievement. Next, two years of teacher assignments were compared (2004-05 to 2005-06) to ascertain the degree to which middle school mathematics teachers, according to certain demographics, were mobile within the school system, left teaching, or remained in teaching. Additionally, multiple-linear regression was used to answer the last research question with concern for whether students' previous test scores and teacher-level predictors could affect the results of students' mathematics achievement scores at the classroom level.

Context

The urban-public school district where this study was conducted (2004-05), was the 12th largest of more than a total of 16,000 districts in the United States at the time of data collection. It continues to be one of the largest districts in Florida, with more than 12,000 instructional personnel employed and more than 5,000 new student entrants in the 2003-04 school year. Total enrollment was more than 174,000 with 38,950 of those students enrolled in middle schools. Beginning salary paid for the school year 2004-05 for a teacher with a bachelor's degree in this district was about $2,700 above the state average of $29,569, while average salary for all teachers was about $1,700 above the state average of $41,578 (FLDOE, 2005d). When this study began, this district had just more than 150 K-12 schools with a student enrollment close to 175,000, with 28 of those being middle schools (grades 6-8).

Student ethnic distribution for the school district included approximately 38% white, 28% black, 28% Hispanic, and about 6% other. Fewer than half (45%) of the students qualified for free or reduced priced lunch and were classified as low socio-economic status (SES). As with many districts across the United States, the distribution of students by SES varied considerably from school to school with middle schools ranging from 25% to 88%. Table 7 displays the number of mathematics teachers and public middle schools in the district by school-level student SES.

Table 7.

Schools and Mathematics Teachers by School-Level Student SES in a Large Urban District (2004-05)

Schools Categorized by Student SES[a]	Number of Schools	Number of Teachers
Top Quartile	7	83
Middle Half	15	151
Bottom Quartile	6	48
Totals	28	282

Note. [a]School-level Student SES was defined as the percent of students who qualified by school for free or reduced priced lunch.

Sources of Data

The primary sources of data for the current study were the Florida Department of Education's *Florida School Grades Report* (FLDOE, 2005c), and records obtained from the district’s Department of Accountability Research and Assessment. Teacher attributes, including degree level, seniority, and certification types, were obtained from district-level reports. A short survey was developed to ascertain the types of degrees the teachers held, along with how and whether teachers chose among different schools when obtaining their current teaching position. Surveys were administered in the spring of 2005. Student-level data were obtained from district records.

Procedures

Teacher and Student Identification

Using district-level reports, middle school mathematics teachers who were employed in the district in August (the first month of school) of the 2004-05 school year were identified. Only teachers (*N* = 282) who taught regular or advanced mathematics, honors algebra, or honors geometry were included in the analysis. Teachers were identified using personnel numbers instead of names to ensure anonymity and so that teachers whose names had changed could be matched. All middle school mathematics students were identified, including those assigned to year-long regular, advanced, algebra I honors, and geometry honors courses in the 2004-05 school year. Only students (*N* = 24,766) with two years of test scores (2003-04 and 2004-05) whose teachers started the school year and stayed in the same position up until the FCAT test was administrated (spring, 2005) were included for analysis related to the last research question, which focused on the relationship between teacher attributes and student mathematics achievement.

Data Collection

School and Teacher Demographics

All 28 middle schools (grades 6-8) in the district were included in this study, with the exception of charter schools and private schools. Some information about these schools was obtained from the *Florida School Grades Report* (FLDOE, 2005c). This report, available at the Florida Department of Education website, contained annual data on school-level student SES, minority rates, and performance data for the last three years beginning in 2002, as well as six measures of student achievement. At the school and district level, the measures of student achievement included three measures for student-learning gains, and three measures for students meeting high standards. At the time of the study, Florida was one of the few states that could track student demographics from year to year. It was the first state in the nation to track annual student-learning gains based on state academic standards (FLDOE, 2005d).

Data used in the current study, obtained from the *Florida School Grades Report*, included school-level student SES and mathematics achievement. School-level student SES was measured using free or reduced priced lunch eligibility (listed as a percent of students who qualify by school). School-level student mathematics achievement, at the school level, was measured by data specifying whether or not a school, according to state 2004-05 guidelines, obtained *Adequate Yearly Progress* (AYP) including a) the percentage of students above or below grade level in mathematics according to state standards; and b) whether or not a school had met the mathematics-proficiency target. Meeting those targets for 2004-05 in Florida was ascertained by whether or not the school, in total and in several subgroups (race, economically disadvantaged, Limited English Proficient, and students with disabilities), had at least 44% of its students scoring at the proficient level (on or above grade level) in mathematics according to FCAT test results (FLDOE, 2005e). For this particular district, 23 of 28 middle schools met this goal and 18% (5 schools) did not. Student achievement was also measured at the individual student level for some exploratory analyses steps.

Data describing teachers—including personnel numbers, course numbers of mathematics classes they were assigned to, gender, race, the level of highest degree earned, seniority, and types and level of certification—were collected from 2004-05 district-level reports. To be sure teachers were actually assigned to those positions, teacher assignments were confirmed with one or more of the following: a) school department chairs, b) school secretaries, and c) school websites. This also helped to confirm several name changes from one year to the next when teacher personnel numbers matched discrepant names. In a few cases, when teachers had either resigned or transferred to other positions prior to FCAT testing, no match with student test results occurred. Results from a short survey administered at teachers' monthly department meetings in the spring of 2005 provided information related to teachers' degrees and employment. Follow-up surveys were mailed to teachers who did not respond.

A brief description of how teacher-related variables were categorized is provided in Table 8.

Table 8.

Description of How Teacher Related Variables Were Categorized

Variable	Description
Degree type	The most recent degree earned. Categories were named at five levels, including major in mathematics, mathematics education, elementary education, other education majors, or other majors. Degree type was also coded as s dichotomous variable for some analyses as a) major in a relevant subject area (mathematics or mathematics education), and b) major not in a relevant subject area (all other degree types).
Degree level	This was a dichotomous variable (Bachelor's or higher degree).
Certification level	Teacher certification was at four levels and treated as a nominal variable, including Mathematics 6-12, Mathematics 5-9, Elementary Education, or Other. For teachers with more than one level of certification, the highest level mathematics related category was used. For example, if a teacher held both Mathematics 5-9 and Mathematics 6-12 certification, the 6-12 designation was used. "Other" included teachers issued temporary certification. Categories for some analyses were compressed to two levels: The first group included mathematics content-area certified teachers (Mathematics 5-9 or 6-12), and the second group were those whose certification did not qualify them as in-content (Elementary Education, Other Education, or Other).
Seniority	Teacher experience was based on how many full-time complete years a teacher had been employed by the district, and was coded both as a continuous variable and categorically [1 year, 1-2 years, 3-5 years, 6-10 years, 11 and up (or 11–15 and 16 and up)].
Course Numbers	Course numbers were used to link teachers and students. Only teachers who were

	listed as teachers of a middle school (grades 6-8) math course as of August 2005, including advanced mathematics, regular mathematics, honors algebra, honors geometry, were included. Note: Students, who as a result of their eligibility for Limited English Proficiency (LEP) or Exceptional Student Education (ESE) services, are pulled out of these regular education courses and/or assigned to self-contained special-instruction classrooms, were not included in this study.
Whether and How Teachers Chose Among Schools	This was an open-ended survey question relating to teachers' current teaching positions (2004-05). For the first question, related to whether teachers chose among different schools when seeking employment teachers chose "yes" or "no". For the second, open-ended question pertaining to why they chose to work at the school where they were, teachers were asked to list one or more main reasons.
Teacher Attrition and Mobility	To determine mobility and attrition, the district's teacher-labor force was compared from one school year (2004-05) to the next (2005-06). Three categories were developed: 1. *Teachers who remained in teaching (stayers)* – These teachers were characterized as middle school teachers who remained in a mathematics teaching position at the same school for two consecutive school terms (2004-05 to 2005-06). 2. *Teachers who resigned from the district or remained in the same district but no longer taught middle school mathematics (leavers)* – These teachers were subdivided into the following categories for further analysis: a) no longer employed in the district in 2005-06, but who held mathematics teaching positions the year before; b) taught at the same school or a different school in the same district, but no longer taught middle school

mathematics; and c) teachers who moved to a high school within the district.

3. *Teachers who moved between schools and continued to teach middle school mathematics (movers)* – These are mathematics teachers included in the study who moved between middle schools from one school term to the next (2004-05 to 2005-06), and continued teaching mathematics.

Student-Level Demographics and Mathematics Test Scores

For student-level SES students were classified as to whether or not they qualified for free or reduced price lunch at school. Free or reduced priced meals are provided for children from households whose combined income is at or below the *Federal Income Eligibility Guidelines* and applications are processed annually at the district. While this may not be the best measure of a student's socioeconomic status, it was within the scope of this study. SES for the purpose of this study is an acronym for socio-economic status, but also represents "supplemental educational services" for the department of education. *Supplemental Educational Services* is a provision of Title I of the Elementary and Secondary Education Act (ESEA), as reauthorized by NCLB and students qualifying for supplemental educational services generally do qualify for free-or-reduced priced lunch.

Student test results from the Norm Reference Test-Normal Curve Equivalent (NRT-NCE) mathematics portion of the Florida Comprehensive Assessment Test (FCAT) for two school years (2003-04 and 2004-05) were used as a measure of students' mathematics achievement. Students' scores for both 2003-04 (Stanford 9) and 2004-05 (Stanford 10) were included in the analysis using class means with 2003-04 test results as a predictor variable, and 2004-05 results as the output variable. The next section provides more information about FCAT tests.

Instruments

Florida Comprehensive Assessment Test (FCAT) Mathematics Scores

The Florida Comprehensive Assessment Test (FCAT) is part of Florida's plan to increase student achievement by implementing higher standards (http://www.firn.edu/doe/sas/fcat.htm). It is the latest version of the *Florida Statewide Assessment Program* which was first initiated as a result of the 1971 Educational Accountability Act (Section 229.57, Florida Statutes). Over the years this assessment program has gone through many changes. For example, in the beginning only a sample of students was used as a measure and eventually all students in selected grade levels were included. These first tests were designed to measure students' acquisition of certain minimum competencies.

In 1995, the *Florida Commission on Educational Reform and Accountability*, which was also formed as a result of the statute, recommended ways of assessing students' learning in an effort to raise educational expectations. It was believed that by implementing higher standards, student achievement would rise to a higher level, and students would be more competitive when entering the job market. As a result of that effort, the FCAT test was developed and first administered in 1998. Florida students are now required to pass this high-stakes test in order to receive a high school diploma, third graders must pass the reading portion of the test to be promoted to fourth grade, and the expectation is that schools test as many eligible students as possible. In 2005, out of 67 districts, 98% of the intended students were tested. Students who met certain exceptional-student-education or limited-English-proficiency criteria were not included in the learning gains components determining school scores. These student's test scores, although many had taken the test, were not included in the current study.

The FCAT has evolved somewhat and is now administered to grades 3-11, and contains two basic components: 1) criterion-referenced tests (CRT) or FCAT SSS, which measure selected benchmarks in mathematics, reading, science, and writing from the Florida Sunshine State Standards (SSS), and 2) norm-referenced tests (NRT) in reading and mathematics, which measure individual student performance against national norms. Information about the FCAT test is available at the Florida Department of Education, Florida Information Resource Network (http://www.firn.edu/)

For this analysis, the Florida Comprehensive Assessment Test (FCAT) was used as a measure of students' mathematics achievement. Two scores were used including 1) whether or not a student was considered on or above grade level in mathematics based on FCAT SSS scores and 2) students' FCAT NRT-NCE scores (ranging from 1-99). These test results are described further below.

The FCAT SSS, a criterion-referenced test, assesses student achievement on the knowledge and skills described in the state curriculum framework called the Sunshine State Standards (SSS). Students, based on results from this test, are assigned to levels 1-5, with 3-5 considered as meeting high standards (on or above grade level), and levels 1-2 being considered as not meeting high standards (below grade level). For the current study, FCAT SSS test results were used to determine students' mathematics achievement at the school level.

For the purpose of this analysis, student percentile ranks on the FCAT NRT 2003-04 (Stanford 9) and 2004-05 (Stanford 10) were converted to Normal Curve Equivalent (NCE) scores and used as a measure of students' mathematics achievement at the classroom level. The *Stanford 9* and *Stanford 10* tests are research-based norm-referenced achievement tests developed by Harcourt Assessment, Inc. that were designed to measure Florida's students' progress in comparison to the progress of students nationwide (FLDOE and Harcourt Assessment, Inc., 2005). Harcourt Assessment Stanford 10 to Stanford 9 percentile-rank conversion tables were used to estimate students' equivalent scores on Stanford 9 based on students' actual scores on Stanford 10.

A Normal Curve Equivalent (NCE) of 50 represents the national average score of any given level. See Table 9, which compares national percentiles and NCE scores. These NCE scores show normal growth as no change in a student's score from one school year to the next. In other words, if a student scores 50 one year and then 50 the following year, he or she has demonstrated normal academic growth. NCE scores were developed to avoid problems that often occur with percentile ranks and other scores. NCEs can be averaged as means, unlike percentile scores, which cannot be manipulated the same way because percentile ranks are ordinal measures. For example, at the high and low ends, points are farther apart than in the middle because that is where the majority of students, scores fall. NCEs of 1 and 99 match percentiles of 1 and 99 because NCEs were derived to have an average of 50 and a standard deviation of 21.06 (Bernhardt, 1998). They can also be interpreted as being related to stanines to one decimal place where, for example, an NCE of 59 can be interpreted as a stanine of 5.9.

Table 9.

FCAT Mathematics Normal Curve Equivalent (NCE) Score

Range of Performance	NCE Score	National Percentile
Very Low	1-24	1-11
Low	25-35	12-25
Low Average	36-44	26-39
Average	45-55	40-60
High Average	56-64	61-74
High	65-75	75-88
Very High	76-99	89-99

The Teacher Demographic Survey

A short survey was developed to determine what types of degrees the teachers held, along with how teachers chose a school, and whether teachers chose between different schools when obtaining their current teaching positions. Results from surveys, administered at teachers' monthly department meetings in the spring of 2005, provided information related to teachers' degrees and employment. Follow-up surveys were mailed with return postage to teachers who had not responded. Survey items included questions related to the type of their most recent degree, the name of the institution awarding their most recent degree, and how and whether they chose among different types of schools. Responses were confidential. Appendix B includes a copy of the Teacher Demographic Survey.

