ABSTRACT


This study examines the course enrollment practices of students into 8th grade Algebra. The placement practices were framed by the Organizational Differentiation of Students Framework, which provides a construct for how students are divided into subgroups for instructional purposes.

The sample (n = 92) for this study included the population of a small school district’s students from the 2005 5th grade cohort until their 8th grade course placements. Prediction models took into account scores from the North Carolina End of Course tests and determined enrollment eligibility for 8th grade Algebra. Chi-Square distributions and calculating Binomial Proportion Confidence intervals were used to analyze the data.

Analysis of the data revealed that students predicted to gain access to 8th grade Algebra did not, in fact, gain access. However, students who were enrolled in courses with certified teachers gained access at a greater rate. The study also suggests that students’ gender and ethnicity have no effect on the enrollment of students into 8th grade Algebra in this school district. Moreover, evidence clearly suggests that students who are simply designated “Academically Gifted” are highly likely to enroll in 8th grade Algebra.

by
Peter M. Eley

A dissertation submitted to the Graduate Faculty of North Carolina State University in partial fulfillment of the requirements for the Degree of Doctor of Philosophy

Mathematics Education

Raleigh, North Carolina

2011

APPROVED BY:

Dr. Karen F. Hollebrands

Dr. Ernest L. Stitzinger

Dr. Allison W. McCulloch

Dr. Lee V. Stiff
Chair of Advisory Committee
DEDICATION

I would like to dedicate this dissertation to every teacher I ever had: inside the classroom and outside of it.
BIOGRAPHY

Peter Madison Eley was born in Henderson, NC on December 2, 1977; he is the son of Lemuel and Wanda Eley. Peter attended and graduated from Southern Vance High School in June of 1996. He attended Elizabeth City State University, where he graduated with a Bachelor of Science in Pure Mathematics in May 2000. He attended graduate school immediately after undergrad at North Carolina State University and earned his Masters Degrees in Applied Mathematics in 2002 and Mathematics Education in 2008.

Peter taught mathematics and science at Eaton Johnson Middle School in 2002. He also taught mathematics at South Granville High School in 2002-2003. Peter worked as the Data Manger/Webmaster for Saint Augustine College in Raleigh, NC 2003-2005. He later relocated to Winston-Salem, NC to work at Winston-Salem State University to serve as the Mathematics and Science Education Pre-College Program Coordinator 2005-2010.

Peter was accepted into the NCSU Mathematics Education Graduate Program in the fall of 2005 under the direction of Dr. Lee V. Stiff, Professor and finished another Master’s Degree in Mathematics Education in fall 2008. He began work on his PhD Spring 2009 under the direction of Dr. Lee V. Stiff Professor. Peter accepted (2010) an assistant professorship in which he would serve as a mathematics educator in the Middle Grades Secondary and Special Education Department at Fayetteville State University where he is currently teaching and researching.
ACKNOWLEDGMENTS

The seemingly eternal quest for this degree has required the help and support of many people. I would like to use this forum to acknowledge their contributions.

First I would like to thank Jesus Christ who is the first love of my life for granting me the ability, strength, patience and endurance to finish this marathon. For that I say Thank You, Jesus…

Thank you to my wife of 8 years Felicia during the writing of this dissertation she has been pregnant with our first child (Maddison) and I am ever grateful for her love and support during all of these life changing events in our lives.

To my natural father Lemuel, thanks for your sacrifice and being a real father by loving my mother and being around to raise me to see me through. I am who I am because of your sacrifice and love. Also to my mother thanks for your reassuring words and teaching me math at such an early age, until this day I remember you teaching me how to add.

To my 2 brothers and 2 sisters I have made it and the challenge is on… which one of you will be next. The bar is set….

To my church families Greater Ransom Way and Christ Temple thanks for your support and prayers to supplement me through.

To my friends Frank, Tracey, Mike and Tyrone I appreciate our friendships that started with us all being grad students at NC State in Mathematics and have carried over for a lifetime. I can play golf without guilt now. See you on the course.

To my colleagues at St. Augustine’s, Winston-Salem State, and Fayetteville State thanks for the support and motivation to finish. I started this degree while working at St.
Augustine’s College; I got into the meat of it at WSSU (Drs. Vince &Pam Snipes, Ms. Poston) and finished it at FSU (Drs. Lewis, Smith, Bogor, Virginia, and Ms. Jenny, Ms. LaRachel).

Special Thanks to my advisor Dr. Stiff, for your patience and clipping my wings when then need to be clipped. I would like to also thank the rest of my committee members Drs. McCulloch and Hollebrands, and especially Dr. Stitzinger, for helping navigate the sometimes-murky waters of NCSU.

Thanks to all of my classmates for the endless hours of help through classes, and my work spouse Dr. Amanda Lamburtus. Arkansas State will never be the same.

Lastly to my family in multicultural affairs and Dr. Tracey Ray, yes I am finally done...
# TABLE OF CONTENTS

**LIST OF TABLES** ................................................................................................................................. ix

**CHAPTER 1** ................................................................................................................................. 1

- **INTRODUCTION** ......................................................................................................................... 1
  - Purpose of the Study ...................................................................................................................... 4
  - Significance of the Study .............................................................................................................. 6

**CHAPTER 2** ................................................................................................................................. 8

- **REVIEW OF LITERATURE** ........................................................................................................ 8
  - A Brief History of Algebra as a School Course ........................................................................ 8
    - Algebra in Secondary Schools ................................................................................................. 9
    - Algebra under Attack ............................................................................................................. 9
    - New Math Era and Algebra .................................................................................................... 10
    - The Era of Standards in Algebra ........................................................................................... 11
    - Algebra in the 21st Century .................................................................................................... 13
  - Sørensen’s Framework for Organizational Differentiation of Students .................................... 15
    - Vertical and Horizontal Differentiation .................................................................................. 16
    - Inclusiveness ........................................................................................................................... 17
    - Assignment Procedure ............................................................................................................ 19
    - Scope and Rigidity .................................................................................................................... 22
  - Placement Practices .................................................................................................................... 23
    - Standards for Course Placement ............................................................................................ 23
    - Parents’ Involvement in Students’ Placements ....................................................................... 25
    - Social Placements ..................................................................................................................... 27
    - Belief Systems and Attitudes of Teachers/Administrators ...................................................... 28
LIST OF TABLES

TABLE 1. STUDENT PARTICIPATION IN THE STUDY ................................................................. 41

TABLE 2. NUMBER OF 6TH GRADE STUDENTS PREDICTED TO ENROLL IN 8TH GRADE ALGEBRA VS. ACTUAL NUMBER OF STUDENTS ENROLLED IN 8TH GRADE ALGEBRA . 43

TABLE 3. NUMBER OF 6TH GRADE STUDENTS NOT PREDICTED TO ENROLL IN 8TH GRADE ALGEBRA VS. ACTUAL NUMBER OF STUDENTS NOT ENROLLED IN 8TH GRADE ALGEBRA .............................................................................................................. 43

TABLE 4. NUMBER OF 7TH GRADE STUDENTS NOT PREDICTED TO ENROLL IN 8TH GRADE ALGEBRA VS. ACTUAL NUMBER OF STUDENTS NOT ENROLLED IN 8TH GRADE ALGEBRA .............................................................................................................. 44

TABLE 5. NUMBER OF 7TH GRADE STUDENTS PREDICTED TO ENROLL IN 8TH GRADE ALGEBRA VS. ACTUAL NUMBER OF STUDENTS ENROLLED IN 8TH GRADE ALGEBRA .............................................................................................................. 45

TABLE 6. TEACHERS’ CERTIFICATION FOR 6TH GRADE STUDENTS ........................................... 45

TABLE 7. TEACHERS’ CERTIFICATION FOR 7TH GRADE STUDENTS ........................................... 46

TABLE 8. TEACHERS’ CERTIFICATION FOR 8TH GRADE STUDENTS ........................................... 47

TABLE 9. COURSE PLACEMENT BY GENDER IN 8TH GRADE .................................................... 48

TABLE 10. COURSE PLACEMENT AND STUDENT ETHNICITY OF 8TH GRADE STUDENTS ....... 49

TABLE 11. ADVANCE COURSE PLACEMENT OF 6TH GRADE SUBJECTS (N = 92) ................. 50

TABLE 12. ACCESS OF 7TH GRADE ACADEMICALLY GIFTED STUDENTS ................................. 50

TABLE 13. ACCESS OF 8TH GRADE ACADEMICALLY GIFTED STUDENTS ................................. 51
CHAPTER 1

INTRODUCTION

The mathematics courses that students take and the timing of when they take them have a significant impact on their future success in school and beyond. Students’ course-taking patterns significantly impact their future in mathematics achievement (Schweiker-Marra & Pula, 2005; Gamoran, 1992; Wang & Goldschmidt, 2003). Furthermore, since mathematics courses in schools are hierarchical in nature, the time when students take courses can hinder or help their overall academic achievement. Schweiker-Marra & Pula (2005) suggest that students who take Algebra I in the 8th grade succeed at higher rates than students who do not. Students in the aforementioned study had better grades and went to college at higher rates than the students that were not afforded the opportunity to take 8th grade Algebra.