Data Analysis

To answer the first question on how middle school mathematics teachers, were distributed among different types of schools, the emphasis was on describing the population of teachers according to aspects of their qualifications (certification, experience, subject of degree, and advanced degrees), both as a whole, and in parts, by comparing how teachers were assigned to different types of schools (considering SES and student mathematics achievement). For SES, schools were defined as “high-poverty schools,” or those in the top quartile in percentage of students eligible for free or reduced priced lunch, and “low-poverty schools,” or those in the lowest quartile. School-level student mathematics achievement was measured by data related to whether or not a school, according to the state of Florida 2004-05 guidelines (FLDOE, 2005f), obtained *Adequate Yearly Progress* (AYP), including: a) the percentage of students above or below grade level in mathematics; and b) whether or not a school had met the mathematics-proficiency target.

Determining whether differences existed among groups based on teacher assignment involved using exploratory data analysis and a variety of statistical tests, including chi-square and Mann-Whitney U tests, together with simple descriptives and graphical analysis. Chi-square was an appropriate test when both variables were assessed on a nominal level of measurement—for example, when examining how teachers, based on their certification type, were placed in high- versus low-poverty schools. A Mann-Whitney U test was used when one variable was categorical with two levels, and another was interval but not normally distributed. For example, when comparing mean years of teachers’ experience (highly skewed) between two groups of schools. The variable teacher seniority (in years) was not normally distributed because of the high proportion of inexperienced teachers.

For the second research question relating to how mathematics teachers, according to certain teacher and school-level demographics, were mobile within the school system, left teaching, or remained teaching in the same school, the first step involved comparing district-level reports of teacher assignments for 2004-05 and 2005-06. Teacher groups, labeled movers, stayers, and leavers were then compared, according to certain teachers and school-level demographics using Kruskal-Wallace and chi-square tests, together with descriptive statistics and simple graphical analysis (similar to the first research question). A Kruskal-Wallace test, not yet mentioned, was used as an appropriate non-parametric test for differences in mobility or attrition (a categorical variable—3 level) and seniority, which was not normally distributed.

To further delve into the problem of mathematics-teacher attrition and ascertain if and why teachers chose among schools when seeking employment, results of open-ended responses were analyzed to determine why teachers chose to work at their current school, and if they had considered other schools when seeking employment. Open coding was used, as advanced by Strauss and Corbin (1990), where data were broken down into discrete parts, closely examined, and compared for similarities and differences.

Next, with regard to the last research question, this study was designed to determine the impact of different aspects of middle school mathematics teacher qualifications (certification, experience, and degree level) on student achievement in mathematics at the classroom level, as measured by the NRT-NCE mathematics portion of Florida’s FCAT test (2004-05) when accounting for students’ past mathematics achievement, or SES. Because some teachers resigned during the school year, or transferred to other positions, the number of teachers for this part of the analysis dropped from 282 to 273. The analysis began with exploratory data analysis of test score results at the student level according to different teacher and student groups. This involved using statistical tests, including chi-square, t test, ANOVA and graphical analysis. A t test was used to compare the mean score, an interval variable, when there were two groups—for example with whether or not a teacher had an advanced degree or certification in-content. ANOVA was appropriate to use when the dependent variable was interval scores, and a polychotomous (three or more groups) independent variable, for example, with teacher movers, leavers and stayers. The main assumptions of regression were tested including sample-size requirements, multicollinearity and singularity, outliers, and various aspects of the distribution for scores and the nature of the underlying relationship between the variables using methods described by Tabachnick and Fidell (2001). No problems were detected.

After that, standard multiple regression was used to determine whether teachers' certification type, seniority, or degree level affected the scores earned on the FCAT test. This was an appropriate test because it can be used to account for (predict) the variance for an interval dependent variable (FCAT test scores) and a set of dichotomous (degree level and certification) or continuous (seniority and student SES/previous test scores) independent variables. It also provides an indication of the relative contribution of each of the independent variables, and allows for determination of the statistical significance of the results, both in terms of the model itself, and the individual independent variables.

Having such a large number of students (N = 24,766) meant it was almost certain that a statistically significant result would emerge, regardless of any practical significance. Because of this, the teacher remained as the unit of analysis for the multiple regression analysis. That way, statistical significance was not as likely to result only because of the large sample size. For each of the 273 teachers, a class mean from the 2004-05 FCAT was used as the dependent variable; and students' results from the previous school year (mean of 2003-04), teachers' certification, degree level, and seniority were independent variables. Classroom-level means were used instead of matching student scores (at a student level). This was done to avoid complications that would come with dropping scores of students with only the current year score on record.

Multiple regression analysis was carried out a second time for school-level SES in place of students' previous test scores to see how the two models compared. See Tables 10 and 11.

Table 10.

Variables for when Teacher Was Used as the Unit of Analysis Accounting for Students' Previous Mathematics Achievement

Variables
Independent Variables
Teacher Degree Level (Bachelor's versus Advanced Degree)
Teacher Certification (Content Certified versus Not-Content Certified)
Seniority (in years)
Students' Previous Mathematics Achievement (FCAT Mathematics 2003-04 Test Scores)
Dependent Variable
Students' Mathematics Achievement (FCAT Mathematics 2004-05 Test Scores)

Table 11.

Variables for when Teacher Was Used as the Unit of Analysis Accounting for School-level Student SES

Variables
Independent Variables
Teacher Degree Level (Bachelor's versus Advanced Degree)
Teacher Certification (In-Content Certified versus Not-Content Certified)
Seniority (in years)
School-level Student SES (Percent of Students Qualifying for Free or Reduced Lunch)
Dependent Variable
Students' Mathematics Achievement (FCAT Mathematics 2004-05 Test Scores)

Limitations

Because there are so many variables influencing student achievement, there is no statistical model that can fully make up for this lack of randomization. Setting a goal for all students to achieve is important, but because students and teachers are not randomly assigned to classrooms, it is difficult to judge, in a defensible way, the effect individual teachers and schools might have on student achievement growth. For example, since the results related to the first two research questions for this study were conducted for the most part at the school level, further analysis might reveal that lower-achieving students might not be being served equitably at the classroom (teacher) level. Not only can parents and teachers choose among schools to some degree by deciding where to live, but teachers may have some choice within schools for which classes they teach. Furthermore, administrators may a) give into demands from parents, which can influence how children are assigned to particular teachers or courses; or b) place teachers among classes according to their perceived worth.

Other limitations to this research include the following:

- This study was limited to middle school mathematics students enrolled in regular, advanced, and honors math classes in one large urban district in the state of Florida so the results can only be generalized to that grade level and coursework. These results will not necessarily apply to other subject areas, grade levels, or remedial mathematics classes.
- No records were kept at the state or district level as to the type of degrees teachers held. The only record available pertaining to degree available from the district database was the level of degree (bachelor’s, master’s, doctoral, or specialists). The

inadequacy caused for this report, was that the process of using surveys to attain the type of degree teachers held only produced results from a segment of the population, which might not accurately reflect that population as a whole. While data related to other teacher characteristics, obtained from district records, was available for all teachers.

- For this research, whether teachers changed to another teaching position outside the district, was not distinguished from teachers who may have left teaching altogether. Although this approach was from the standpoint of schools, where all departures have the same effect, it does not ignore the fact that the teacher-labor supply might not be so affected at the state or national level.
- Because seniority is a measure of how many years a teacher has been employed in this particular district, it may not a true measure of experience. Teachers may have transferred from other districts, states, and even countries, the number of years seniority will understate the number of years of true experience.
- FCAT test scores was the only variable used to measure student achievement. Although, there is no statistical model that can fully make up for the myriad of variables influencing student achievement, a more complex model could account for some.
- Gains from one year to the next may reflect only one facet of students' learning of mathematics; meaning there was a broad assumption that the role of the teacher, student SES and previous achievement were the only things influencing those scores.

- This study only pertained to one particular time period in one particular district. A more longitudinal approach of a broader spectrum of schools might conclude differently.

Summary

This chapter provided an overview of the design of this research; the particular context, including a description of the district and subjects, and detail about the procedures for data collection and data analysis procedures. It also included a section listing acknowledged limitations of this work. The emphasis was on profiling a large urban workforce by describing its basic features and distributions, as well as how middle school mathematics teachers, according to those differences, relate to student mathematics achievement, teacher attrition and teacher mobility. The methodology incorporated mostly quantitative methods, including descriptive analysis employing several statistical tests, and standard multiple regression. A short survey was used to attain some data not available at the district level. The following chapter provides information about data analysis and details about the results that were found.

CHAPTER FOUR: ANALYSIS OF DATA

This chapter provides information about the data analysis and reports the findings of the study. It is separated into two major sections: 1) descriptive-analysis-based results, and 2) regression-analysis-based results. The first section provides the findings related to the population of middle school mathematics teachers and their students, including some detail about how teacher and student attributes relate to students' test scores. The second section discusses how much of the variance in test scores can be explained both in terms of the model itself, and in the individual independent variables.

This research addressed the following questions:

1. How are middle school mathematics teachers, according to four aspects of their qualifications (certification, experience, degree type, and degree level), distributed among different types of schools (considering SES and student mathematics achievement)?
2. What is the degree to which middle school mathematics teachers, according to certain demographics (teacher certification, experience, degree type, degree level, and school level student mathematics achievement and socio-economic status), are mobile within the school system, leave teaching, or remain teaching at the same school?
3. How do different aspects of middle school mathematics teachers' qualifications (certification, experience, and degree level) relate to student achievement in mathematics at the classroom level, when accounting for students' socio-economic status or past mathematics achievement status?

Descriptive Analysis-Based Results

The focus of this study was on middle school mathematics teachers who were employed in the target district in August (the first month of school) of the 2004-05 school year. Only teachers (N = 282) who taught regular or advanced mathematics, honors algebra, or honors geometry were included in the analysis. Data for teacher demographics, including school and course assignment(s), degree level, certification(s), seniority, race, and gender, were obtained from the district's department of Accountability Research and Assessment. School-level data were obtained from the Florida Department of Education's *Florida School Grades Report* (Florida DOE, 2005c) and district reports. The Teacher Demographic Survey (see Appendix B) was used to ascertain the types of degrees the teachers held, along with whether and how teachers chose among different schools when obtaining their current teaching position. Surveys were administered in the spring of 2005. Student-level data, including test scores and demographics, were obtained from district records.

Teacher Preparation, Certification and Seniority

To answer the first question—How are middle school mathematics teachers, according to four aspects of their qualifications (certification, experience, degree type, and degree level), distributed among different types of schools (considering socio-economic status and student mathematics achievement)?—the emphasis was on a) describing this group of teachers as a whole, and b) comparing different teacher groups according to aspects of their qualifications by school-level student mathematics achievement, and school-level student SES. School-level mathematics achievement was measured by whether or not a school had met the mathematics proficiency criteria according to the state of Florida's 2004-05 Adequate Yearly Progress (AYP) standards. For school-level socio-economic status (SES), schools were defined as either a) high-poverty schools, or those in the top quartile in percentage of students eligible for free or reduced priced lunch, or b) low-poverty schools, or those in the lowest quartile.

Teacher Seniority (Experience)

Teacher seniority was used as a measure of experience. Seniority was defined as the length of time (in completed years) an employee had served in a district based on the most recent period of full-time contracted employment, exclusive of long-term leaves of absence without pay. A comparison of middle school mathematics teachers grouped by seniority by the percent of teachers employed is displayed in Figure 6.

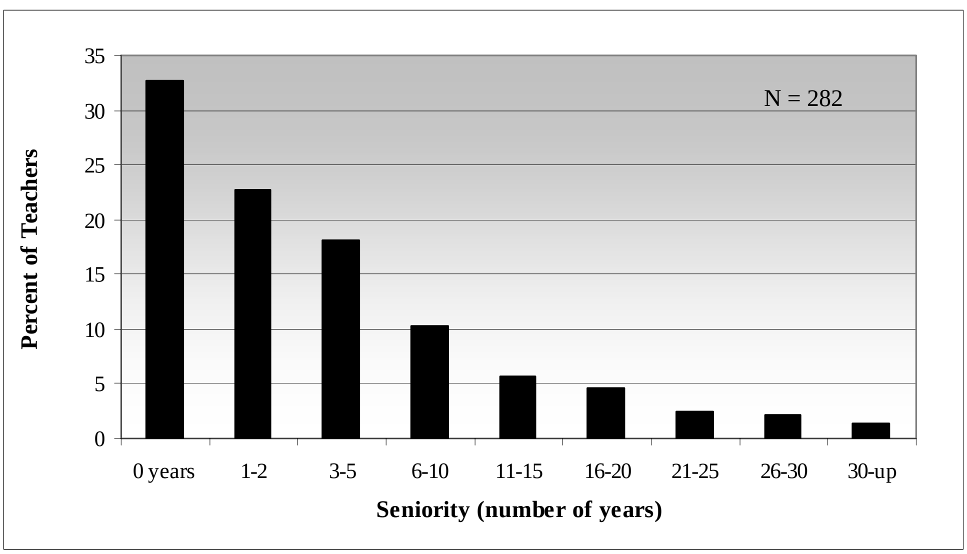

Figure 6. *Percent of Middle School Mathematics Teacher by Seniority in a Large Urban District*

Note. Teachers in their first year are described as having "0 years" seniority.

In this district, at the time of the study, the average middle school mathematics teachers' seniority was 5.0 years. Depicted in the figure above, of the 282 teachers, 33% had less than one year of service, and more than half (55%), had fewer than three years. Note the precipitous drop in the number of teachers by seniority in the first few years. Overall, the number of teachers by years of experience continued to decline as the number of years' seniority increased.

The higher proportion of novice middle school mathematics teachers, illustrated in Figure 6, reflects well the problem of attrition. As in many other districts across the nation, a large number of middle school mathematics teachers quit within the first few years of service. It should be mentioned, however, that part of the challenge of hiring large numbers of new middle school mathematics teachers year after year in this district is reflected by increasing demand due to a growing student population. This challenge was discussed in some detail in chapter two.

Provided in Table 12 is a comparison of the profiles of teacher seniority in high-poverty versus low-poverty schools. Teachers are grouped categorically by seniority, and the range of differences by school-level SES is shown.

Table 12.

Middle School Mathematics Teachers' Seniority by School-Level Student SES in a Large Urban District (High- versus Low-Poverty Schools)

	School-Level SES				
	Lowest Poverty Quartile		Highest Poverty Quartile		
Seniority	N (83)	Percent	N (48)	Percent	Range
11-up	21	25.3%	9	18.8%	6.5%
6-10	11	13.3%	4	8.3%	5.0%
3-5	11	13.3%	6	12.5%	0.8%
1-2	15	18.1%	15	31.3%	13.2%
Less than 1 year	25	30.1%	14	29.2%	0.9%

Note. Teachers in their first year are described as having "0 years" seniority. Only teachers in the top (highest-poverty) and bottom quartiles of schools based on SES were included in this analysis (N = 131).

In both groups there was a high ratio of first-year teachers—30.1% in the poorest schools versus 29.2% in the wealthier schools—but some differences within the profiles did exist. For example, the mean years of experience of teachers in schools with the least amount of poverty schools was somewhat higher (6.6) than teachers in the schools with the most poverty (5.4). In general, high-poverty schools had teachers with less experience. While most of the teachers (60.5%) who taught in the high-poverty schools had fewer than three years' seniority, in schools with the least amount of poverty this figure was less than half (48.2%)—a range of 12.3%. Most of this difference was compensated for by teachers with the most experience. In the 11-years-and-up category, the range of the percent of teachers between high- (18.8%) and low-poverty schools (25.3%) was 6.5%.

To test overall profile differences, a Mann-Whitney U test was calculated. This technique is appropriate for testing differences between two independent groups (high- versus low-poverty schools) on a continuous measure (seniority) that is highly skewed. Results, displayed in Table 13, show differences in mean ranks were not large enough to be significant ($z = -.790$, $p > .05$).

Table 13.

Mann-Whitney U Test Statistics[a] for Teachers' Seniority by *School-Level Student SES (High- versus Low-Poverty Schools)*

	Teacher Seniority
Mann-Whitney U	1829.000
Z	-.790
Asymp. Sig. (2-tailed)	.429

Note. [a]Grouping Variable: School-level student SES (high- versus low-poverty schools). Only teachers in the top and bottom quartiles of schools based on SES were included in this analysis. (N = 131)

When comparing how teachers, according to seniority, were situated among different types of schools based on whether or not a school had reached AYP standards in mathematics, little difference was found. These comparisons are shown in Table 14.

Table 14.

Middle School Mathematics Teachers' Seniority by School-Level Student Mathematics Achievement in a Large Urban District

	School-Level Mathematics Achievement "Was Math Proficiency (AYP) Target Accomplished?"				
	YES		NO		
Seniority	N (228)	Percent	N (54)	Percent	Range
11-up	37	16.2%	9	16.7%	0.4%
6-10	26	11.4%	4	7.4%	4.0%
3-5	41	18.0%	7	13.0%	5.0%
1-2	49	21.5%	16	29.6%	8.1%
0 years	75	32.9%	18	33.3%	0.4%
Average Seniority	5.0 years		4.9 years		0.1 years

Note. Mathematics proficiency, at the school level, was measured by whether or not a school had met Florida's Adequate Yearly Proficiency (AYP) target. For 2005, that goal was for having 44% of students in all subgroups on or above grade level in mathematics (FLDOE, 2005e). Teachers in their first year are described as having "0 years" seniority. (N = 282)

In both the "met proficiency" and "not met proficiency" groups about one out of every three (33%) teachers had begun teaching that same year. Also found, by combining results shown in the table, was that 63% of teachers had fewer than three years' seniority in schools that did not meet the mathematics-proficiency target, versus 54% in other schools, a difference of 9%. The mean years of experience of teachers in the schools meeting the proficiency target (5.0) was only one-tenth of a percentage point higher than schools not meeting the target (4.9). These differences, upon further analysis, were not found to be significant according to Mann-Whitney U test results ($z = -.412$, $p > .05$) displayed in Table 15.

Table 15.

Mann-Whitney U Test Statistics for Teachers' Seniority by School-Level Student Mathematics Achievement

	Teacher Seniority
Mann-Whitney U	5938.500
Z	-.412
Asymp. Sig. (2-tailed)	.680

Note. [a]Grouping Variable: Whether or not school met the Mathematics-Proficiency Target According to Florida's 2004-05 AYP Standards (N = 282).

Certification Type

Teacher certification types were categorized as Mathematics 5-9, Mathematics 6-12, Elementary Education, or Other. Teachers were also classified as being *content certified* (Mathematics 5-9 or 6-12) or *not content certified* (Elementary Education or other). Percentages for each of these categories are displayed in Table 16, along with the mean years' experience (seniority) those teachers held.

Table 16.

Middle School Mathematics Teachers' Seniority by Mathematics Certification in a Large Urban District

Teacher Certification	N	%	Mean Experience in Years	Standard Deviation
Content Certified				
Mathematics 6-12	54	19.1%	7.96	9.779
Mathematics 5-9	139	49.3%	4.60	6.294
Total In-Content (5-9 or 6-12)	193	68.4%	5.54	7.561
Not Content Certified				
Elementary Education	46	16.3%	7.26	8.109
Other	43	15.2%	.19	.500
Total Not In-Content	89	31.5%	3.84	8.609
Total	282	100.0%	5.00	7.363

From the table, for all middle schools 68.4% of mathematics teachers were content qualified according to their certification. The mean years of experience for content-certified teachers was higher (5.5) than for teachers who did not hold math certification (3.8). The average of .19 years experience for the 43 teachers who held “other” certification was very low as compared to other groups and those with elementary credentials had almost the same mean experience (7.26 years) as teachers who were certified Mathematics 6-12 (7.96 years). A Mann-Whitney U test was calculated and it was found that this difference was significant ($z = -3.308$, $p < .01$). Those results are displayed in Table 17. Below that, Figure 7 charts further analysis, where differences with teacher certification were grouped by seniority categorically.

Table 17.

Mann-Whitney U Test Statistics for Teacher Seniority by Whether or Not a Teacher Held In-Content/Math Certification

	Teacher Seniority
Mann-Whitney U	6525.000
Z	-3.308
Asymp. Sig. (2-tailed)	.001*

Note. [a]Grouping Variable: Teacher Certification. (N = 282)
*p < .05

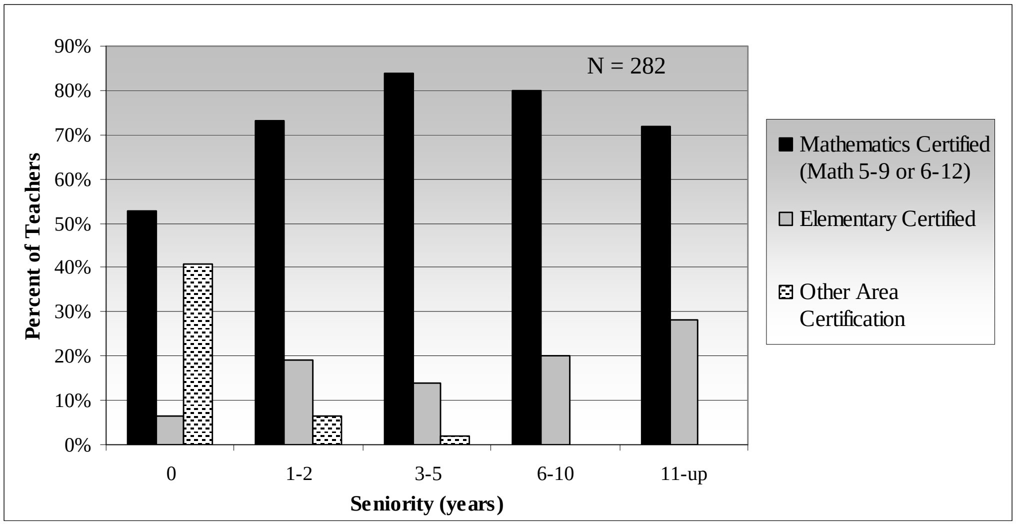

Figure 7. *Percent of Middle School Mathematics Teachers with Certification in Area Assigned by Seniority in a Large Urban District*

Note. Teachers in their first year are described as having "0 years" seniority.

It can be seen from this chart, that for all middle school mathematics teachers in their first year, which comprises about one-third of the middle school teaching force as a whole, just over half (53%) were content qualified according to their certification. This figure rose quickly to 84% for years three to five, and then decreased again to 72% for teachers with 11 or more years of experience. The jump in the first few years is not surprising; because of a shortage of qualified mathematics teachers, many new teachers were being hired out-of-field.

In all, 40% of first-year teachers had "other" certification types. If this pattern is consistent over time, then it appears those out-of-field teachers generally obtained appropriate certification or quit within the first years of service, shown by the quick drop to 2% of teachers having "other" certification from zero to years 3-5. Interestingly, the highest concentration (28%) of elementary-certified teachers had taught 11 or more years, with only a small number (7%) of first-year teachers being elementary certified. No data were available regarding how many years elementary-certified teachers who more than likely began their careers teaching in elementary schools, had taught in these middle schools, but a higher distribution in the 11-and-up category likely means those teachers transferred to middle schools late in their careers. Additional results detailing how teachers according to certification type were distributed are displayed in Table 18.

Table 18.

Middle School Mathematics Teacher Certification by School School-Level Student SES in a Large Urban District (High- versus Low-Poverty Schools)

	School-Level SES				
	Lowest Poverty Quartile		Highest Poverty Quartile		
Certification	N (83)	Percent	N (48)	Percent	Range
In-Content Certified					
Mathematics 6-12	18	21.7%	9	18.8%	2.9%
Mathematics 5-9	42	50.6%	20	41.7%	8.9%
Total In-Content (5-9 or 6-12)	60	72.3%	29	60.5%	11.8%
Not Content Certified					
Elementary	13	15.7%	13	27.1%	11.4%
Other	10	12.0%	6	12.5%	0.5%
Total Not In-Content	23	27.7%	19	39.9%	11.9%

Note: Only teachers in the top (highest poverty) and bottom quartiles of schools based on SES were included in this analysis. (N = 131)

According to these results, while 60.5% of middle school mathematics teachers in high-poverty schools held Mathematics 5-9 certification, a higher concentration of these content-qualified teachers were in schools with the least amount of poverty (72.3%). Furthermore, a higher proportion of elementary-certified teachers worked in high-poverty (27.1%) schools versus low-poverty schools (15.7%). Teachers certified in other areas were somewhat evenly distributed.

Since the differences in how teachers are grouped by certification were complex and some inequities were observed, a chi-square test of independence was calculated. This was the most appropriate test to explore the relationship between two categorical variables. Results of that test are displayed in Table 19.

Table 19.

Chi-Square Test Statistics for Teacher Certification by School-Level Student SES

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.968[b]	1	.161
Continuity Correction[a]	1.461	1	.227
N of Valid Cases	131		

Note. [a]A Continuity Correction was computed for the 2x2 table. [b]0 cells (.0%) have expected count of less than 5. and the minimum expected count is 15.39. School-level student SES (high- versus low-poverty schools). Only teachers in the top and bottom quartiles of schools based on SES were included in this analysis (N = 131).

The chi-square test of independence with Yates's correction for continuity revealed no significant difference between teachers grouped by certification (content certified versus not content certified) in high-poverty versus low-poverty schools ($\chi^2 = 1.968$, Yate's correction 1.461, df = 1, $p > .05$).

Next, this analysis led to comparisons of how teachers with different certifications were placed based on whether or not a school had met Florida's 2004-05 mathematics AYP standards. See Table 20.

Table 20.

Middle School Mathematics Teacher Certification by School-Level Student Mathematics Achievement in a Large Urban District

Certification	School-Level Mathematics Achievement "Was Math Proficiency (AYP) Target Accomplished?" YES N (228)	YES Percent	NO N (54)	NO Percent	Range
In-Content					
Mathematics 6-12	43	18.9%	11	20.4%	1.5%
Mathematics 5-9	117	51.3%	22	40.7%	10.6%
Total In-Content (5-9 or 6-12)	160	70.2%	33	61.1%	9.1%
Not Content Certified					
Elementary	32	14.0%	14	25.9%	11.9%
Other	36	15.8%	7	13.0%	2.8%
Total Not In-Content	68	29.8%	21	38.9%	9.1%

Note. Mathematics proficiency, at the school level, was measured by whether or not a school had met Florida's Adequate Yearly Proficiency (AYP) target. For 2005, that goal was for having 44% of students on or above grade level in mathematics in all subgroups. (FLDOE, 2005e)
(N = 282)

In comparing teachers from schools that met the AYP math-proficiency that year versus teachers in schools that did not, these results show that there was about the same percent of math 6-12 certified teachers (18.9% and 20.4% respectively). Teachers with "other" certification were also distributed rather evenly. Yet, similar to the results of schools compared by SES, schools that met the AYP mathematics-proficiency target had a higher percentage of content-certified teachers (70.2%) than schools not meeting the target (61.1%). That difference was comprised of a higher number of elementary-certified teachers in schools that had not met AYP math proficiency—percentages ranged nearly 12% between schools meeting (14.0%) and not meeting (25.9%) that goal.

Based on results from a chi-square test for independence, with Yates's correction for continuity, displayed in Table 21, there was no significant difference in the certification profiles for the two categories of schools that had or had not met the target. For this test, teachers were categorized in two groups, in content versus not in content ($\chi^2 = 1.661$, Yate's correction 1.268, df = 1, p > .05).

Table 21.

Chi-Square Test Statistics for Teacher Certification by School-Level Student Mathematics Achievement

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.661[b]	1	.198
Continuity Correction[a]	1.268	1	.260
N of Valid Cases	282		

Note. [a]A Continuity Correction was computed for the 2x2 table. [b]0 cells (.0%) have expected count of less than 5. and the minimum expected count is 17.04. (N = 282)

Degree Level

To describe education degrees attained, two levels, bachelor's or graduate degrees, were used. Only three of the middle school mathematics teachers (N = 282) held a doctorate or specialist's degree. Specifics as to the level of degree teachers held are displayed in Table 22.

Table 22.

Teacher Degree Level by Seniority in a Large Urban District

Teacher Degree Level	N	%	Mean Experience in Years	Standard Deviation
Bachelor's	208	73.8%	4.1	6.38
Advanced Degree	74	26.2%	7.5	9.20
Total	282	100.0%	5.0	7.36

While 74 of these teachers (26.2%) held an advanced degree, the mean years of seniority of advanced-degreed teachers was considerably higher (7.5 years) than teachers who did not hold an advanced degree (4.1years). These means are considerably lower than the 2004-05 state and county averages where master's degreed teachers averaged 15.6 and 14.9 years respectively (FLDOE, 2005d). For the target district, first-year teachers were the least likely to hold an advanced degree. Where percentages ranged from 16.1% for first-year teachers to 46.7% for teachers in the 11-15 year range, they dropped slightly to 39.0% for teachers with more than 16 years' seniority.

A Mann-Whitney U test revealed that these difference were significant ($z = -3.514$, $p < .001$). Results from that test are listed in Table 23.

Table 23.

Mann-Whitney U Test Statistics for Teacher Seniority by Whether or Not a Teacher Held an Advanced Degree

	Teacher Seniority
Mann-Whitney U	5621.000
Z	-3.514
Asymp. Sig. (2-tailed)	.000*

Note. Grouping Variable: Teacher Degree Level. (N = 282)
*p < .05

Table 24 provides an illustration of the difference in how teachers were situated among different types of schools by school-level SES according to their degree level. As mentioned earlier, SES was measured by the percent of students who qualified for free and reduced lunch; and schools were classified as high-poverty (top quartile) or low-poverty (bottom quartile).