Students who have taken Algebra in 8th grade have more opportunities for future success in all areas. In particular, students’ chances of being competitive in the college admission process are increased if they have been enrolled in an 8th grade Algebra course (North Carolina Department of Instruction, 2010). Wang & Goldschmidt (2003) support these claims of future success; they discovered that students who experience early success in mathematics continue to be successful in high school.

Students who take Algebra in 8th grade also have significantly lower dropout rates. Data suggest that students who take Algebra in the 8th grade dropout at lower rates because students gain confidence in their abilities (Callahan, 2005). According to Callahan (2005),
the effects of self-confidence carries over into other courses and the students do better overall. Data from the Triangle High Five Regional Partnership of North Carolina (2008) reveal that counties with lower dropout rates have lower crime rates. Furthermore, a correlation between the dropout rate and the average income of families, suggests that dropouts have a lower average family income in the future in comparison to students who complete high school (Triangle High Five Regional Partnership, 2008). Kerckhoff (1993) concludes that it is imperative that students graduate from high school in order to build stronger individuals, families, communities, and create a stronger economic impact over time.

North Carolina agencies report that students that have low socioeconomic status (SES) take 8th grade Algebra at lower rates than students who have high SES (North Carolina Department of Public Instruction, 2010). SES is determined by whether students receive free/reduced lunch or not. Students who qualify for free/reduced lunch tend to have the following characteristics: minority, low income, and/or have parents who are less likely to have a high school diploma or college education. Students with these characteristics tend to attend schools with fewer resources, which result in fewer course offerings (O’Connor, Lewis, & Mueller, 2007). It has been discovered that in schools with many low-level, less rigorous course offerings, inequalities in course-taking behaviors are becoming the norm (Abu El-haj & Rubin, 2009; Kelly, 2009). Students from low SES families are less likely to take high quality courses, and therefore, have fewer opportunities to learn worthwhile mathematics (Cauley & Jovanovich, 2006; Kelly, 2007; Spade, Columbia, & Vanfossen, 1997; Stone, 1998; Oakes, 1985).
The opportunity to take Algebra in the 8th grade is also a mathematics equity and achievement issue. In 2000, the National Council of Teachers of Mathematics (NCTM) released *Principles and Standards for School Mathematics* in which six guiding principles were created to support high-level student achievement in the schools. The first of these principles is Equity. According to NCTM, equity is defined as the ability to give “all students, regardless of their personal characteristics, background, or physical challenges, opportunities to study and support to learn mathematics” (National Council of Teachers of Mathematics, 2000, p. 12). NCTM also suggests that equity involves “high expectations and strong support for all students” and “requires high expectations and worthwhile opportunities for all” (p. 12). Consequently, providing greater access to Algebra in the 8th grade is an important step toward reaching NCTM’s Equity goals.

For many years, schools have implemented practices of exclusion in school mathematics (Schweiker-Marra & Pula, 2005). Often the reasons for excluding students from high quality math offerings have little to do with their academic qualifications. In today’s society, it is important to re-examine schools’ course placement policies and practices in order to provide the Nation with the best talent possible. Beyond the practical nature of such placement decisions, proper course placement is also a moral issue in that students who deserve access to better courses should not be denied that access because of social and political inequities (Shakeshaft, 1990).
Purpose of the Study

Why do some children gain access to high quality mathematics and others do not? What are the characteristics of the students, teachers, mathematics courses/programs, and schools associated with placement into 8th grade Algebra?

What we do know so far is that students’ previous course taking behaviors often determine the courses students will take or be eligible to take (North Carolina Department of Public Instruction, 2010). For example in North Carolina if a student is taking a general course in 7th grade math they are less likely to take 8th grade Algebra even if the student does significantly well. The question is often asked why can’t a student take a general course in 7th grade and take the Algebra course the next year? The simple answer would be because the student has not taken the prerequisite course for 8th grade Algebra, which is usually Pre-Algebra. Since math is hierarchical in structure, most students take Pre-Algebra before taking Algebra.

The follow-up question usually is, if students were doing so well why were they in the general 7th grade mathematics course? The simple answer to this question is: students were either tracked into the course by previous course placement, or the student chose the course. From previous research on tracking we have learned that students are tracked into courses for a variety of reasons or factors, such as ability grouping for instruction (Oakes, 1985; Sørensen, 1987; Useem, 1992). Also clear from previous research is that some students choose courses based on their social contexts and not their academic ability (Frank, et al., 2008).
To offer more answers to the above and similar questions, it is important to examine the characteristics of students, teachers, mathematics courses/programs, and schools in a variety of contexts. Such characteristics will be examined for one of the Local Education Agencies (LEAs) in the state of North Carolina.

This study will determine if significant relationships exist among key variables describing the 5th grade through 8th grade cohort for the years 2006-2010. The relationships between course predictions and actual course placement will be studied. More specifically, we will examine data from the North Carolina Window of Information on Student Education (NCWISE) system, where we have the students grouped into two different categories: regular students and Academically Gifted students. Through our analysis we will compare and contrast the access privileges and other factors that directly affect access to rigorous mathematics courses.

Factors that could have an effect on course placement include constructs such as student ethnicity, SES, parent educational level, teachers’ belief systems, teacher certification, and special school district designations such as academically gifted or learning disabled. Financial factors could possibly limit students’ access to high quality mathematics courses because of limited course offerings and lack of qualified teachers. Student performance on standardized tests is another factor that affects access to 8th grade Algebra.

The purpose of the study is to determine the impact such factors may have on student access to and success in 8th grade Algebra.
Significance of the Study

The study will contribute to the ongoing discussion in mathematics education as it relates to access in high quality mathematics in middle grades and high school. Given the Nation’s need for more engineers, scientists, and mathematicians, it is critical that proper placement decisions be made throughout a student’s career. Moreover, gaining the proper placement in school mathematics is also an equity issue that should not go unresolved. Thus, the study will address key educational needs and concerns and contribute to the scientific well being of a nation.

The goal of the study is to identify the significant factors that determine 8th grade Algebra placement. At the conclusion of the study these significant factors and how they relate to course-taking patterns will be examined. Finally, recommendations for gaining access to 8th grade Algebra will be provided. Since students tend to take courses in tandem (e.g., geometry & biology) (North Carolina Department of Public Instruction, 2009), we believe the findings of the study will also address course-taking behaviors in other academic areas.

Research questions need to be developed to investigate the factors that have impacted the placement of students in the advanced mathematics track. By examining such variables as ethnicity, gender, and projected placements, we can begin to address questions of the following nature:

1) How is course placement in 8th grade Algebra I determined?
   a) Do students who are projected to take 8th grade Algebra actually gain access?
b) What is the frequency of students in the 8th grade Algebra track?

c) What are the demographics of students that gain access to 8th grade Algebra?

2) What factors affect course placement in 8th grade Algebra I?

   a) Does student gender affect course placement?
   
   b) Does student ethnicity affect course placement?
   
   c) Does the level of teacher certification impact student course placement?
   
   d) Does the number of course offering in the school affect course placement?

3) Do students with the Academically Gifted (AG) designations gain greater access than students who do not have such designations?

   a) Are the actual placements of AG and regular students highly correlated to their math performance predictions?

   b) Do students who are not projected to gain access into 8th grade Algebra gain access?

This study should contribute to the ongoing dialogue in mathematics education about all students gaining access to rigorous mathematics and ensuring that qualified student gain the opportunity to take rigorous mathematics course.
CHAPTER 2

REVIEW OF LITERATURE

A Brief History of Algebra as a School Course

Initially, in American education, Algebra was a college course. It was first taught at Harvard University in 1786 (Kilpatrick & Izsák, 2008). The course consisted of what was called specious arithmetic or universal arithmetic. Specious or universal arithmetic is the expressed symbolic rules for operating with any species of quantity. In addition, students were taught how to manipulate expressions and solve simple equations with numerical coefficients. The rules were taught in general without proof. The theorems and formulas introduced were taught as exercises. Factoring was not in the course curriculum and a concerted effort was made to avoid negative quantities in the early Algebra curriculum (Kilpatrick & Izsák, 2008).