Table 24.

Middle School Mathematics Teachers Degree Level by School-Level Student SES in a Large Urban District

	School-Level SES				
	Lowest Poverty Quartile		Highest Poverty Quartile		
Degree Level	N (83)	Percent	N (48)	Percent	Range
Bachelor's	54	65.1%	40	83.3%	18.3%
Advanced Degree	29	34.9%	8	16.7%	18.3%

Note: Only teachers in the top (highest poverty) and bottom quartiles of schools based on SES were included in this analysis (N = 131).

In the highest-poverty schools, 16.7% of teachers had an advanced degree compared to 34.9% in the schools with the lowest poverty—a range of 18.3%. To further examine these differences, a chi-square test of independence with Yate's correction for continuity was calculated and significance was found ($\chi^2 = 5.01$, Yate's correction 4.149, df = 1, $p < .05$). Those results are displayed in Table 25.

Table 25.

Chi-Square Test Statistics for Teacher Degree Level by School-Level Student SES (High- versus Low-Poverty Schools)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.011[b]	1	.025
Continuity Correction[a]	4.149	1	.042*
N of Valid Cases	131		

Note. [a]A Continuity Correction was computed for the 2x2 table. [b]0 cells (.0%) have expected count of less than 5. and the minimum expected count is 13.56. Only teachers in the top and bottom quartiles of schools based on SES were included in this analysis (N = 131).
*p < .05

Similar to the case with high- versus low-poverty schools, in schools that met the AYP math-proficiency target, a higher percentage of teachers holding advanced degrees (28.5%) was found than in schools not meeting the target (16.7%). However, that difference (11.8%) was not as wide. Table 26 provides detailed comparisons of the distribution of those teachers.

Table 26.

Middle School Mathematics Teacher Degree Level by School-Level Student Mathematics Achievement in a Large Urban District

	School-Level Mathematics Achievement "Was Math Proficiency (AYP) Target Accomplished?"				
	YES		NO		
Degree Level	N	Percent	N	Percent	Range
Bachelor's	163	71.5%	45	83.3%	11.8%
Advanced Degree	65	28.5%	9	16.7%	11.8%
Total	228	100.0%	54	100.0%	0.00%

Note. Mathematics proficiency, at the school level, was measured by whether or not a school had met Florida's Adequate Yearly Proficiency (AYP) target. For 2005, that goal was for having 44% of students on or above grade level in mathematics in all subgroups (FLDOE, 2005e).
(N = 282)

Next, to detect if a difference existed in distribution of teachers by degree level among schools that had or had not met the AYP mathematics-proficiency target a chi-square test of independence was calculated. See Table 27. Those results, unlike the results comparing groups by school-level SES, revealed *no* significant differences in the proportions of teachers holding advanced degrees in schools according to whether or not the school was achieving high standards in mathematics ($\chi^2 = 3.16$, Yate's correction 2.581, df = 1, p > .05).

Table 27.

Chi-Square Test Statistics for Teacher Degree Level by School-Level Student Mathematics Achievement

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.163[b]	1	.075
Continuity Correction[a]	2.581	1	.108
N of Valid Cases	252		

Note. [a]A Continuity Correction was computed for the 2x2 table. [b]0 cells (.0%) have expected count of less than 5. and the minimum expected count is 14.17. (N = 282)

Teacher Degree Type

Of all the teacher-level variables described in this section, teacher degree type was the only variable not obtained from district or state-level reports. Instead, teacher degree types were obtained by using the *Teacher Demographic Survey* (see Appendix B). In all, 188 of 282 or 66.7% of the teachers responded. Details on the types of degrees teachers held are displayed in Figure 1.

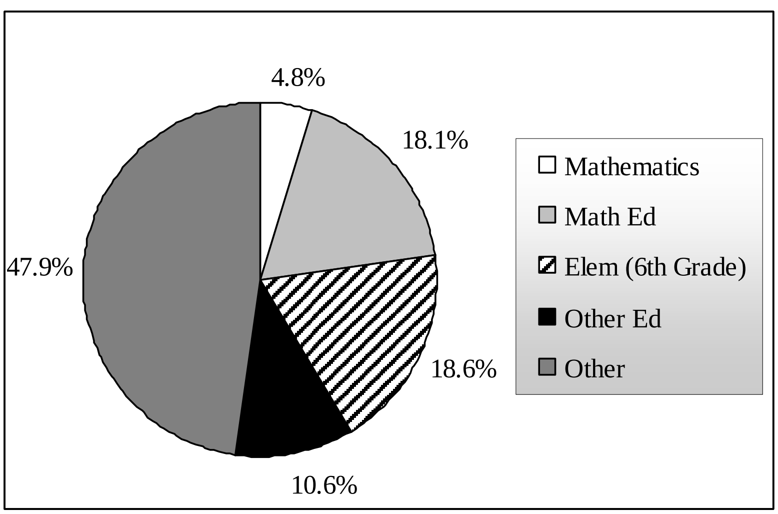

Figure 8. *Middle School Mathematics Teacher Degree Types in a Large Urban District*

Note. Data for teacher degree were obtained from surveys where 67.5% percent of teachers responded. (N = 188)

Of the teachers who responded to the Teacher Demographic Survey, only one out of four (25%) held a major (mathematics or mathematics education) in the content area to which they were assigned. Also, the data revealed that a little more than half of the sixth grade students in this district were being taught by teachers who had come through an elementary education program of study (18.6% of the total for all grade levels); 10.6% majored in other education areas—mostly educational leadership; and almost half (47.9%) held other majors. Other majors included many types, among others, business related degrees, political science, liberal studies, psychology, engineering, and social work.

It was found that all middle schools, regardless of the level of student SES or student mathematics achievement, had a large number of teachers who were not content qualified according to what degree they had earned. For example, for SES, in schools in the top quartile (highest-poverty) 20.5% had a degree in mathematics or mathematics education compared to 23.3% in the schools in the bottom quartile. For whether or not a school made the target AYP gain for a certain number of students on or above grade level, the distribution was also similar (23.4% and 21.1%).

Summary

To summarize, although inequities did exist in favor of schools with less at-risk students, in this district—for the most part—teachers were fairly distributed according to the "quality" of their backgrounds and experiences. The only significant gap was in that students in wealthier middle schools were more likely to have a mathematics teacher with an advanced degree. There did exist, a problem with a shortage of well-qualified mathematics teachers for this particular demographic in all types of schools regardless of SES or mathematics achievement.

Movers, Leavers, and Stayers

In the 2004-05 school year, in the district where this study was conducted, 282 middle school mathematics teachers were employed to teach regular or advanced middle school mathematics. In the previous section this teaching workforce was described, and it was revealed that about a third of these teachers were new hires (33%). Most new hires were replacing teachers who either resigned or moved on to teach high school mathematics or other subject areas (teacher turnover), and a smaller number of those teachers were hired for new positions due to enrollment growth.

This section addresses the second research question: *What is the degree to which middle school mathematics teachers, according to certain demographics (teacher certification, experience, degree type, degree level, and school level student mathematics achievement and socio-economic status), are mobile within the school system, leave teaching, or remain teaching at the same school?* By comparing this workforce for two consecutive school years (2004-05 to 2005-06) and describing how its basic features and distributions relate to teacher attrition and mobility, the purpose was to gain new insights into understanding the teacher labor supply.

Results describe the attributes of middle school mathematics teachers, defined as *movers, leavers*, and *stayers* and whether differences in those employment patterns exist between different types of schools (SES and students' mathematics achievement). *Movers* were defined as teachers who continued teaching mathematics but moved to a different school within the district.

Leavers remained in the same district but no longer taught middle school mathematics or resigned; and *stayers* remained at the same school and continued to teach mathematics.

Teacher Turnover

This study found that at the beginning of the 2005-06 school year, middle schools had lost 29.1% of the mathematics-teacher workforce employed the previous year. See Figure 9.

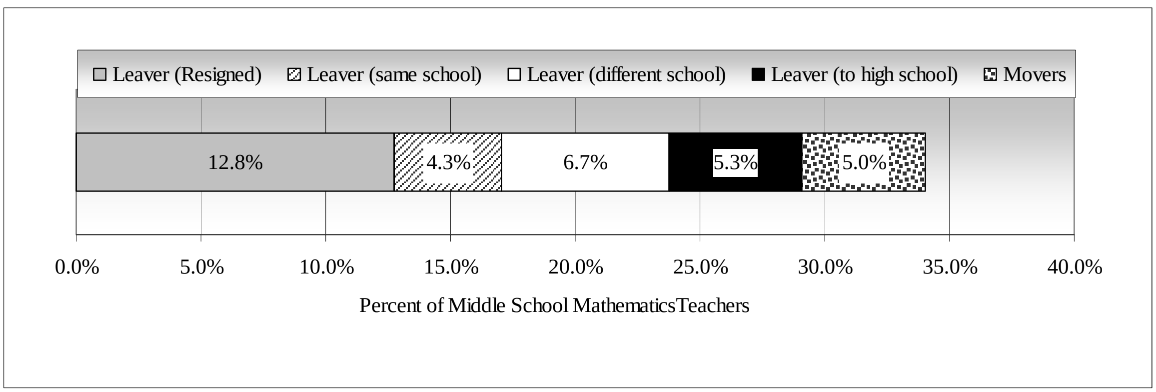

Figure 9. *Percentage Distribution of Middle School Mathematics Teachers by the Employment Backgrounds in a Large Urban District: Comparing 2004-05 to 2005-06*

N = 282

Of those *leavers*, many resigned (12.8%), some came back to teach another subject at the same or different middle school (11.0%), and others (5.3%) transferred to high school mathematics teaching positions. Additionally, about 5.0% of mathematics teachers transferred to other middle schools within the same district (movers) bringing the total turnover to 34.1%.

To determine whether proportions of teachers described as movers, leavers, and stayers were different in schools based on whether or not the school had met the mathematics-proficiency target under Florida's AYP plan, a chi-square test of independence was performed.

Results of that test ($\chi^2 = 6.251$, df = 2, $p < .05$), showed that the differences in the frequency in the turnover of mathematics teachers were significant between schools that met the target for student mathematics proficiency versus schools that had not met the target (See Table 28).

Table 28.

Chi-Square Test Statistics for Teacher Turnover by School-Level Student Mathematics Achievement

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.251[a]	2	.044*
N of Valid Cases	282		

Note. [a]0 cells (.0%) have expected count of less than 5. and the minimum expected count is 3.64. School-level mathematics achievement was defined as whether or not a school met the Mathematics-Proficiency Target according to Florida's 2004-05 AYP Standards. (N = 282)
*p < .05

Profiles of teachers, according to turnover (movers, leavers, and stayers) were also compared by how those groups were situated in schools that had met Florida's AYP mathematics-proficiency target. Details of that distribution can be seen in Table 29.

Table 29.

Middle School Mathematics Teacher Employment Backgrounds (Movers, Leavers, and Stayers) by School-Level Students' Mathematics Achievement in a Large Urban District

"Did School Meet AYP Mathematics-Proficiency Target?"	Teacher Employment Backgrounds Comparing 2004-05 to 2005-06					
	Movers		Leavers		Stayers	
	N	Percent	N	Percent	N	Percent
YES	12	5.3%	59	25.9%	157	68.9%
NO	7	13.0%	18	33.3%	29	53.7%
Total/Average	19	6.7%	77	27.3%	186	66.0%

Note. School-level student mathematics achievement was defined by whether or not school met the Mathematics-Proficiency Target according to Florida's 2004-05 AYP Standards (N = 282).

Teachers left (33.3%) and moved (13.3%) more frequently than expected in schools with students with lower math performance. In schools where students were achieving those goals for high standards, the opposite effect was true.

The same was not found for schools based on school-level SES, however. Results of differences in expected frequencies and outcomes in how movers, leavers, and stayers, were distributed among high-poverty versus low-poverty schools are displayed in Table 30. While a higher proportion of teachers in the high-poverty schools either moved or left—10.4% movers and 33.3% leavers in schools with the most poverty versus 2.4% movers and 25.3% leavers in the low-poverty schools.

Table 30.

Middle School Mathematics Teacher Employment Backgrounds (Movers, Leavers, and Stayers) by School-Level Student SES in a Large Urban District

School-Level SES	Teacher Employment Backgrounds Comparing 2004-05 to 2005-06					
	Movers		Leavers		Stayers	
	N	Percent	N	Percent	N	Percent
Lowest Poverty Schools	2	2.4%	21	25.3%	60	72.3%
Highest Poverty Schools	5	10.4%	16	33.3%	27	56.3%
Total/Average	7	5.3%	37	28.8%	87	66.0%

Note: Only teachers in the top and bottom quartiles of schools based on SES were included in this analysis (N = 131).

To test differences those relative frequencies, a chi-square test for independence was calculated and the results, which are displayed in Table 31 showed no significance ($\chi^2 = 5.522$, df = 2, $p > .05$) meaning that these differences are not so wide that we cannot rule out that they may have actually occurred by chance.

Table 31.

Chi-Square Test Statistics for Middle School Mathematics Teacher Employment Backgrounds (Movers, Leavers, and Stayers) by School-Level Student SES (High- versus Low-Poverty Schools)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.522[a]	2	.063
N of Valid Cases	131		

Note. [a]1cell (16.7%) has an expected count of less than 5 and the minimum expected count is 2.56. Only teachers in the top and bottom quartiles of schools based on SES were included in this analysis (N = 131).

Next, profiles of teachers according to their seniority, certification, and degree level were compared to determine how those factors related to teacher turnover. Teacher seniority by employment status is displayed in Table 32.

Table 32.

Average Middle School Mathematics Teacher Experience (Seniority) by Teacher Employment Status (Movers, Leavers, and Stayers) in a Large Urban District

Employment Status	N	%	Mean Experience in Years	Standard Deviation
Stayers	186	66.0%	5.60	7.554
Leavers	77	27.3%	4.34	7.378
Movers	19	6.7%	1.89	3.770
Total	282	100.0%	5.00	7.363

Note. Teachers in their first year are described as having “0 years” seniority.

Teachers who left teaching positions (leavers) had an average of 4.3 years seniority compared to stayers at 5.6 years and movers at 1.9 years. These mean calculations were significantly different across these groups as determined by results from a Kruskal-Wallis Analysis of Variance test ($\chi^2 = 7.193$, df = 2, and $p < .05$). This test was an appropriate choice for comparing a continuous variable (seniority) with three groups (movers, leavers, and stayers). See Table 33.

Table 33.

Kruskal-Wallis Test Statistics for Middle School Mathematics Teacher Experience (Seniority) by Teacher Employment Status (Movers, Leavers, and Stayers)

	Teacher Seniority
Chi-Square	7.193
Df	2
Asymp. Sig.	.027*

[b]Grouping Variable: Teacher Employment Status. (N = 282)
*p < .05

As with the other teacher characteristics previously examined, there was a desire to see whether there were differences in turnover by how much experience teachers had. Levels of seniority (2004-05 to 2005-06) according to turnover are displayed in Figure 10.

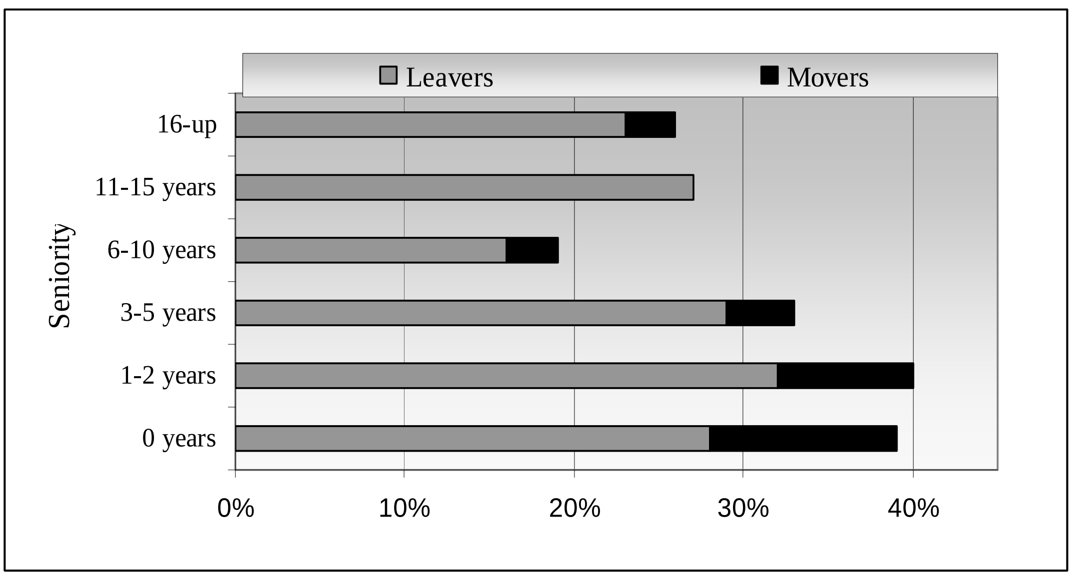

Figure 10. *Differences in Middle School Mathematics Teacher Turnover by Levels of Teacher Seniority in a Large Urban District*

Note: Teachers in their first year are described as having “0 years” seniority. (N = 282)

Teacher turnover was higher for teachers in their first few years of service (0 years at 39%, 1-2 years at 40% and 3-5 years at 34%), while teachers in the 6-10-year range had the lowest rate of turnover (19%). New teachers were more likely to transfer to other middle schools to teach mathematics, with more than half of all movers (53%) being first year teachers, and fewer (only 11%) transferring for teachers in all groups with more than five years seniority combined.

Finally, analysis turned to an examination of teachers by degree level and certification. Table 34 compares the number of movers, leavers, and stayers based on whether or not teachers held advanced degrees or certification in the content area they taught.

Table 34.

Middle School Mathematics Teacher Employment Backgrounds (Movers, Leavers, and Stayers) by Whether or Not a Teacher Held an Advanced Degree or Certification in the Content Area they Taught

Teacher Preparation	Teacher Employment Backgrounds Comparing 2004-05 to 2005-06					
	Movers		Leavers		Stayers	
	N	Percent	N	Percent	N	Percent
Teacher Degree Level						
Bachelor's Degree	16	7.7%	55	26.4%	137	65.9%
Advanced Degree	3	4.1%	22	29.7%	49	66.2%
Teacher Certification						
In-Content (Math 5-9 or 6-12)	13	6.7%	47	24.4%	133	68.9%
Not In-Content (Elem Ed or Other)	6	6.7%	30	33.7%	53	59.6%
All Teachers	19	6.7%	77	27.3%	186	66.0%

A chi-square test of independence was used next to test these differences. See Table 35, showing no statistically significant difference between the expected frequencies of teacher turnover and the data gathered (advanced degrees versus bachelor's: $\chi^2 = 1.28$, df = 2, $p > .05$; and in-content versus not in-content certified: $\chi^2 = 2.76$, df = 2, $p > .05$).

Table 35.

Chi-Square Test Statistics for Middle School Mathematics Teacher Employment Backgrounds (Movers, Leavers, and Stayers) by Whether or Not a Teacher Held an Advanced Degree or *Certification in the Content Area They Taught*

	Value	df	Asymp. Sig. (2-sided)
Teacher Degree Level			
Pearson Chi-Square	1.289[a]	2	.525
Teacher Certification			
Pearson Chi-Square	2.762[b]	2	.251
N of Valid Cases for Both Tests	282		

Note. [a]1 cell has an expected count of less than 5 and the minimum expected count is 4.99. [b]0 cells have an expected count of less than 5 and the minimum expected count is 6.00.

Whether and How Teachers Choose Among Schools

Although the preceding analysis has described how the basic features and distributions of this particular labor supply relate to teacher turnover, one can also get a picture by asking teachers directly about some of the choices they make when seeking employment. In all, 188 out of 282 responded (66.7%) to the following questions which were included in the Teacher Demographic Survey (see Appendix B): 1) Did you consider different schools when you obtained your current position? (yes or no); and 2) Please provide the main reason or reasons you chose to teach at the school where you are now employed (open ended).

For the first question, pertaining to whether teachers considered different schools, results showed that 64% of teachers *did* consider other schools when seeking employment and the remaining (36%) did not. For the second question, pertaining to the why teachers choose the particular school where they were at, there were numerous reasons in a given year, but teacher reported some reasons more frequently than others. Just under half gave multiple answers so the following adds up to more than 100%. The most commonly identified response was location (46%), followed by supportive or “nice” administration/principal (24%), and “pleasant” or “good” atmosphere/working environment (24%). Another answer that was frequently provided was that the job was offered to them or was available (21%). Among the factors less often reported, were “friendly,” “excellent,” or “good,” staff (17%) or student body (15%), that students were performing well academically (13%), and ethnicity (same as theirs) (5%).

Student Mathematics Achievement

The following results, relate to the third research question: *How do different aspects of middle school mathematics teacher qualifications (certification, experience, and degree level) relate to student achievement in mathematics at the classroom level, when accounting for students’ socio-economic status or past mathematics achievement status?* To describe student mathematics achievement, individual records were examined of the 24,766 students of 273 teachers who remained for the entire 2004-05 school year. Before describing the results of more sophisticated multiple regression, this section begins to identify which attributes are related to the level of achievement with several explorations comparing mean scores across different subgroups. This preliminary analysis, at the student level, involved several variables including student gender, free or reduced priced lunch eligibility (SES), grade level, school and course codes (used to match students with individual teachers), and FCAT NRT-NCE test scores (2004-05). FCAT Mathematics NCE scores ranged from very-low, low, low-average, average, high-average, high, and very-high). Cutoffs for those scores were listed in a previous chapter (see Table 9). For classroom level analysis, other variables included teacher demographics (certification, experience, degree type, and degree level), and class means of test scores, again from 2003-04 and 2005-06.

To begin, the relationship between students' socio-economic status and student achievement was explored at the student level by comparing students' NCE scores by whether or not they qualified for free or reduced priced lunch. See Table 36. Analysis revealed that the mean for students who qualified for free or reduced priced lunch was considerably lower than for students who did not qualify and about half of the students in these schools were eligible for free or reduced price lunch.

Table 36.

Middle School Student FCAT Mathematics NCE Scores (2004-05) by Student SES in a Large Urban District

Student Eligibility for Free or Reduced Priced Lunch (SES)	Mean NCE	N	Standard Deviation	Median NCE	% of Total N
YES	55.5	12,210	16.6	56.4	49.3%
NO	67.4	12,556	16.9	67.0	50.7%
Total	61.5	24,766	17.8	62.3	100.0%

To test whether differences in these mean test scores were statistically significant an independent samples t test was performed. This was the appropriate test to use for comparing a continuous variable (test scores) between two groups. It was found that there was a significant difference in scores for those who qualified (M = 67.5, SD = 16.9) whose mean was in the *high* range of performance, and for those who did not qualify were in the *averag*e range [M = 55.5, *SD* = 16.6, t(24,764) = -55.8, p <.001]. The magnitude of the differences in the means was modest (eta squared = .11). T test results are displayed in Table 37.

Table 37.

Independent Samples t test Statistics Comparing FCAT NCE Mathematics Test Results for Middle School Students by Whether or Not They Qualified for Free or Reduced Lunch (SES)

		Levene's Test for Equality of Variances		T test for Equality of Means			
		F	Sig.	t	df	Sig (2-tailed)	Mean Difference
NCE 2004-05	Equal variances assumed	1.64	0.20	-55.83	24,764	.000*	-11.9

*p < .05

The next step in the analysis was to examine whether students of teachers with more experience had higher test scores. First, the mean FCAT NCE scores for middle school mathematics students across six subgroups of teachers were compared by seniority. Those results are displayed in Table 38.

Table 38.

Middle School Student FCAT Math NCE Scores (2004-05) by Teacher Seniority in a Large Urban District

Seniority	Mean NCE	N	Standard Deviation	Median NCE	% of Total N
0 years	59.7	7,475	17.0	60.4	30.1%
1-2 years	60.6	5,871	17.6	60.4	23.7%
3-5 years	61.7	4,260	17.6	62.3	17.2%
6-10 years	64.7	2,705	18.5	64.9	10.9%
11-15	60.7	1,519	18.3	61.7	6.7%
16 or more years	65.2	2,936	18.6	64.9	11.9%
All Math Teachers (N = 282)	61.5	24,766	17.8	62.3	100.0%

Note. Teachers in their first year are described as having “0 years” seniority.

As can be seen in the table, the mean scores increased slightly for higher levels of seniority, from a low of 59.7 for first-year teachers, to 64.7 for teachers in the 6-10-year range. It then dropped for teachers with 11-15 years of seniority and rose again for those in the 16-or-more-years range to the highest mean overall of 65.2.

Next, a one-way between groups analysis of variance was conducted to explore the impact of teacher seniority on test results, as measured by the FCAT. This test was performed with seniority as a categorical variable since it was suspected that the effect might not be linear. Results of that test showed that there was a statistically significant difference at the $p < .001$ level in mean class scores for these six groups [$F(5, 24760) = 63.08$]. Table 39 displays the results.

Table 39.

ANOVA Test Statistics for Middle School Student FCAT Math NCE Scores (2004-05) by Teacher Seniority (Categorical)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	98537	5	19707.46	63.084	0.000*
Within Groups	7734985	24,760	312.40		
Total	7833523	24,765			

Note. A total of 282 teachers and 24,766 students were included in this analysis.
*p < .05

Despite reaching statistical significance, the actual difference in mean scores between the groups was extremely small according to the effect size of .01 (Cohen, 1988). Mean scores of all groups of students by teacher seniority fell within the same *high average* range of performance except for those students whose teachers had 16 plus years whose mean score fell in the *high* range. Post-hoc comparisons using the Tukey HSD test indicated that these mean scores for teachers according to these groups were all different with the exception of between the 11-15 year group, between the groups with 6-10 years, and 16 or more years. See Appendix C for a chart with details about these comparisons.

Table 40 displays a comparison of student test scores based on whether or not mathematics teachers held advanced degrees or were certified in the content area they taught. In addition to information about test scores, are standard deviations, median scores, and percentages for how teachers were grouped by category.

Table 40.

Middle School Student FCAT Math NCE Scores (2004-05) by Whether or Not a Teacher Held an Advanced Degree or Certification in the Content Area They Taught

Teacher Preparation	Mean NCE	N	Standard Deviation	Median NCE	% of Total N
Teacher Degree Level					
Bachelor’s Degree	60.7	18,243	17.8	60.4	74%
Advanced Degree	63.6	6,523	17.6	63.5	26%
Teacher Certification					
In-Content (Math 5-9 or 6-12)	62.7	17,433	17.8	62.9	70%
Not In-Content (Elem Ed or Other)	58.5	7,333	17.5	58.7	30%
All Teachers	61.5	24,766	17.8	62.3	100.0%

From the analysis, summary statistics showed students of advanced degreed teachers and teachers who were certified in the content they taught, on average, performed in the *high average* range (M = 63.6 and M = 62.7 respectively) and students performed slightly lower but still in the *high average* range when their teacher held only a bachelor’s degree or certification not in the content that they taught (M = 60.7 and M = 58.5). T tests results, displayed in Table 41, revealed that even though these differences were significant; the magnitude of these differences was very small for both degree level and for certification.

Table 41.

Independent Samples t test Statistics Comparing FCAT NCE Mathematics Test Results for Middle School Students by Whether or Not a Teacher Held an Advanced Degree or Certification in the Content Area They Taught

	Levene's Test for Equality of Variances		t test for Equality of Means			
	F	Sig.	t	df	Sig (2-tailed)	Mean Difference
Degree Level						
Equal Variances Assumed	1.807	.179	-11.555	24,764	.000*	-29.57
Certification Type						
Equal Variances Assumed	1.000	.317	-16.971	13994.557	.000*	-4.18

*p < .05

Regression Analysis-Based Results

Standard multiple regression used the teacher (*N* = 273) as the unit of analysis for the next step in answering the third research question. Each record contained teachers' certification type, years of seniority, degree level, class means for both the 2003-04 and 2004-05 FCAT NRT-NCE test results, and school-level SES (percentage of students qualifying for free or reduced price lunch). For this analysis, seniority was a continuous variable (years), certification was dichotomous (in content versus not in content), and degree level was also dichotomous (bachelor's or advanced degree).

For the first model, standard multiple linear regression was performed to predict students' mathematics achievement. For each of the 273 teachers, a class mean from the 2004-05 FCAT was used as the dependent variable, and students' results from the previous school year (class mean of 2003-04), teachers' certification, degree level, and seniority were all independent variables. Independent variables are commonly called *predictor* variables, because regression analysis allows one to see how well all of the predictor variables together can *predict* the outcome variable. It also provides information about the relative contribution of each of the variables that make up the model. The ability level of the class, measured by the *previous* test scores from the previous school year (2003-04), provided a measure to account for students' prior mathematics achievement. Analysis was performed using SPSS REGRESSION and SPSS FREQUENCIES for evaluation of assumptions.

To begin, the model was evaluated and found to have met common assumptions according to Tabachnick and Fidell (2001). The sample size was sufficiently large, less than 1% of the values were outliers, and the assumptions of homoscedasticity, normality, and linearity were not a problem; and no missing data were found. Next, the results of these analyses were summarized. Table 42 displays the correlations between the variables, the unstandardized regression coefficients (B) and intercept, the standardized regression coefficients (β), the semi partial correlations R^2, and adjusted R^2.