Over the course of time, as society’s needs changed, Algebra was introduced into secondary schools. As a result, Algebra was required for admission to Columbia (1821), Yale (1849), Princeton (1848), and Harvard 1920 (Kilpatrick & Izsak, 2008). Once the nation’s leading colleges and universities changed their admission policies to include Algebra, it soon became a mandatory course at the secondary level. The consequences of not offering Algebra in secondary schools resulted in students not being admission-ready for the top colleges and universities.
Algebra in Secondary Schools

Algebra was introduced to secondary schools because it served a practical need of the nation since it included surveying and navigation applications. According to Overn (1937), its initial introduction was not for disciplinary reason but to add to the skilled labor force.

Algebra was also introduced into the secondary curriculum because of the changes in admission standards of colleges and universities. The campaign for moving the Algebra curriculum to secondary schools was spearheaded by the state of Massachusetts in 1827, which passed a law that required Algebra to be taught in towns with at least a population of 500 families (Kilpatrick & Izsák, 2008).

There were two major competing views of what should gain emphasis in Algebra teaching—“generalized arithmetic” and “functional thinking”. From 1820 to 1928 the generalized arithmetic view of Algebra dominated American secondary schools’ mathematics curriculum (Chateauneuf, 1929; Osborne & Crosswhite, 1970). The use of functions as a unifying concept was clearly prevalent in Europe, but it had little influence on America. In fact, the Committee of Ten (1892) proposed that Algebra be treated as generalized arithmetic in the middle grades to provide preparation for the formal introduction of it in the 9th grade (National Educational Association, 1894). Therefore, it was decided that a reduced Algebra program that put emphasis on equations over functions would be taught at the junior high school level (Betz, 1926).

Algebra under Attack

During the periods of 1890 until 1940 there was a tremendous growth in school enrollment. With the growth in enrollment came the increased enrollment of students into
Algebra. However, the fast growth of Algebra brought with it a very high failure rate. As a result, the enrollment of students into Algebra began to decline. A solution to the problem of a steady decline of enrollment in Algebra was deciding to make Algebra an elective rather than a required course for students in secondary school (Kilpatrick & Izsák, 2008).

The decline in school enrollment caused educators to revise the Algebra course that was being taught to reflect more of the ideal of “social efficiency”: the doctrine that “the job of the schools first and foremost was to train children and youth for their predicted adult roles” (Kliebard & Franklin, 2003, p. 405; Kilpatrick & Izsák, 2008). According to David Eugene Smith (1926) the purpose of teaching Algebra “a quarter of a century ago seems to have been to make mathematicians; the purpose today is to make well-informed American citizens” (Smith, 1926, p. 20; Kilpatrick & Izsák, 2008). He also stated that it “consists in giving to everyone a general idea of the meaning of algebra, together with a few definite and useful applications which everyone is likely to meet” (Smith, 1926, p. 21).

New Math Era and Algebra

Algebra underwent significant changes during the 1950s-1970s, changing from “generalized arithmetic to systemic structure and proof” (Kilpatrick & Izsák, 2008, p. 7). The changes in the Algebra curriculum were necessary to prepare students for more advanced study in mathematics. Four points characterized the new approach to Algebra: understanding the nature and role of deductive reasoning in Algebra and Geometry, appreciation of mathematical structures (i.e. patterns), judicious use of unifying ideas (i.e. sets, variables, functions), and treatment of inequalities along with equations (College Entrance Examination Board, Commission on Mathematics, 1959, p. 33). Unifying ideas
replaced (or redefined) things such as *literal numbers* and *literal equations* with *numbers* and *equations* (Kilpatrick & Izsák, 2008). Some of the other changes that were made were to concepts such as variable, which was no longer defined as a “quantity that varies” but as a symbol that replaced numbers. Many of the changes in the new math era have had some lasting effects on current mathematics today.

The Era of Standards in Algebra

In the 1970s and 1980s, like many students during 1940-1970, students continued to fail Algebra in high school (Moses & Cobb, 2001). Problems that students had with Algebra were addressed by NCTM’s Standards-based reform programs (National Council of Teachers of Mathematics, 1989; 2000). The changes in Algebra were a direct result of the Standards-based reform that was introduced by NCTM.

Many researchers during the late 1970s and 1980s investigated how students understood algebraic manipulations and function concepts (Kieran, 1992; Leinhardt, Zaslazsky, & Stien, 1990). Many recommended the introduction of Algebra earlier in the mathematics curriculum because Algebra concepts were typically presented in an abrupt manner in high school. In particular, many of the algebraic concepts that students needed to be successful in Algebra could have been introduced in middle grades but were not. NCTM (1989) responded to the abrupt introduction of Algebra by introducing the Patterns and Relationship Standards for K-4, the Patterns and Functions Standard and the Algebra Standard for 5th grade through 8th and lastly, the Algebra and Functions Standards for 9th - 12th grades. The introduction of these Standards allowed Algebra concepts to be introduced and developed over the course of time versus everything at once. The Standards-based
reform in mathematics promoted *Algebra for All*. NCTM’s (1989; 2000) Standards demonstrated the need for rigorous mathematics for all students with particular attention to Algebra because of Algebra’s ability to relate to a broader range of students (Kilpatrick & Izsák, 2008). However, there were two influences that mathematics educators had to consider. The first was “economic opportunity and equal citizenship” and the second was re-conceptualizing elementary school mathematics to better prepare students for the rigors of Algebra (p. 11). As educators were considering these two influences, a landmark study by Pelavin & Kane (1990) gave insight on the direction to go.

The landmark study “Changing The Odds: Factors Increasing Access to College” (Pelavin & Kane, 1990) spoke to our capacity to engage all students in rigorous curricula. It highlighted three findings: (a) a relationship exists between course taking patterns and increased college attendance, (b) ethnicity and family income affect high school course taking patterns, and (c) ethnicity, family income, and high school courses taken affect college graduation. Pelavin & Kane (1990) suggested that there were significant differences in college attendance and completion between minority and White students, and between poor and non-poor students. Furthermore, minority students were behind White students in aspiring to obtain bachelor’s degrees. Armed with the findings of this study, the College Board sponsored *Equity 2000* (1998), which addressed giving access to advance math courses to everyone.

The primary goal of *Equity 2000* (1998) was to eliminate tracking and to provide rigorous academic courses as the foundations of excellence. Secondarily, it helped districts raise expectations and performance levels by providing student assistance and support
systems for counselors, teachers, and administrators (The College Board, 1994). As a result of Pelavin & Kane’s study (1990) and *Equity 2000* (1998), NCTM responded with a position statement *Algebra for All* (National Council of Teachers of Mathematics, 1994), which expressed the importance of all students gaining access to Algebra.

Algebra is used as the gatekeeper course to high quality mathematics courses, which is needed to be competitive for college admission. The Equity Principle from NCTM (2000) *Principles and Standards* clearly states that high expectation levels and support for all students is expected but it also explicitly states that all students should learn Algebra.

**Algebra in the 21st Century**

Contemporary issues in mathematics education have led to the political reform legislation known as *No Child Left Behind Act of 2001* (NCLB). This legislation used scientifically-based research as a guide for instructional practices in classrooms. It was considered a major shift in policy from the traditional history of decentralized education decision-making (Feuer, Towne, & Shavelson, 2002).

Current issues in society often directly drive policies in mathematics education. Changes in policy always have critics and result in other changes or modifications about every decade or so. Such policy shifts directly affect how students take courses and how the curriculum is taught. In an effort to stay current and relevant, states have to review and update their academic and curricula standards. As a result of such a process, in 2010 North Carolina’s Department of Public Instruction (NCDPI) recently adopted the Common Core State Standards. The Common Core State Standards are sponsored by the National Governors Association Center for Best Practices and the Council of Chief State School
Officers. These standards are designed to help North Carolina embrace clear and consistent goals for learning to prepare children for success in college and work.

Documents on the NCDPI’s website give a detailed overview of what students are expected to gain from the newly adopted standards. Students are expected to be aligned with college and work expectations. Students will also be expected to embrace rigorous content and application of knowledge through high-order skills. Furthermore, they will be expected to build upon strengths and lessons of current state standards, to name a few. The Common Core State Standards in North Carolina does not directly address 8th grade Algebra. The major components of the 8th grade course include emphasis on expressions, equations and inequalities, and functions and modeling (North Carolina Department of Public Instruction, 2010).