Table 42.

Standard Multiple Regression Analysis of NCE2004-2005 (the SPSS REGRESSION DV) with NCE2003-2004 (previous mathematics achievement) Certification, Experience (seniority), and Degree Level

DESCRIPTIVE STATISTICS

	Mean	Std. Deviation	N
NCE2004-05	61.266	8.4685	273
NCE2003-04	60.733	9.2066	273
Certification	1.69	.462	273
Experience	5.11	7.445	273
Degree Level	1.26	.437	273

Note. Teachers in their first year are described as having “0 years” seniority.

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	18123.611	4	4530.903	878.092	.000*
Residual	1382.865	268	5.160		
Total	19506.476	272			

*p < .05

Table 43.

Standard Multiple Regression Results of Students’ Previous Mathematics Achievement Certification, Experience, and Degree Level on Class Mean FCAT NCE-NRT Scores

Variables	NCE04-05 (DV)	NCE 03-04	Cert	Exp	Degree Level	B	β
NCE03-04	.963					.879**	.955
Certification	.205	.188				.398	.022
Experience	.157	.137	.094			.027	.023
Degree Level	.129	.119	.228	.205		.113	.006
					Intercept = 6.949		
Means	61.27	60.73	1.69	5.11	1.26		
Standard Deviations	8.47	9.21	.462	7.45	.437		
						R^2 =.929	
						Adjusted R^2 =.928	
						R =.96**	

**p < .001

As can be seen from Table 42, student achievement as measured by the 2004-05 FCAT test results was positively and significantly correlated with the criterion. The resulting values of R^2, are a measure of how well the independent variables predict test scores. From Table 43, as much as 92.9% of the variation in the FCAT NCE standardized test scores can be explained, with all four predictors combined ($F_{4, 268} = 878.09$, $p < .001$). An examination of the simple correlation figures indicates that of these four variables, students' previous mathematics achievement (FCAT NCE 2003-04) was the only variable that uniquely and significantly contributed to the model (beta = .955). There is, however, a major concern that having such a large beta, would very likely cause problems of multicollinearity. Therefore, although certification, degree level, and seniority were not significant according to values in the table, the amount of the uncontrolled effects on the dependent attributable to covariance they shared reduced greatly the level of confidence that one can place in the standard error of the estimates. Because if this, one cannot draw inferences about the relative contribution of each of these predictors to the success of the model leaving the results inconclusive.

Next, to further investigate, a sequential multiple regression analysis was employed to predict students' test scores using a new model for school-level SES in place of students' previous mathematics achievement scores. Assumptions of the model were checked. Findings are summarized in the following tables.

Table 44.

Standard Multiple Regression Analysis of NCE2004-2005 (the SPSS REGRESSION DV) with School-level SES (percent of students qualifying for free or reduced priced lunch) Certification, Experience (seniority), and Degree Level

DESCRIPTIVE STATISTICS

	Mean	Std. Deviation	N
NCE2004-05	61.266	8.4685	273
SchlLvlSES	48.70	14.668	273
Certification	1.69	.462	273
Experience	5.11	7.445	273
Degree Level	1.26	.437	273

Note. Teachers in their first year are described as having “0 years” seniority.

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	5040.473	4	1260.118	23.345	.000*
Residual	14466.004	268	53.978		
Total	19506.476	272			

*p < .05

Table 45.

Standard Multiple Regression Results of School-level SES, Certification, Experience, and Degree Level on Class Mean FCAT NCE-NRT Scores

Variables	NCE04-05 (DV)	SchLvl SES	Cert	Exp	DegLvl	B	β
SchlLvl SES	-.474					-.257**	-.446
Certification	.205	-.126				2.417**	.132
Experience	.157	-.081	.094			.116	.102
Degree Level	.129	-.103	.228	.205		.113	.006
					Intercept = 6.949		
Means	61.27	48.70	1.69	5.11	1.26		
Standard Deviations	8.47	14.67	.462	7.45	.437		

R^2 =.258
Adjusted R^2 =.247
R =.508**

**p < .001

Results were calculated the same way as in the previous model. As can be seen in Table 44 on the previous page, FCAT mathematics test score results were positively and significantly correlated with the criterion in this case where school-level SES was used as one of the predictor variables. According to results from Table 45, as much as 25.8% of the variation in test scores was explained with all four predictors combined ($F_{4, 268} = 23.34$, $p < .001$). An examination of the simple correlation figures indicates that of the three predictors related to the effect of the teachers, two—degree level and seniority—did not contribute significantly to the model. The results, however, did show that school-level student SES (beta = -.446), and teacher certification (beta = .132) contributed significantly to students' test scores. School-level SES contributed negatively and whether or not a teacher held in-content certification contributed positively.

Conclusion

This chapter presented the analysis of data describing the basic features and distributions of a large urban mathematics-teacher workforce, as well as how teachers, according to the differences discussed, relate to student mathematics achievement, teacher attrition, and teacher mobility. These results all combined, which describe the backgrounds and experiences of middle school mathematics teachers that often distinguish "quality" teachers, support a culminating finding: That regardless of the level of student SES or student mathematics achievement at a particular middle school, high rates of teacher turnover exist, and that there are deficient numbers of well-qualified mathematics teachers—that the greatest deficiencies are with novice teachers—and novice teachers make up a very large part of the middle school mathematics teaching workforce. Another finding was that although inequities did exist in favor of schools with less at-risk students, in this district—for the most part—teachers were equitably distributed according to the “quality” of their backgrounds and experiences. The only significant gap was in that students in wealthier schools were more likely to have a mathematics teacher with an advanced degree.

This exploration also led to analysis of the effects of teacher characteristics on student achievement. The analysis began with the individual student as the unit of analysis (*N* = 24,766), the impact was statistically significant. There were differences in mean scores of students based on their teachers according to teachers’ degree level, experience, and certification. However, the effect sizes demonstrated in all cases indicated that results were of little practical significance.

To assure that those results were not just due to a large *N*, further tests were conducted with the teacher as the unit of analysis (*N* = 273). When regression was used to determine whether middle school mathematics teacher qualifications relate to student achievement at the classroom level when controlling for students’ past mathematics achievement test problems with multicollinearity led to inconclusive results. When a second model was run replacing previous test scores with school-level SES as a predictor, SES and teacher certification did contribute significantly to students’ test scores. School-level SES contributed negatively and whether or not a teacher held in-content certification contributed positively.

CHAPTER FIVE: DISCUSSION, RECOMMENDATIONS AND CONCLUSION

Many decisions about educational reform center on the premise that teachers and schools make a difference when it comes to improving student achievement. Yet, while the overall number of underprepared teachers may appear to be decreasing due to legislation from the No Child Left Behind Act (NCLB), there clearly remains an acute problem of not being able to staff classrooms with enough well-qualified teachers.

This study was designed to gain new insights into understanding the teacher labor supply, and to add to the existing literature that guides important policy decisions intended to address issues related to its improvement. The investigation focused on middle school mathematics—a critical teacher-shortage area—by examining the backgrounds and experiences of middle school mathematics teachers that often distinguish quality teachers, and how those demographics and others vary for different types of schools. The emphasis was on profiling a large urban workforce of middle school mathematics teachers by describing its basic features and distributions, as well as how those teachers, according to different profiles, relate to student mathematics achievement, teacher attrition, and teacher mobility.

A variety of analytic approaches and methods were used to examine how different teacher characteristics relate to teacher employment patterns and student achievement, including chi-square, Kruskal-Wallace, Mann-Whitney U, ANOVA, and t tests, together with simple descriptives and graphical analysis. Standard multiple regression was used to evaluate whether students' previous test scores and teacher- and school-level predictors could affect the results of students' mathematics achievement. A short survey was administered, which provided some insight to ascertain whether and why teachers choose among schools when seeking employment. This chapter reports the summary of findings, discussion, recommendations, and conclusions of this study.

Summary of Findings

Teacher Distribution

The first question focused on how middle school mathematics teachers were distributed among different types of schools, and described the population of teachers according to four aspects of their qualifications—certification, experience, subject of degree, and advanced degrees—both as a whole, and in parts, by comparing how teachers were assigned to different types of schools (SES and student mathematics achievement).

For middle schools in the large urban district where this study took place, there are troubling issues whereby an alarming number of students are being taught by inexperienced mathematics teachers without certification or degrees appropriate for the mathematics content they teach. In the year this study was conducted (2004-05), for example, while average seniority was five years, one out of every three middle school mathematics teachers was in their first year, more than half (55%) had fewer than three years' experience. It also was apparent that, because of a shortage of well-qualified mathematics teachers, many new teachers were being hired out-of-field—of those first-year teachers, only about half (53%) had certification in their content area and most (67%) did not have a degree in mathematics or mathematics education. Differences in seniority for both degree level, and whether or not a teacher was certified in the content they taught, were statistically significant. Making matters worse, approximately half of the sixth-grade mathematics teachers had elementary credentials, which means they, too, may have lacked the adequate expertise and content knowledge to teach effectively (Conference Board of the Mathematical Sciences, American Mathematical Society, 2001). A summary of the teachers' characteristics is provided in Appendix D.

This research revealed that although inequities did exist in comparing the distribution of middle school mathematics teachers between high- and low-poverty schools, degree level was the only variable in which the difference was statistically significant. A summary of the results is provided in Table 46.

Table 46.

A Summary of Middle School Mathematics Teacher Average Characteristics by School-Level Student SES (High- versus Low-Poverty Schools)

Teacher Characteristics	School-Level SES Lowest Poverty Quartile Percent	 Highest Poverty Quartile Percent	Range
Average Experience	6.6 years	5.4 years	1.2 years
% 11 and up	26.5%	18.8%	7.7%
% less than 3	48.2%	60.5%	12.3%
% first year	30.1%	29.2%	0.9%
% Advanced Degree	34.9%	16.7%	18.2%
% Degree in Math or Math Education	23.3%	20.5%	2.8%
% Certified Math (5-9 or 6-12)	72.3%	60.5%	11.8%
% Elementary Credentialed	15.7%	27.1%	11.4%

Note: Only teachers in the top (highest poverty) and bottom quartiles of schools based on SES were included in this analysis.
Teachers in their first year are described as having "0 years" seniority.
(N = 131).

These results revealed the proportion of teachers with advanced degrees in schools with low poverty (34.9%) was more than double that which existed for schools with the most poverty

(16.7%). The differences were not as wide with regard to how teachers were distributed by experience and certification. Almost one in three teachers was in their first year in both the poorest and wealthiest schools. For certification, the gap for content-qualified teachers ranged from 72.3% in wealthier schools to 60.5% in poorer schools, and elementary-credentialed teachers ranged from 15.7% to 27.1% respectively.

In comparing the distribution of teachers grouped according to seniority, degree level, or certification (in-content versus not in-content) among schools based on students' mathematics achievement, no significant difference was found. Achievement, at the school level, was measured by whether or not a school had met Florida's mathematics proficiency target. For 2005, that goal was to have 44% of students in all subgroups on or above grade level in mathematics (FLDOE, 2005e). As was true in the case of comparing high- and low-poverty schools, the mean years of experience varied very little (one-tenth of one percent) according to school-level student achievement. Students in schools that did not meet the mathematics proficiency target did have a lower number of experienced teachers in general, but that difference was not statistically significant. Sixty-three percent of teachers had fewer than three years' seniority in schools that did not meet the target goal; in schools that did meet the target the percentage was lower, at 54%. The ratio of content-certified teachers to all middle school mathematics teachers for these groups ranged from 70.2% in schools meeting Florida's Adequate Yearly Progress (AYP) math proficiency target to 61.1% in the schools that did not. Elementary-credentialed teachers ranged from 14.0% to 25.9% respectively. A summary of teachers' average characteristics within these two types of schools is provided in Table 47.

Table 47.

Summary of Middle School Mathematics Teachers' Average Characteristics by School-Level Student Mathematics Achievement

Teacher Characteristics	School-Level Mathematics Achievement "Was Math Proficiency (AYP) Target Accomplished?"		Range
	YES	NO	
Average Experience	5.0 years	4.9 years	0.1 year
% 11 and up	16.2%	16.7%	0.5%
% less than 3	54.4%	62.9%	8.5%
% first year	32.9%	33.3%	0.4%
% Advanced Degree	28.5%	16.7%	11.8%
% Degree in Math or Math Education	23.4%	21.1%	2.3%
% Certified Math (5-9 or 6-12)	70.2%	61.1%	9.1%
% Elementary Credentialed	14.0%	25.9%	11.9%

Note. Mathematics proficiency, at the school level, was measured by whether or not a school had met Florida's Adequate Yearly Proficiency (AYP) target. For 2005, that goal was to have 44% of students in all subgroups on or above grade level in mathematics (FLDOE, 2005e).
Teachers in their first year are described as having "0 years" seniority.
(N = 282)

Teacher Mobility and Attrition

To determine middle school mathematics teacher mobility and attrition from one school (2004-05) year to the next (2005-06), according to certain demographics, three categories were developed: 1) teachers who remained in teaching (stayers); 2) teachers who resigned from the district or remained in the same district but no longer taught middle school mathematics (leavers); and 3) teachers who moved between schools and continued to teach middle school mathematics (movers). Some of the concerns addressed were: whether or not schools with high numbers of lower-achieving or economically disadvantaged students were facing higher turnover rates; if a middle school mathematics teacher's background or experience make a difference in whether or not they stay or move the following year; and also whether and why teachers choose among schools when seeking employment.

As mentioned in the previous section, for the 2004-05 school year, fully one-third of all middle school mathematics teachers were new hires, and more than half (55%) had fewer than three years seniority. This is about twice the national average for newly hired teachers for 1999-2000 (Provasnik & Dorfman, 2005) confirming the difficulties that schools have with retaining teachers—especially middle school mathematics teachers. Although there was some growth in student enrollment, a large majority of these new hires were replacing teachers who either resigned or moved on to teach in other subject areas.

Turnover by Teacher Characteristics and School SES and Mathematics Achievement

This research also described district-wide employment patterns of the same 282 teachers. At the beginning of the 2005-06 school year, there were high rates of teacher attrition whereby middle schools had lost almost a third of the middle school mathematics teacher workforce employed the previous year. This is a higher rate of attrition than for all teachers across the state, estimated at 10% for both 2002-03 and 2003-04 and higher than ever before (FLDOE, 2005a). Of the leavers from the present study, many resigned (13%), some came back to teach another subject at the same or different middle school (11%), and others (5%) transferred to high school mathematics teaching positions. Additionally, about 5% of mathematics teachers transferred to other middle schools within the same district (movers), bringing the total turnover to 34%.

Like Hanushek et al. (2005), who also studied transition rates in a large urban district, the present study found that less-experienced teachers were more likely to move to other schools.