North Carolina does not directly address 8th grade Algebra in the Common Core State Standards. In 2008, the state of California passed legislation that mandated that as of 2011 all 8th grade students will be required to take Algebra (Asimov, 2008). As the needs of society and technology continue to change it may be inevitable for others states to follow the lead of California in requiring 8th grade Algebra for all of their students.

Algebra in the 21st Century has evolved in how it is being taught. Advances in technology allow teachers to teach using simple dynamic computer programs. Students are also taught using calculators that have advanced computing power. Using technology to teach mathematics brings in a new motivational factor for students to learn mathematics (Eley, 2008).
Economics severely effects access to Algebra in the 21st Century. Economics may also determine how much each school district is willing to spend to teach Algebra and assess students’ success in Algebra. Economics can play another role in that the best teachers frequently go to school districts where they are paid more, leaving low-income students with less qualified teachers or lateral entry teachers (Figlio, 1997).

In order to study how students gain access to 8th grade Algebra, an appropriate framework needs to be utilized to ensure that the process is studied in a systematic way. Sørensen’s Organizational Differentiation provides an appropriate structure for analyzing student placements.

Sørensen’s Framework for Organizational Differentiation of Students

Sørensen’s Framework for Organizational Differentiation (1969) of students is the division of a school’s student-body into subgroups of a relatively permanent character for instructional purposes. Any educational setting where students are assigned to groups for instructional purposes has created an organizational differentiation. The emphasis of organizational differentiation is the structured learning environment that is created by administrators or administrative processes for instructional purposes.

Organizational differentiation is not classified by one particular form; rather, it can exist in numerous embodiments. These forms are often viewed as grouping structures such as age-grade groupings or ability groupings of students. Sørensen created four dimensions of differentiation. In this study we examine all four dimensions of Sørensen’s Framework for Organizational Differentiation.
The framework consists of four components: (a) Vertical and Horizontal Differentiations, (b) Inclusiveness, (c) Assignment Procedure, and (d) Scope and Rigidity. Vertical Differentiation refers to how instruction is assigned for a given amount of time. Horizontal Differentiation refers to how varied the curriculum is during the provided time for instruction. Vertical and Horizontal Differentiation are talked about in tandem because of the overlap that exists in these constructs. Inclusiveness refers to the opportunities that a student has to be included in rigorous mathematics courses. An Assignment Procedure is the process used to create a desired classroom composition. Scope is a measure of how long a given group of students stay together as a cohort over a period of time, and Rigidity refers to students’ ability to transfer from one cohort to another. Scope and Rigidity are often discussed together because they have an inverse relationship. Each component is discussed in greater detail below.

Vertical and Horizontal Differentiation

Vertical differentiation is a dimension of organization differentiation that divides students into sub-groups. More specifically, it is a differentiation of a group to reduce the amount of variation in what they learn during a given period of time (Sørensen, 1969). For example, age-grade, and ability grouping are all types of vertical differentiation in that students are taught according to the appropriate age level or taught to the ability of the group of students in the course.

Horizontal differentiation is intended to control what is being taught in the curriculum during the amount of time the instructor has to provide instruction (Sørensen, 1969). Examples of horizontal differentiation are subject stratifications such as Algebra and
Geometry. These subjects are not taught according to age or ability grouping; generally, students are given the same instruction.

Vertical and Horizontal Differentiation have a tendency to overlap and that is why we often talk about them together. Specifically, middle schools are organized by age-grade grouping and then are re-grouped again according to ability level or courses depending on the school and student. Clearly, Vertical and Horizontal Differentiation criterion divide students into several groups depending on age, ability, and courses. An example of Vertical and Horizontal differentiation is a student who is in the 7th grade taking (grouped by age) an advance math course (grouped again by ability).

Inclusiveness

Inclusiveness is another dimension of organization differentiation that is defined as “the number of opportunities assumed to be available at different educational levels” (Sørensen, 1969, p. 9). An example of inclusiveness would be students gaining access to Algebra in the 8th grade. An LEA or a school district could be deemed inclusive or exclusive according to the opportunities available to students for course enrollment. An exclusive school would not have the opportunities that students need and are eligible for. Kelly (2009) defines inclusiveness as “the proportion of students in the highest track, controlling for the ability distribution of the students” (p.17).

During a further look into inclusiveness, Wang & Goldschmidt (2003) discovered in their study that advanced courses enrolled 1.49 times as many White students in comparison to African American students. It was almost the converse in remedial classes where Hispanic students were enrolled 1.27 times as often as White students and African American students.
were enrolled 2.05 as often as White students. In terms of inclusiveness, White students are more inclusive to the higher track course while the remedial courses are more inclusive to Black students.

Analyzing the effects of race, academic background, and school racial composition on mathematics course-taking behavior, Kelly (2009) indicated that differences exist in course-taking behaviors between Black and White students. It was found that White students were twice as likely to be in the top two mathematics sequences when compared to Black students, when controlled for academic ability.

Spade, Columba, & Vanfossen (1997) indicated that enrollment in college-track mathematics classes were 6% higher in schools that where designated as excellent middle schools than schools that did not have the excellent middle school designation. They further noted that schools designated excellent middle schools in the study did not enroll students in general or basic mathematics courses. This was in contrast to schools designated average middle schools for which the college track enrollment rate was 1/5 that of the excellent middle schools.

Lucas & Gamoran (2002) found that Black students who attended a school with a high percentage of Black students have a greater probability of being placed in a high track. This was also found to be true in private Catholic schools (Kelly, 2009). “If White students are more likely than Black students to be enrolled in Catholic and other private schools, this enrollment pattern would contribute to both the between-school and the total course-taking gap between Blacks and Whites” (p.49). Kelly (2009) suggests that the gap would widen and cause more disparities between the groups because the percentage of enrollment of Blacks
would be lower and inclusiveness would be low. Practices of inclusiveness are more common in Catholic schools than in public schools (Bryk, Lee, & Holland, 1993). As a result, the course-taking patterns in mathematics result in higher-track placements in Catholic schools and smaller differences in the achievement gains across tracks (Kelly, 2009).

Variations in the inclusiveness dimension have been associated with the achievement growth of students. Differences of interpretation of inclusiveness result in multiple track placements for students. Multiple track placements are used instead of allowing all students access to rigorous mathematics courses. Differences of interpretation of the inclusiveness dimension have resulted in the use of multiple tracks in mathematics placements that are affected by students’ SES.

Assignment Procedure

The Assignment Procedure dimension in Sørensen’s Framework for Organizational Differentiation is the procedure for the placement of students into groups that determine the classroom composition relative to the composition of the cohort from which the class is drawn (Sørensen, 1969, p.10). An example of an Assignment Procedure would be selecting students from a class in a process that results in the classroom composition containing only low SES students. The Assignment Procedure uses two distinct criteria to make assignments: “electivity” and “selectivity.”

Electivity is the degree to which students’ own decisions are allowed to be a determining factor in the assignment to groups (Sørensen, 1969, p.10). An example of how electivity is used in course taking is a student gaining access to 8th grade Algebra because he simply chooses to take the course. Kelly’s (2007) study informs us that course placement in
North Carolina is referred to as a student/parent “informed choice system.” This means that students may enroll in any course that they are eligible for. The eligibility of a student is based on requirements that the school has set, therefore enabling the school to create any tracking structure that they want.

The second criterion used by the Assignment Procedure is selectivity. Selectivity is “the amount of homogeneity that educational authorities intend to produce by the assignment, in terms of the index of learning” (Sørensen, 1969, p.11). The term “index of learning” refers to the “various assignment criteria that are used to determine track placement.” An example of selectivity is the criterion “academic performance” which refers to how well a student did in a course the previous year (Kelly 2007, p.17).

Many selectivity criteria exist. For example, Stone (1998) found that the placement of students into gate-keeping courses was not a meritocratic process. A meritocratic process would mean that students are assigned to courses based on performance. However, many critics of meritocracy claim that the meritocratic process is inequitable in assigning students to gate-keeping courses because no valid measures of students’ academic ability (other than past performance) exist (Gamoran, 1992; Welner & Oakes, 1996).

According to Stone (1998), school assignment, socioeconomic status, and the combination of gender and socioeconomic status are significantly related to students’ placement into college-track mathematics courses. Stone (1998) found that students who scored in the upper quartile on math assessments were not always systematically assigned college-track mathematics courses. Indeed, student assignments into college-track mathematics did not meet the meritocratic definition of fairness since 27% of the students
who were eligible were not allowed to enroll into college-track mathematics. In fact, students that were low SES were 3 times more likely to be denied access to college-track mathematics courses (Stone, 1998).

Spade, Columba, & Vanfossen (1997) reported that high middle-class schools and schools of excellence were the most likely to use objective criteria for course placement. These high middle-class schools used several objectives to make course placement decisions. They also had formulas for students who were not placed into accelerated courses in 9th grade such as mathematics. The formula for 9th grade mathematics course placement was done in a systematic way using aptitude tests given in the 7th and 8th grades, teachers’ recommendation, and students’ past performance. Objective placement measures were also used after students’ 9th grade year.

Excellent middle and high schools offered 1 or 2 more advanced courses in their area of excellence than did the average middle and high schools of the same social class (Spade, Columba, & Vanfossen, 1997). The higher social-class school offered higher track mathematics courses. In the higher social-class districts, schools offered 6 to 7 accelerated, honors, or AP courses in both mathematics and science.

Spade, Columba, & Vanfossen (1997) indicated that in schools of higher social classes, more advanced classes were available to students. They concluded that selectivity was high and was a direct reflection of available financial resources of schools. The higher social-class schools used more objective measures to assign students courses in mathematics and science. Research suggests that social class plays a very important role in equity issues.
The higher the social classes were in this study the more equitable the situations became for all students.

Scope and Rigidity

The Scope and Rigidity dimension has two distinct parts. Scope, in organizational differentiation, refers to how long a given group of students will be members of the same classroom or cohort over time. Scope is categorized as being high or low (Sørensen, 1969). For example, a group of students have high Scope if the stay in the same cohort from 6th grade through 12th grade. Groups of students have low Scope if members of the cohort are constantly changing.

Scope is an important construct because the characteristics of students that assigned them to that cohort may have actually influenced the achievement of the group. This influence may be positive or negative. Schools having groups of students with high Scope are often seen in LEAs with relatively small populations because there are fewer combinations of students that can be created.

Rigidity (or mobility) is the “extent to which an individual student may transfer to another group other than the one originally assigned to” (Sørensen, 1969, p.13). Rigidity is also described as being high or low. An example of high Rigidity is a group of students who have formed the same cohort over a long period of time. An example of low Rigidity is a group of students who move from general math to advanced math within the same school year. Schools frequently promote high Rigidity among their students because they do not want students to frequently change tracks.
Scope and Rigidity differ in that Scope describes changes to the cohort of students whereas Rigidity describes an individual student’s ability to move from one instructional setting to another.

Limitations on course enrollments point to high Rigidity in schools. Such Rigidity indicates that students’ ability to move between tracks is restricted. For example, it is very difficult at the high school level for students to move to the college-bound tracks if they did not take 8th grade Algebra. For example, a student in a traditional school who takes Algebra IA in the 9th grade will only be eligible to take Algebra IB during their sophomore year. At this rate, as a senior, the will only be eligible to complete Algebra II.

Sørensen’s Framework for Organizational Differentiation provides a very adequate lens to view course placement practices. The framework reviews the critical components of placement practices and helps us to understand how they are implemented. Since LEAs handle education decisions, each LEA is responsible for their own criteria for student course placement. A general review of the placement practices will help us to understand how students currently get assigned to the course they are in.

Placement Practices

Standards for Course Placement

Virtually all mathematics departments create courses with differentiated levels of curriculum. This occurs among mathematics courses more than any other subject at the middle and high school levels (Braddock, 1990). However, course offerings, tracking levels, and placement policies are inconsistent. Significant variations in middle school assignment
policies lead to inequities in opportunities to learn mathematics (Useem, 1992). Such variations in placement policies include the use of standardized tests, teacher recommendations, restrictive course entrance requirements, and student preferences.

Course placement is vital to the success of students who want to be competitive for college admission. Most colleges require that students have a minimum of Algebra II and for students interested in majoring in the sciences they need to consider Calculus at a minimum (North Carolina Department of Public Instruction, 2009). Therefore, students’ 8th grade course placement is critical to having access to rigorous mathematics in high school, and ultimately, college admission.

Course placement for 8th grade Algebra can vary from state to state, from district to district, and from school to school within a district. Kelly (2009) discussed how students are assigned to 8th grade Algebra by student achievement scores on the End of Grade assessments. However, Stone (1998) explains that a number of students who achieve the prerequisite score for placement into 8th grade Algebra still do not gain access. Often, school districts do not follow the placement policies that they have established. Stone (1998) and Useem (1992) observed that significant variations in course placement practices were evident among schools within the same district.

Course placement in more inclusive schools typically uses a formula to make placements that incorporates standardized test scores; grades earned in the previous math courses, and teacher and/or counselor recommendations. Schools that are inclusive have more students in Algebra because they offer more ways for the students to be eligible for the course (Kelly, 2009; Yonezawa, Wells, & Serna, 2002).
School district policies often allow schools to fill courses with students of higher economic standing rather than with students who need or desire the course. School administrators often take classes that are not filled and fill them up with students who do not meet the policy standards for being in that particular course (Kelly, 2009). This can sometimes be to students’ benefit (Useem, 1992) in terms of gaining greater access to rigorous courses. Useem described cases in which middle grades students whose test scores did not meet policy guidelines were given access to accelerated mathematics courses. Many of these cases occurred in middle schools that had “cluster structured organizations.” Clusters structured organizations are groups of students that are tracked according to academic ability and place in clusters or teams to take their courses together. Clusters allow teachers to provide instruction to students that are all on the same academic level.

Useem (1992) observed that different school-level and district-level policies affect students’ chances of being exposed to the best the school system has to offer. The school size and course offerings also play a significant role in the placement of students. The smaller the school the fewer resources they have. Therefore, small schools are not able to offer all of the courses that a larger school could offer. Sørensen (1987) and Garet & DeLany (1988) argue that local “policies create a ‘microstructure’ of groupings within each school. These school-level stratification systems play a significant role in students’ opportunities to learn” (Useem, 1992, p. 347).

Parents’ Involvement in Students’ Placements

Parents play a very important role in course placement as it relates to 8th grade Algebra. If students do not qualify for 8th grade Algebra through standardized test scores
then parents are allowed to ask for a waiver for their child to be placed into the course (Kelly, 2009). Parents have the option of removing their children out of their assigned course placements. Useem (1992) found that parents are allowed to override teachers’ recommendations for course placements, but that various districts differed on the degree to which they would allow parents to do so. This finding is consistent with what Stone (1998) reported. Useem (1992, p. 339) describes some districts as having “well-developed policies that discourage [parental] overrides, whereas others are relatively open to requests that a student be placed in a high ability group.”

Research has provided evidence of a direct correlation between parent’s involvement in school assignment and parents’ education level (Oakes, 1985; Useem, 1992; Stone, 1998; Kelly, 2009). Schools with high enrollments in accelerated mathematics track tend to have parents with a high level of education. These studies also suggest that parents’ educational levels are important to students’ enrollment into an Algebra course. Useem (1992) reported that 89% of the students in accelerated math had fathers with advanced degrees, while only 11% of the students not in accelerated math had fathers with advanced degrees. Moreover, 56% of the students in the accelerated group came from homes where the father had a PhD, MD, or some other professional degree (Useem, 1992, p. 268).

Parents that were involved in the schools are more knowledgeable about the ability-grouping systems and they often form a network of parents that are in the know (Useem, 1992). There is also a high correlation between educational levels and parents’ involvement in other school activities. As a result, the social interactions and the school activities keep the parents’ knowledgeable about the school.
Social Placements

The social environment is a critical part of the school experience. Students join groups, make friends, and continually prepare for their social future. Not all students take school as seriously as others. Frank, et al. (2008) argued that students make their course placement choices based on their social contexts. Social context is defined as “the network of peers with whom adolescents identify, and with whom they would like to be friends” (Frank, et al., 2008, p. 1648).

Social placements and academic tracks have been a significant part of the social organization of schools but they are not a complete representation of adolescents’ social context in modern high schools (Sørensen, 1969). Modern course taking patterns find students taking courses across subjects at various levels of difficulty. Decisions about what courses to take are made within a social context. For example, Black students may not take a more rigorous mathematics course because they might feel social isolation since few Blacks may be in the course. Such students make their course placement decisions based on what their friends choose to do.