Where differences in transition rates by seniority were significant, leavers averaged 4.3 years, compared to movers at 1.9 years, and stayers at 5.6 years. High rates of turnover were not just evident with first-year teachers, but extended through year five of service, peaking at 37% for those finishing year two or three. Middle school mathematics teachers in the six-to-ten-year range were the least likely to leave (7%); and while much of the turnover was due to an aging teacher workforce, far more teachers were resigning for other reasons.

Another finding related to teacher preparation was that there was no statistically significant difference between the expected frequencies of teacher turnover, and the data gathered for whether or not a teacher had an advanced degree or was certified in the content area they taught (mathematics 5-9 or 6-12). This is different from findings by Henke et al. (2000)—who found that uncertified teachers were three times more likely to leave than certified entrants—and others, who found attrition was higher for those with little initial preparation (Darling-Hammond & Sykes, 2003). But since there was a significant difference in the number of years of seniority for these groups—higher for both in-content certified and advanced degreed teachers—a combination of these factors should be considered in future analyses of this type.

While high rates of teacher turnover are a problem for all middle schools, and a higher proportion of teachers in the high-poverty schools either moved or left than in schools with low poverty, those differences were not found to be statistically significant. Findings of this study did, however, reveal significance between mathematics teacher turnover rates at the school level, based on students' mathematics performance. Turnover was higher for schools with high numbers of students below grade level in mathematics (13% movers and 33% leavers) than in schools that had met the target for student mathematics proficiency according to Florida's

Adequate Yearly Progress (AYP) plan (5% movers and 26% leavers). Appendix E displays a summary of results of turnover for these various school and classroom-level factors.

Whether and Why Teachers Choose Among Schools

Since mathematics teachers were a scarce commodity and may have had the option to move between schools and choose among schools, a short survey was administered to ascertain whether and why teachers choose among schools when seeking employment. Results showed that about 64% considered working at other schools when seeking employment at their current job, and there were numerous reasons why they chose to work there. There were no other data gathered on why they did not consider other teaching positions or schools within the county, but more research is recommended to determine whether labor policies regarding hiring practices might aid in reducing turnover. For example, whether requiring new hires to interview at two or more schools before obtaining employment might lead to better decision making regarding initial placements and reduced turnover.

The most commonly identified response was location (46%), followed by supportive or “nice” administration/principal (24%), and “pleasant” or “good” atmosphere/working environment (24%). Another answer that was frequently provided was that the job was offered to them or was available (21%). Among the factors less often reported, were “friendly,” “excellent,” or “good” staff (17%) or student body (15%), that students were performing well academically (13%), and ethnicity was the same as theirs (5%). Further studies along these same lines might shed more light on the reasons why teachers may choose to work at certain schools.

Teacher Qualifications and Student Achievement

The third research question pertained to how different aspects of teachers' qualifications (degree level, certification, and seniority) related to students' mathematics achievement at the classroom level. The effects of SES and students' previous achievement in mathematics were taken into consideration.

Several explorations comparing mean scores across different subgroups were performed at the student level prior to performing standard multiple regression. Consistent with other findings, those results showed a significant difference when comparing students by whether or not they qualified for free and reduced lunch. Wealthier students did perform better, but the magnitude of that difference was modest. There were significant differences in how students performed by teacher seniority, degree level, and certification; however, the magnitude of those differences were quite small. Similar to other studies (Ferguson & Ladd, 1996; Grissmer et al., 2000; Murnane & Phillips, 1981), the results of this study showed that the effect of seniority—although it improved with additional years for the most part—was not linear. Students of the most senior (16 or more years) performed the highest, and students of teachers in the 6-10 year range outperformed teachers in the 11-15 year range.

Having such a large number of students (*N* = 24,766) meant it was almost certain that a statistically significant result would emerge which might override any practical significance. Because of this, the teacher remained as the unit of analysis for the multiple regression, so that statistical significance was not as likely to result only because of the large sample size.

In the first test, for each of the 273 teachers, a class mean from the 2004-05 FCAT was used as the dependent variable; students' results from the previous school year (mean of 2003-

04), teachers' certification, degree level, and seniority were independent variables. Results showed as much as 92.9% of the variation in the FCAT NCE standardized test scores could be explained, but of the four variables, students' previous mathematics achievement (FCAT NCE 2003-04) was the only variable that uniquely and significantly contributed to the model. The contributions of teacher degree level, certification, and seniority, were not significant. However because previous test scores had such a high correlation with the dependent variable, very little variance was left, and multicollinearity made the model unstable.

A second multiple regression analysis was employed to predict students' test scores using a new model for school-level SES in place of students' previous mathematics achievement scores. Outcomes revealed test score results were positively and significantly correlated with the criterion in this case as well, with as much as 25.8% of the variation in test scores explained with all four predictors combined. A closer examination indicated that degree level and seniority did not contribute significantly to the model, but results did show that school-level student SES—higher levels meaning higher poverty—contributed significantly and negatively to students' test scores, and whether a teacher held in-content certification contributed significantly and positively. Overall the effect of SES was much lower when compared to that of students' previous mathematics achievement.

Discussion

This research examined the different backgrounds and experiences of middle school mathematics teachers, and how those demographics and others vary for different outcomes in schools, and types of schools. Outcomes explored include the impact teachers have on mathematics achievement, and whether teachers stay in teaching or move to other schools within the same district. Types of schools for this analysis were grouped by student SES and mathematics achievement. Findings were, for the most part, focused at the level of individual schools and classrooms.

The purpose was to gain new insights into understanding the teacher-labor supply by comparing this workforce for two consecutive school years (2004-05 to 2005-06), and describing how its basic features and distributions relate to teacher turnover and student achievement. It is hoped that having a more accurate picture of how teacher backgrounds and experiences can influence differences in employment patterns and student achievement will help guide important state and national policy decisions to address improvements.

Setting a goal for all students to achieve is important, but because students and teachers are not randomly assigned to classrooms, it is difficult to judge, in a defensible way, the effect individual teachers and schools might have on student achievement growth. Not only can parents and teachers choose among schools to some degree by deciding where to live, but teachers may have some choice in which classes they teach. Also, administrators may give into pressure from parents, which can influence how children are assigned to particular teachers or courses. A review of literature on teacher quality initiates concerns about possible inequities of distributions. Because there are so many variables influencing student achievement and teacher turnover, there is no statistical model that can fully make up for this lack of randomization. The models used in the current study made an attempt.

Data—such as those used in this report—that track changes in teacher assignments from school to school, between districts, and between states are difficult to find (Allen, 2003, Guarino et al., 2004; Voorhees & Barnes, 2003), and can be difficult and time consuming to analyze.

Database systems in this particular district, which are more modernized than in many other Florida districts, were designed to disaggregate student achievement by different student groups, and not necessarily by groups of teachers. Fortunately, most of the data contained in this report *were* available at the district level and, after careful and time-consuming coding and merging of files, proved to be reliable. It was helpful that the researcher was completing a one-year internship in the Department of Accountability, Research, and Assessment in this district and was aided by analysts and other staff who worked there. During that time—the same year the study was conducted—the researcher was able to learn a great deal about the data available and the capacities of the systems that supported it. Other rich sources of data were several school-, state- and district-level reports, which are available and maintained by the FLDOE [See the *Florida Information Resource Network (FIRN)* website at http://www.firn.edu/]. Another benefit to this research was that the researcher had a broad and relevant perspective of just who and what was being taught in this district, having been a former middle school mathematics teacher and mathematics teacher leader there for several years.

The large urban district where this study took place presented an exceptional context in which to explore issues related to the research questions for other reasons. The urban setting provided a variety of schools according to student socio-economic status and mathematics performance, and there was an ongoing shortage of well-qualified mathematics teachers. Also, at the time of this study, Florida was one of the few states in the nation that could track student demographics from year to year, and was the first to track annual student learning gains based on state academic standards (Florida DOE, 2005d). Furthermore, the middle school context is thought to have a pronounced problem of retaining highly qualified teachers (Jerald & Ingersoll, 2002).

Results of this study show that the goal of ensuring an equitable distribution of quality teachers among different schools, even with such a diminutive supply, is far less a problem than attracting and keeping enough qualified mathematics teachers for all middle schools. This particular district was doing well managing distribution, but seriously high rates of attrition and a shortage of well-qualified teachers were taxing the quality of the workforce as a whole. Most of the middle school mathematics teachers in this district, for example, had been there for fewer than three years, and more than half lacked appropriate certification or appropriate degrees for the subject matter that they taught.

Although this study focused on identifying and analyzing the quality and dynamics of the teacher labor supply, it was clear from high levels of turnover that many of these teachers were not satisfied in their current positions. It was also apparent that because of an ongoing exorbitant demand on a supply of highly qualified mathematics teachers, it is likely that some teachers who might not be good candidates to teach are being hired, while others, who *should* go, stay. It is important to point out that some degree of teacher attrition should be expected, but previous studies are inconclusive on what a reasonable rate might be (Allen, 2005; Price, 1977, 1997). However, as a result of this research, it does seem that, a) since there was such a critical shortage of middle school mathematics teachers in this district, and b) a disproportionate number of new teachers were being hired without appropriate certification or background in the content they teach, that more attrition might be expected for this particular subgroup than for teachers in other subject or grade levels. Future research might lead to this conclusion, as it makes sense that individuals hired to do a job for which they are not well prepared would likely result in an increased level of turnover.

Whatever the acceptable level, what this study did illuminate was that the teacher staffing problem is huge for this particular demographic, and needs to be addressed. Total turnover of mathematics teachers in this district was 34% from just one year to the next—much higher than previous reports had revealed. No doubt, this is very costly for schools, which must recruit, train, and support new teachers year after year. It is also costly for children who may lose an opportunity to be taught by an experienced and otherwise well-qualified teacher. It was evident that the solution to this problem extends well beyond just expanding the teacher labor supply. Ingersoll (2001) found the following:

> Employee turnover is especially consequential in worksites, such as schools, which have ‘production processes’ requiring extensive interaction among participants. Such organizations are usually dependent upon commitment, continuity, and cohesion among employees and, therefore, especially vulnerable to high turnover….[and that] high turnover of teachers from schools is of concern not simply because it may be an indicator of sites of potential staffing problems, but because of its relationship to school performance (p. 3).

He goes on to propose that the best approach to decreasing the demand for new teachers is by decreasing turnover. The solution does not lie in recruitment and other supply-side solutions like lowering standards, which can make things worse. Suggestions include increasing salaries and support from school administration, reducing discipline problems, and also allowing for more faculty input into school decision making.

Many reports and previous research studies show that the need for qualified teachers is particularly great in lower-performing schools with higher numbers of low-income and minority students (Allen, 2005; Betts, Rueben, & Danenberg, 2000; Hanushek et al., 2004; Lankford, Loeb, & Wyckoff, 2002; Peske & Haycock, 2006; Sanders & Rivers, 1996; Schields et al, 2003; U.S. DOE, Office of Postsecondary Education, 2005). Another concern was that more and better teachers might be attracted and more likely to transfer to better performing or wealthier schools, leaving more at-risk students poorly served. However, these findings have shown was that schools serving both the wealthiest *and* poorest of students had similar levels of difficulty obtaining and keeping middle school mathematics teachers. And although some inequities did exist by school-level SES, in most cases they were not found to be statistically significant. One significant finding, however, was that mathematics teachers did tend to move from schools more frequently when a large proportion of students were not achieving high standards in mathematics. This could mean that teachers are sorting themselves in ways that leave better performing schools with better teachers; an effect, not strong enough to cause significant differences in those distributions overall. These findings should not be generalized to other districts and schools, as Florida supports an equitable funding structure and in accordance with the uniformity requirement of article IX of the state constitution, the *Florida Education Finance Program* provides state funds to offset differences in property tax revenues among different districts.

This thesis adds to the literature showing that middle schools have alarmingly high rates of mathematics teacher turnover. The particular model used has revealed that teachers' experience and degree types have little or no significant impact on students' mathematics achievement. That these characteristics draw little to bear on a child's achievement is an uncomfortable finding, but may not mean that we should rush to revisit Coleman et al. (1966) and Jencks et al. (1972) just yet. There are myriads of other factors involved which were not included in these simple models. Additional research in developing better and more sophisticated models that track student gains over more than two years should provide a clearer picture of student learning and how it is influenced by the quality of the teachers and the schools in which they teach.

This study found that part of the problem with evaluating the effectiveness of a teacher on student achievement was the high proportion of new teachers in this particular labor force, which may have skewed results. Whether or not a teacher held certification was the only teacher-related variable examined that contributed significantly and positively to students' test scores. It is very likely that in the first years of teaching that some of the attributes that we hold most dear are less important than other skills not measured in this report. No amount of lectures, books, student teaching, or support, can fully prepare new teachers for the enormity of the first year(s) of teaching. Much of what is learned is learned by doing. Or, in other words, perhaps it is really a matter of how the important business of ensuring that our teachers are well prepared is, to a great extent, being overshadowed by the inefficiencies that schools have with supporting and keeping them. This study also highlights the importance of ensuring that children remain on or above grade level, because by the time they get to middle school, it is apparent that last year's standardized test scores have more of an effect than anything else on how well they will do.

Recommendations

This research has identified the following issues to be addressed:

- At the forefront of recommendations is a more concentrated effort to improve the management of state-labor resources. Far too many teachers are leaving, and far too few are interested in careers in teaching mathematics. More research is needed to ascertain how to improve perceptions of a profession seen as "offering low pay, lock-step advancement opportunities, poor working conditions, and public distain" (Business-Higher Education Forum, 2005, p. 48).
- More research should be done to investigate the problem of teacher attrition and increased action taken to reduce it. This study revealed that high rates of attrition were evident not only for new teachers, but extended to teachers completing their fifth year of service, and was at a height in years two and three. School policy and practice should better focus on molding salary and support structures for teachers according to seniority.
- Because the literature is inconclusive as to what a reasonable rate of attrition might be for teachers (Allen, 2005; Price, 1977, 1997), more research is recommended that compares teachers with other fields and among teachers of different grade levels and subject areas. Since so many in this particular demographic are being hired without appropriate background in the content that they teach, it makes sense that individuals hired to do a job they are not well prepared for will likely add to the level of turnover.
- When making decisions with regard to improving schools, decision makers should be cognizant of the problems with turnover and the short supply of highly qualified teachers. Because of this already grinding problem with teacher shortages, there is a concern that

some well-intended actions, such as limiting class size or school vouchers—unless carefully articulated, could lay even more weight on the problem of teacher quality. It is recommended that over the next few years, as new Florida legislation is being phased in that researchers watchfully measure the effects of such actions on teacher quality and student achievement, and evaluate its worth—especially in areas of critical shortage.

- Another implication of this study is that since a majority of middle school mathematics teachers do not have degrees in mathematics or mathematics education, it is important that these teachers be provided access to and encouraged to attend effective professional development related to mathematics and pedagogy.
- More needs to be done to improve collaboration and heighten the level of more advanced and effective analysis of student achievement data, both within and between districts, universities, and other outside organizations. Mounds of data, gathered by the taxing roll of ongoing assessment, may otherwise continue to go sorely underutilized.
- When designing models for measuring the impact of various factors on student achievement, the relative measures of the strengths of SES and previous mathematics achievement should be considered.
- The results of this work provide little evidence that having an advanced degree or additional years of experience contribute substantially to how well a teacher performs. The implications raise some doubt about the prevalence of using teacher pay scales to reward these attributes.
- This study provided evidence that having a middle school mathematics teacher who is certified in-content (Mathematics 6-9 or 6-12) can make a difference in how well they

perform. It is therefore recommended that efforts be made to reduce the number "out-of-field" and elementary-credentialed teachers in middle schools.

- As content expectations continue to grow more challenging, we should reconsider whether teachers with elementary credentials, who typically are required to take only nine credit hours of mathematics content as compared to teachers with mathematics majors who may complete more than 30 hours, should be required to take additional coursework for certification to teach mathematics in middle schools.
- This research revealed that elementary-certified teachers tend to move to middle schools late in their careers. Questions were raised as to why and as to how much of that mobility is due to supply and demand.
- Since there is an increasing number of teachers entering the profession from other fields (Lowry, 2006), and it is difficult to otherwise identify from what paths they have come, additional information regarding various degree types might be gathered and included in educational databases for future research pertaining to the effects of teachers from alternate routes on student achievement.
- Because this study tracked student test scores from one year to the next, a longitudinal study would heighten the confidence that differences in students' achievement do or do not exist.
- This study focused on specific demographics, and caution should be taken not to generalize to other subjects or to other types of students.
- In the review of literature, it was found that researchers often made claims about the relative proportions of teacher qualities without considering their practical importance. In short, researchers do not always expose the strength, or "effect size." For example,

statistical significance assesses the reliability of the particular test, while the strength measures how much of an association actually exists. It is recommended that when examining differences for future studies, these be considered to avoid publicizing trivial results as though they had practical utility.

Conclusion

While the ability of colleges to attract top-performing students into entering programs geared toward preparing them for teaching careers continues to decline (Corcoran, Evans, & Schwab, 2004), enormous turnover, especially of novice teachers, continues to be a major factor driving the demand for new teachers. Ingersoll and Smith (2003) maintain that the dominant-policy attempts at fixing our retention problem in this revolving-door profession is like pouring more water into a leaky bucket. “Pouring more water into the bucket will not do any good if we do not patch the holes first” (p. 31-33).

This research has revealed that teacher attrition is a huge problem in *all* types of middle schools regardless of the level of poverty, and that mathematics teachers are more likely to leave schools not meeting high standards in mathematics. It illuminates more fully the growing concern that while much of the emphasis in teacher quality remains in how to find and equitably place teachers, most of the problem is with keeping them. Exceedingly high rates of teacher attrition in this sector of the teacher-labor market is a crisis that will no doubt continue without increased and better attention to policies and practices within and among schools.

This study also found some inequities in teacher distribution according to experience, certification, and degree type among different types of schools. The analysis of data did indicate that advanced-degreed teachers were more often found in wealthier schools. Findings related to other teacher qualifications raised questions as to whether and how much some of these qualifications affected student achievement. For example, teacher seniority and degree level were not significant in their effects on student achievement; however, having a level of mathematics content to be certified in mathematics at the middle school level was significant. This pattern in the findings creates a concern that “highly qualified” teachers, according to NCLB, may still remain under prepared in the content that they teach.

APPENDIX A: IRB APPROVAL FORM

University of Central Florida

Office of Research & Commercialization

November 15, 2005

Bonnie Swan, Doctoral student
University of Central Florida
Department of Teaching and Learning Principles
ED 206
Orlando, FL 32816-1250

Dear Ms. Swan:

With reference to your protocol #05-2933 entitled, **"Middle-School Teacher Preparation Effects on Teacher Attrition and Mobility in a Large Urban District"** I am enclosing for your records the approved, expedited document of the UCFIRB Form you had submitted to our office. **This study was approved on 11/14/05. The expiration date will be 11/13/06.** Should there be a need to extend this study, a Continuing Review form must be submitted to the IRB Office for review by the Chairman or full IRB at least one month prior to the expiration date. This is the responsibility of the investigator. **Please notify the IRB office when you have completed this research study.**

Please be advised that this approval is given for one year. Should there be any addendums or administrative changes to the already approved protocol, they must also be submitted to the Board through use of the Addendum/Modification Request form. Changes should not be initiated until written IRB approval is received. Adverse events should be reported to the IRB as they occur.

Should you have any questions, please do not hesitate to call me at 407-823-2901.

Please accept our best wishes for the success of your endeavors.

Cordially,

Barbara Ward

Barbara Ward, CIM
UCF IRB Coordinator
(FWA00000351, IRB00001138)

Copies: IRB File
Michael Hynes, Ph.D.

BW:jm

12201 Research Parkway • Suite 501 • Orlando, FL 32826-3246 • 407-823-3778 • Fax 407-823-3299

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APPENDIX B: TEACHER DEMOGRAPHIC SURVEY & LETTER OF INTRODUCTION

Teacher Demographics Survey

I have read the letter above and voluntarily agree to participate in the survey. Please respond by choosing one of the following options.

[ ] I agree to participate in the following survey.

[ ] I do not choose to participate in the following survey.

Participants must be at least 18 years of age. Are you at least 18?

[ ] yes [ ] no

Please answer the following in the space provided:

1. Institution from which you obtained your <u>most recent degree</u> and the year it was awarded

   ____/__________________
   Institution Year

2. Type of the most recent <u>degree</u> you have obtained (i.e. Mathematics Education, Elementary Education, Business Administration, Engineering).

   ____

3. Did you consider different schools when you obtained your current position?

   Please check Yes ____ or No _____

4. Please provide the main reason or reasons you chose to teach at the school where you are now employed.

____

____

____

THANK YOU!

February 1, 2005

Dear Educator:

I am a former [redacted] mathematics teacher and am now a doctoral student at the University of Central Florida (UCF) conducting research related to mathematics teacher attrition and mobility by teachers' preparation and certification.

Results from this district wide survey will be used along with other data obtained from [redacted] to inform decision makers about the demographic profiles of middle school mathematics teachers and how those profiles relate to student achievement. This is a collaborative project involving UCF and [redacted]. What we would like you to do is answer the questions on the enclosed survey.

Your answers are completely confidential and will be released only as summaries in which no individual can be identified. When you return this form, your name will be deleted from the mailing list and never connected to your answers in any way. This survey is voluntary. If for some reason you prefer not to respond, please let me know by returning this letter with your name indicated below in the enclosed stamped envelope. That way I will not contact you again.

There are no anticipated risks, compensation or other direct benefits to you as a participant in this survey. If you have any questions or comments about this study, please feel free to call me at [redacted]. My faculty supervisor is [redacted]. Thank you very much for your consideration. Questions or concerns about research participants' rights may be directed to the UCFIRB office, University of Central Florida Office of Research, Orlando Tech Center, 12443 Research Parkway, Suite 207, Orlando, FL 32826. The phone number is [redacted].

Sincerely,

Bonnie Swan
Doctoral Candidate, Mathematics Education
Department of Teaching and Learning Principles
College of Education
University of Central Florida

APPENDIX C: TABLE OF COMPARISONS OF FCAT NRT-NCE MATHEMATICS CLASS MEANS BY TEACHERS GROUPED BY SENIORITY

Table 48.

One-Way Analysis of Variance Statistics Comparisons of Class Means of Students' FCAT NRT-NCE Scores by Teachers Grouped by Seniority (N = 282)

		Mean Difference	Std. Error	Sig.
Less than 1 year	1-2 years	-0.99	0.31	0.02
	3-5 years	-2.04	0.34	0.00
	6-10 years	-5.05	0.40	0.00
	11-15 years	-1.07	0.50	0.26
	16 or more years	-5.54	0.38	0.00
1-2 years	Less than 1 year	0.99	0.31	0.02
	3-5 years	-1.05	0.36	0.04
	6-10 years	-4.06	0.41	0.00
	11-15 years	-0.08	0.51	1.00
	16 or more years	-4.55	0.40	0.00
3-5 years	Less than 1 year	2.04	0.34	0.00
	1-2 years	1.05	0.36	0.04
	6-10 years	-3.01	0.43	0.00
	11-15 years	0.97	0.53	0.44
	16 or more years	-3.50	0.42	0.00
6-10 years	Less than 1 year	5.05	0.40	0.00
	1-2 years	4.06	0.41	0.00
	3-5 years	3.01	0.43	0.00
	11-15 years	3.98	0.57	0.00
	16 or more years	-0.49	0.47	0.90
11-15 years	Less than 1 year	1.07	0.50	0.26
	1-2 years	0.08	0.51	1.00
	3-5 years	-0.97	0.53	0.44
	6-10 years	-3.98	0.57	0.00
	16 or more years	-4.47	0.56	0.00
16 or more years	Less than 1 year	5.54	0.38	0.00
	1-2 years	4.55	0.40	0.00
	3-5 years	3.50	0.42	0.00
	6-10 years	0.49	0.47	0.90
	11-15 years	4.47	0.56	0.00

APPENDIX D: SUMMARY OF MIDDLE SCHOOL MATHEMATICS TEACHERS' CHARACTERISTICS

Table 49.

Characteristics of Middle School Teacher Subjects

Characteristics	*n*	%	Seniority in Years Mean	Seniority in Years Standard Deviation
Certification Type				
Mathematics (6-12)	54	19.1%	7.96	9.78
Mathematics (5-9)	139	49.3%	4.60	6.30
Elementary (K-6)	46	16.3%	5.54	8.11
Other	43	15.2%	7.26	.50
Teacher Degree Level				
Bachelors	208	73.8%	4.13	6.38
Advanced (Masters or Higher)	74	26.2%	7.47	9.21
Total	282	100.0%	5.00	7.36
*Teacher Degree Type				
Mathematics	9	4.8%	6.11	9.25
Mathematics Education	34	18.1%	8.94	9.17
Elementary Education	35	18.6%	8.29	7.83
Other Education	20	10.6%	5.50	8.21
Other (not education or math)	90	47.9%	2.74	6.00
Total	188	100.0%	5.35	7.80

Note. *Data for teacher degree type was obtained from surveys where 67% of teachers responded. Other teacher-level data were obtained from district level database. Percentages are rounded.

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APPENDIX E: PERCENTAGE OF MIDDLE SCHOOL MATHEMATICS TEACHER TURNOVER BY SCHOOL AND TEACHER DEMOGRAPHICS CHART

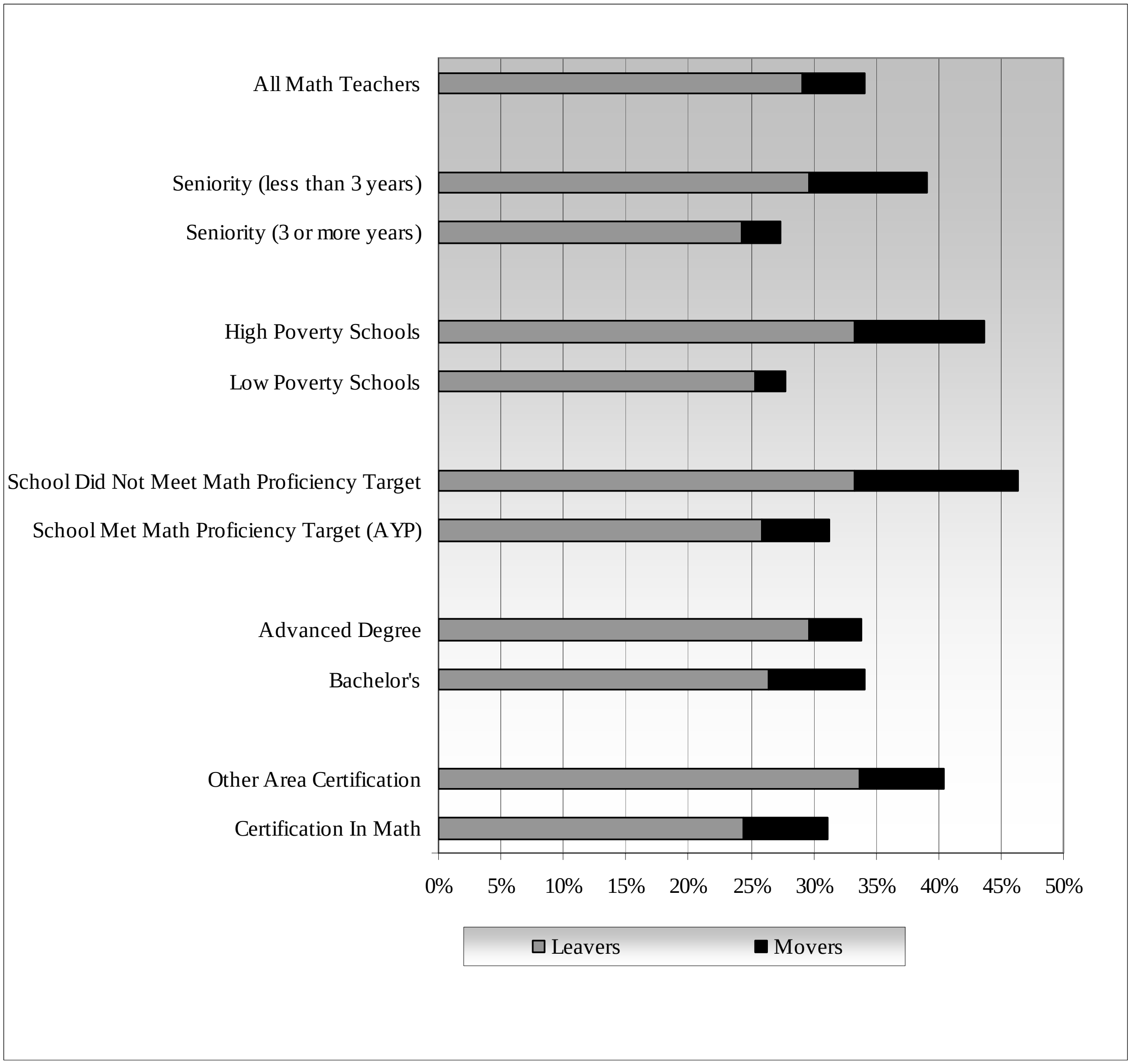

Figure 11. *Percentage of Middle School Mathematics Teacher Turnover by School and Teacher Demographics in a Large Urban District*

(N = 282)

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