Strong evidence exists that students’ academic efforts are influenced by the behaviors and beliefs of others (Bryk, Lee, & Holland, 1993). In general, there are several social groups that students could belong to: athletes, burnouts, nerds, and student clubs of one type or another. Such groups may or may not contribute to students’ success in the school curriculum (Frank, et al., 2008). Akerlof & Kranton (2002) argue that students want to fit into a social category, and often, that social category determines the motivation that students exert in the form of academic effort.
Frank, et al. (2008) shed light on another construct within social placements known as “local position.” Local position is defined as “a set of students within a school who participate in a set of courses that differentiate them from other students in the school” (p. 1654). Students gain these positions in the social context of their course selections. For example, students who take 8th grade Algebra could be known as the “Algebra kids,” or in another social context, they may be labeled the “nerds.” Furthermore, it was concluded that girls’ course placements were influenced more by their social context than were boys (Frank, et al., 2008).

Although social course placement can be a factor in students’ course-taking decisions, other factors can affect student course placements. One such important factor is teacher recommendations. Teachers play a significant role in the lives of their students. Often teachers are included in the course placement process and their recommendation can affect placement results outside of the social placement structure. However, teacher recommendations are often affected by their beliefs and attitudes about students.

Belief Systems and Attitudes of Teachers/Administrators

Beliefs can be defined as “mental constructions of experience-often condensed and integrated into schemata of concepts” (Sigel, 1985, p. 351). Dewey (1933) described belief as “something beyond itself by which its value is tested; it makes an assertion about some matter of fact or some principle or law” (p. 6). Additionally, Dewey stated, “it covers all the matters of which we have no sure knowledge and yet which we are sufficiently confident of to act upon and also the matters that we now accept as certainly true as knowledge, but which nevertheless may be questioned in the future” (p. 6). Dewey’s perspective about beliefs
point to a confidence that people are more than willing to act upon. In the case of school policies, placement decisions are often the result of teachers acting on their beliefs about student abilities.

Teachers’ beliefs can significantly alter students’ pathway via course taking patterns especially as related to 8th grade Algebra. Although teachers often claim that they see students as being all the same and they do not treat any of them differently, evidence to the contrary supports that teachers usually favor a dominant group (Garrahy, 2001). For example, Garrahy (2001) observed that boys benefited from female teachers because female teachers gave boys more attention without realizing it. Ernest (1989) agrees that this favoritism in teachers’ beliefs and practices occur because teachers are not aware of their actions in the classroom.

Biased attitudes and beliefs of teachers can positively or negatively affect students’ academic success. Such biases and beliefs can be seen in the course placement recommendations made by teachers. Biased attitudes are reflected in teacher expectations. Van den Bergh et al., (2010) suggest that biased attitudes can be gauged using two types of measurements: explicit self-reporting and implicit measures. Explicit self-reporting relies on the individual’s perspectives. Implicit measures evaluate attitudes of participants who are unaware their disposition is being assessed or monitored.

Van den Bergh et al. used the Implicit Association Test (IAT)(Greenwald, McGhee, & Schwartz, 1998) to measure implicit attitudes. This test measured the relative strength of the association between ethnic background (i.e. Black, White, etc.) and the valence of words (i.e. the positive versus negative connotations of words). Van den Bergh et al. (2010)
discovered that interactions between implicit biased attitudes of teachers and students’ ethnicity were statistically significant. In other words, the teachers in the study had an implicit biased attitude towards students based on their ethnicity. Furthermore, the study implies that teachers’ expectation levels of the students change according to the students’ ethnicity. Researchers argued “the effects of the implicit prejudiced attitudes of teachers on student achievement can thus be quite substantial” (Van den Bergh et al., 2010, p. 514). They also suggest that such bias leads to the enlarging of the achievement gap among different ethnic groups. More interestingly, teachers are often “unaware” of their own biased attitudes when it comes to working with students.

Teacher Certification Affect

Research has indicated that students who have certified teachers do significantly better academically than students who do not have certified teachers (Darling-Hammond, Holtzman, Gatlin, & Heilig, 2005; Darling-Hammond, Berry, & Thoreson, 2001) However, there are researchers such as Goldhaber & Brewer (2000) who say that students can succeed without the benefit of certified teachers. This raises the question whether students taught by certified teachers have greater access to high quality courses than students taught by non-certified teachers?

Goldhaber & Brewer (2000) claim that teacher certification has little bearing on student achievement. However, Goldhaber & Brewer surprisingly found that students achieve better with teachers having emergency certifications. Darling-Hammond, Berry, & Thoreson (2001) analyzed Goldhaber & Brewer’s study and determined that the teachers who were granted emergency certifications had similar course preparation and qualifications as the
teachers who were certified. Darling-Hammond, Berry, & Thoreson (2001) suggested that the teachers in Goldhaber & Brewer’s study could have been certified using traditional measures and that is why they were give the emergency certifications until the could complete their formal certification.

In another study, Darling-Hammond, Holtzman, Gatlin, & Heilig (2005) compared the achievement of students taught by certified teachers and Teach for America (TFA) teachers. Teach for America teachers are non-certified teachers that usually teach in high needs or low SES schools. Darling-Hammond and her colleagues found that in no instance did TFA teachers have student to outperform teachers who were certified. Moreover, they discovered that students taught by TFA teachers made significantly less progress on 3 out of 6 standardized tests.

Studies have shown again and again that having certified teachers in the classroom is important to student success. It is also equally important that students have access to the best courses that schools offer. The question is: Do certified teachers promote greater access among all students to more rigorous courses?

Access to High-quality Mathematics Courses

De-tracking School Mathematics

De-tracking school mathematics is critical for students to have access to high quality mathematics courses. De-tracking in mathematics allows students to enroll in mathematics classes without restrictions. Since the placement of students in an accelerated mathematics curriculum (leading to 8th grade Algebra) confers significant advantages on those who gain
access (Useem, 1992; Bottoms & Cooney, 2008; Wang & Goldschmidt, 2003; Spade, Columbia, & Vanfossen, 1997), de-tracking is an important aspect of student success. In fact, according to the Massachusetts State Department of Education (1986), students that were placed in 8th grade Algebra were much more likely to pursue academically rigorous curricula in high school than the students who did not.

One advantage of students gaining access to 8th grade Algebra is that they are exposed to other highly motivated students (Useem, 1992). Students that gain access to 8th grade Algebra have an advantage in the college admission process since they are highly competitive because of their course taking decisions (Useem, 1992; Bottoms & Cooney, 2008; Kelly, 2009). It was also found that students gaining access to 8th grade Algebra were more likely to major in math and science in college (Bottoms & Cooney, 2008).

Three major obstacles keep qualified students from gaining access to high quality mathematics: institutional barriers, tracked aspirations, and choosing respect (Yonezawa, Wells, & Serna, 2002). Institutional barriers are defined as how information about courses and course placements is disseminated. Institutional barriers keep students from gaining access to high quality mathematics because student don’t know if they are eligible for courses or the importance of taking them. Tracked aspirations are the influences of past educational experiences that cause students to overlook or ignore their options. Students who are not motivated or inspired to take the higher track courses often do not take them (Yonezawa, Wells, & Serna, 2002). Moreover, students often wavier between taking rigorous courses or staying in less challenging courses with their social peer group (Frank, et al., 2008). Lastly, choosing respect refers to students’ decisions to forego more challenging
mathematics courses because they fear a lack of respect for who they are and what their
cultural experiences bring to bear in class. Frank, et al. (2008) argued that students also make
course decisions based on social structures, which is similar to choosing respect. When
students choose respect in their course taking decisions they look for courses where they feel
valued as a student (Yonezawa, Wells, & Serna, 2002).

After reviewing the literature of Algebra, and the various placement practices that are
used, several questions are raised that need to be investigated. This study attempts to
determine whether the obstacles to gaining access to mathematics that others have
encountered in the research are present in the small North Carolina school district under
investigation.

Research Questions

This study looked at how students gain access to rigorous mathematics courses. A 5\textsuperscript{th}
grade cohort (2005-2006) of students from a small rural school district in North Carolina was
examined. The student cohort was followed until the students were enrolled in their 8\textsuperscript{th} grade
mathematics courses. The following questions were investigated.

1. Is there a significant difference between the number of 6\textsuperscript{th} grade students who were
   predicted to be in 8\textsuperscript{th} grade Algebra and the actual number that were in 8\textsuperscript{th} grade
   Algebra?
2. Is there a significant difference between the number of 7\textsuperscript{th} grade students who were predicted to be in 8\textsuperscript{th} grade Algebra and the actual number that were in 8\textsuperscript{th} grade Algebra?

3. Is there a significant difference between students taught by certified teachers and students taught by non-certified teachers in their course placements, per grade levels: 6, 7, and 8? That is, are students taught by certified teachers more likely to be placed in high-level math courses than those not taught by certified teachers?

4. Is there a significant relationship between students’ gender and their placement in 8\textsuperscript{th} grade Algebra I?

5. Is there a significant relationship between students’ ethnicity and their placement in 8\textsuperscript{th} grade Algebra I?

6. Is there a significant difference in access to high level math courses between students designated as academically gifted and students not-so designated, per grade level?
CHAPTER 3

METHODOLOGY

Overview

This study was designed for the primary purpose of determining how students gain access to 8\textsuperscript{th} grade Algebra. This chapter describes student data and how the student data was selected to be included in this study. The research instruments used in the study are presented, and the statistical methods used to analyze the data are described. Where appropriate, links are made to relevant literature and the ways in which the raw data was analyzed.

School District, Students and Teachers

The students in this study were from one LEA in the Piedmont Region of North Carolina. The LEA or school district in the study had an enrollment of 2,617 students with a student ethnicity breakdown of 29.4\% White, 48.5\% Black, 20.8\% Hispanic, 1\% Asian or Pacific Islander, and 0.3\% Native American. In this district, 80.4\% of the students are economically disadvantaged. The study population revealed that about 11.8\% of the total K-12 student population was enrolled in 8\textsuperscript{th} grade Algebra. It is worth noting that there was only one 8\textsuperscript{th} grade Algebra course offered by the LEA.

The school district that participated in the study had 151 teachers; 48 of them were middle school teachers. Furthermore, 75\% of the middle school teachers were certified and 19\% of the middle school teachers had advanced degrees. The teacher retention rate for
middle school teachers during the 2005-06 school year was 15%, as reported by the NC Report Card Website (2011).

The school district has a policy that students are placed into courses based on performance results according to prediction models discussed later in this chapter. The models use previous test scores and current-year test scores to place students in a systematic way. Students are then assigned teachers based on the courses selected.

Quantitative Research Methods

Data Collection

We started our data collection by selecting a student cohort to follow as they matriculated through the selected LEA. Previous research (Stiff, Johnson, & Akos, 2011; Conger, Long, & Iatarola, 2009; Farkas, 2003) indicated that 5th grade course placement has been a significant factor in student course placement in 8th grade. Therefore, we started with the 5th grade cohort (2005-2006) of the LEA and followed them until their 8th grade placement in 2008-2009.

We requested detail data files from the school district that included data from 2005-2009 school years. The data files contained 178 data records. The data files were reviewed and 86 student data files were removed because they were not complete records. For the remaining 92 (complete) data files, the researcher reorganized the data for use in this study. The data was transformed into a usable format from the raw data.

We collected 5th grade course predictions for 2005-2006, 6th grade course predictions for 2006-2007, and 7th grade course predictions for 2007-2008. In conjunction with
collecting these data, we collected actual student placements in the: 6th grade (academic year 2006-2007), 7th grade (2007-2008), and 8th grade (2008-2009). Later in this chapter we describe in detail how the course predictions were calculated for each student.

The data was stratified into two groups of students. We compared and contrasted the Academically Gifted populations versus the regular populations. The stratification allowed us to determine if one group gains access at a higher rate than the other group for comparable academic performance.

Design of Study

Course predictions of students enrolled in the 6th grade in 2006-2007 were analyzed in their 9th grade year (2009-2010) to determine whether students predicted to place in 8th grade Algebra gained access to 8th grade Algebra 1. The data was further examined to determine which courses the 6th grade students in the study’s cohort took as 8th grade students in 2008-2009.

Prediction Policy and Methodology

The school district provided prediction formulas that gave estimates of students’ academic achievement levels at 8th grade based on the assumption that students had an average school experience. More specifically, the model used students’ achievement test scores from previous grades in conjunction with average test scores from across the state to make its predictions. The LEA indicated that these prediction scores formed the basis for assigning students to future courses.
Prediction Models:

The 6\textsuperscript{th} grade prediction model follows:

\[
\text{Grade 6 prediction Model} = \frac{A-C}{E} + \frac{B-D}{F} \times 2 \times .92 \times G + H
\]

The prediction model has several components. Each variable in the mathematical model has specific values: A represents Grade 4 End of Grade test scale score, B represents Grade 5 End of Grade test scales score, C represents Grade 4 End of Grade test state mean, D represents Grade 5 End of Grade test state mean, E represents Grade 4 state standard deviation, F represents Grade 5 End of Grade test state standard deviation, G represents Grade 6 standard deviation, and H represents Grade 6 End of Grade test state mean.

The 7\textsuperscript{th} grade prediction model was:

\[
\text{Grade 7 prediction Model} = \frac{A-C}{E} + \frac{B-D}{F} \times 2 \times .92 \times G + H
\]

The seventh grade prediction model used variable similar to those of Grade 6: A represents Grade 5 End of Grade test scale score, B represents Grade 6 End of Grade test scales score, C represents Grade 5 End of Grade test state mean, D represents Grade 6 End of Grade test state mean, E represents Grade 5 state standard deviation, F represents Grade 6 End of Grade test state standard deviation, G represents Grade 7 standard deviation, and H represents Grade 7 End of Grade test state mean.

Similarly, for the 8\textsuperscript{th} grade prediction model,

\[
\text{Grade 8 prediction Model} = \frac{A-C}{E} + \frac{B-D}{F} \times 2 \times .92 \times G + H
\]
we have that: A represents Grade 6 End of Grade test scale score, B represents Grade 7 End of Grade test scales score, C represents Grade 6 End of Grade test state mean, D represents Grade 7 End of Grade test state mean, E represents Grade 6 state standard deviation, F represents Grade 7 End of Grade test state standard deviation, G represents Grade 8 standard deviation, and H represents Grade 8 End of Grade test state mean.

Predictions were computed for all students in the study. To avoid measurement errors in the test scores, predictions were made only for students who had at least two available test scores.

Data Analysis

Data files of all students (6th grade students in academic year 2006-2007) were examined to identify students who were predicted for placement in 8th grade Algebra. Once these students were identified, the researcher examined the data to determine if these students had gained actual course placement into 8th grade Algebra I in school year 2008-09. For purposes of analysis, students were separated into two groups. Students were separated into advanced courses or “other maths” courses. Advanced courses were the highest or most challenging courses offered at a grade level; other maths were all other courses at that grade level. For example, other maths included general math and remedial math courses.

Binomial proportion confidence intervals and chi-square distributions were used to examine the effect of ethnicity, gender, course predictions, and teacher certification on student course placement in mathematics. Placement (access vs. no access) in the advanced mathematics track in middle school was modeled as a function of ethnicity, gender, course predictions, and teacher certification. For example, if a Black student had an equal
likelihood of being placed in the advanced mathematics track compared to White students, the estimate would be zero.

Binomial proportion confidence intervals are used when an experiment is repeated a fixed number of times, each trial of the experiment has two possible outcomes (arbitrarily labeled success and failure), the probability of success is the same for each trial, and the trials are statistically independent. This test is a critical part of the analysis process in that it measures student access or lack of access.

Chi-square distributions are used in this study to test hypotheses. A chi-square distribution is appropriate to use because we are interested in knowing if differences exist among the categorical variable distributions. More specifically chi-square examines the frequency distribution of certain events observed in a sample are consistent with a particular theoretical distribution (Eck, 2011). The events in the sample must be mutually exclusive and have a total probability of 1. The events are usually in terms of categorical data or numerical data.
CHAPTER 4

RESULTS

Introduction

This study examined course enrollment practices of one North Carolina school district. We examined all of the students with complete data sets who took the End of Grade tests in 5th grade who remained in the school until the 8th grade. The results of the study are presented in this chapter. The research hypotheses will serve as the organizer for the results. Statistical significance occurs for p-values at p < .05.

Descriptive Statistics

The original population of 173 students was narrowed down to 92 students due to missing data entries of students who left the district. The population of the students that participated in this study was diverse. The demographic breakdown of the students in the study was 48.9% Black, 30.4% Hispanic, 15.2% White, and 5.4% Multiracial. The gender breakdown was 43.4% male and 56.5% female (see Table 1).

<table>
<thead>
<tr>
<th>Demographics</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>52</td>
<td>56.52%</td>
</tr>
<tr>
<td>Male</td>
<td>40</td>
<td>43.48%</td>
</tr>
<tr>
<td>Black</td>
<td>45</td>
<td>48.91%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>28</td>
<td>30.43%</td>
</tr>
<tr>
<td>Multiracial</td>
<td>5</td>
<td>5.43%</td>
</tr>
<tr>
<td>White</td>
<td>14</td>
<td>15.21%</td>
</tr>
</tbody>
</table>
Research Questions Results

There were six (6) research questions we investigated that pertained to the placement practices resulting in students being placed into Algebra in the 8th grade. A number of the six research questions suggest follow-up questions that will be appropriately designated. As noted in Chapter 3, these research questions were analyzed using chi-square distributions to compare differences among groups. Chi-square distributions become invalid if 25% of the cells from the contingency table of the chi-square distribution have expected counts less than 5. In such cases, Fisher’s Exact Test is used to assess the validity of the chi-square distributions. Furthermore, we used “relative risk ratios” to help explain some data. In general, relative risk is a ratio of the probability that an event will occur versus the probability that the event will not occur. In this study, we were interested in the relative risk of students gaining access to algebra versus students not gaining access.

Each research question will be addressed in turn. Research Questions 1 and 2 can be discussed in terms of students gaining and not gaining access to 8th grade Algebra. Follow-up research questions that are provided for added emphasis are also discussed. Chi-square distributions were used to evaluate Research Questions 1 and 2, and their follow-up counterparts.

Research Question 1. Is there a significant difference between the number of 6th grade students who were predicted to be in 8th grade Algebra and the actual number that were in 8th grade Algebra?
Research Question 1 Follow-up. Is there a significant difference between the number of 6th grade students who were not predicted to be in 8th grade Algebra and the actual number that were not in 8th grade Algebra?

Of the students projected to be in 8th grade Algebra, about 27% of the students were actually enrolled in 8th grade Algebra. There is a significant difference between 6th grade students who were predicted to be in 8th grade Algebra and the actual number that were in 8th grade Algebra as indicated in Table 2.

Table 2. Number of 6th Grade Students Predicted to Enroll in 8th Grade Algebra vs. Actual Number of Students Enrolled in 8th Grade Algebra

<table>
<thead>
<tr>
<th>Number of 6th Grade Subjects</th>
<th>Predicted to Gain Access</th>
<th>Actually Gained Access</th>
<th>$\chi^2$</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>92</td>
<td>36</td>
<td>10</td>
<td>12.92</td>
<td>.0346**</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01

Of the students not predicted to be in 8th grade Algebra, about 89% of the students did not enroll in 8th grade Algebra. There is significant difference between 6th grade students who were not predicted to be in 8th grade Algebra and the actual number that were not in 8th grade Algebra; see Table 3.

Table 3. Number of 6th Grade Students Not Predicted to Enroll in 8th Grade Algebra vs. Actual Number of Students Not Enrolled in 8th Grade Algebra

<table>
<thead>
<tr>
<th>Number of 6th Grade Subjects</th>
<th>Not Predicted to Gain Access</th>
<th>Did Not Gain Access</th>
<th>$\chi^2$</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>92</td>
<td>56</td>
<td>82</td>
<td>20.66</td>
<td>&lt; .001**</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01
Research Question 2. Is there a significant difference between the number of 7th grade students who were predicted to be in 8th grade Algebra and the actual number that were in 8th grade Algebra?

Research Question 2 Follow-up. Is there a significant difference between the number of 7th grade students who were not predicted to be in 8th grade Algebra and the actual number that were not in 8th grade Algebra?

Chi-square distributions indicated that among students predicted to be in 8th grade Algebra, only 12% of the students actually were enrolled in 8th grade Algebra. Fisher’s exact test was used because chi-square distributions became invalid since 25% of the cells from the contingency table had expected counts less than 5. The results of the test were significant. The results are shown in Table 4. Although only 1 student was not predicted to gain access to 8th grade Algebra, 81 students did not gain access, which was a significant difference; see Table 5.

Table 4. Number of 7th Grade Students Predicted to Enroll in 8th Grade Algebra vs. Actual Number of Students Enrolled in 8th Grade Algebra

<table>
<thead>
<tr>
<th>Number of 7th Grade Subjects</th>
<th>Predicted to Gain Access</th>
<th>Actually Gained Access</th>
<th>$\chi^2$</th>
<th>Fisher’s Exact Test p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>92</td>
<td>91</td>
<td>11</td>
<td>2.86</td>
<td>0.02609*</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01
Table 5. Number of 7th Grade Students Not Predicted to Enroll in 8th Grade Algebra vs. 
Actual Number of Students Not Enrolled in 8th Grade Algebra

<table>
<thead>
<tr>
<th>Number of 7th Grade Subjects</th>
<th>Not Predicted to Gain Access</th>
<th>Did Not Gain Access</th>
<th>$\chi^2$</th>
<th>Fisher's Exact Test p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>92</td>
<td>1</td>
<td>81</td>
<td>27.47</td>
<td>0.03285*</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01

Research Question 3. Is there a significant difference between students taught by certified teachers and students taught by non-certified teachers in their course placements, per grade levels: 6, 7, and 8? That is, are students taught by certified teachers more likely to be placed in high-level math courses than those not taught by certified teachers?

Research Question 3 uses chi-square distributions to determine significance. At each grade level, teacher-certification status is determined. All of the students in the 6th grade had certified teachers. Therefore, no statistical analysis was performed; see Table 4.

Table 6. Teacher Certification for 6th Grade Students

<table>
<thead>
<tr>
<th>Course Placement</th>
<th>Students in given course</th>
<th>Certified Teachers</th>
<th>Non-Certified Teachers</th>
<th>Relative Risk Value</th>
<th>$\chi^2$</th>
<th>Fisher's Exact Test p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Math</td>
<td>11</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Maths</td>
<td>81</td>
<td>3</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p-value < .05, **p-value < .001
At 7th grade, it was found that certified teachers taught 60% of the students taking math courses other than advanced math. Certified teachers taught all of the students taking Pre-Algebra. The number of the students having certified teachers while taking Pre-Algebra was 1.65 times higher than that of students in other maths as indicated by the relative risk value shown in Table 7. The test revealed that a significant relationship exist between student course placement and teacher certification at grade 7.

<table>
<thead>
<tr>
<th>Course Placement</th>
<th>Students in given course</th>
<th>Certified Teachers</th>
<th>Non-Certified Teachers</th>
<th>Relative Risk Value</th>
<th>$\chi^2$</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Algebra</td>
<td>36</td>
<td>3</td>
<td>0</td>
<td>1.65</td>
<td>18.58</td>
<td>$p &lt; .0001^{**}$</td>
</tr>
<tr>
<td>Other Maths</td>
<td>56</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p-value < .05 **p-value < .001

In the 8th grade, 91.36% of the students who took other math courses had certified teachers. All of the students who took 8th grade Algebra had teachers who were certified. Again, Fisher’s Exact Test was used because the Chi-square test became invalid when 25% of the cells from the contingency table of chi-square test had expected counts less than 5. A significant relationship did not exist; see Table 8.
### Table 8. Teacher Certification for 8th Grade Students

<table>
<thead>
<tr>
<th>Course Placement</th>
<th>Students in given course</th>
<th>Certified Teachers</th>
<th>Non-Certified Teachers</th>
<th>Relative Risk Value</th>
<th>$\chi^2$</th>
<th>Fisher's Exact Test p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra</td>
<td>11</td>
<td>1</td>
<td>0</td>
<td>1.094</td>
<td>1.02</td>
<td>0.5925</td>
</tr>
<tr>
<td>Other Maths</td>
<td>81</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p-value < .05, **p-value < .001

Research Question 4. Is there a significant relationship between students’ gender and their placement in 8th grade Algebra?

Chi-square distributions were used to test Research Question 4. Among the students in the study population, less than 50% of the males were enrolled in 8th grade Algebra while more than 50% of the female students were enrolled in 8th grade Algebra. In addition, Fisher’s Exact Test yielded a p-value of .7508 indicating that a significant relationship did not exist.
<table>
<thead>
<tr>
<th>Gender</th>
<th>Students N = 92</th>
<th>Enrolled in Algebra</th>
<th>Enrolled in Other Maths</th>
<th>Relative Risk Value</th>
<th>$\chi^2$</th>
<th>Fisher's Exact Test p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>40</td>
<td>4</td>
<td>36</td>
<td>.7143</td>
<td>.257</td>
<td>.7508</td>
</tr>
<tr>
<td>Female</td>
<td>52</td>
<td>7</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p-value < .05, **p-value < .001

Research Question 5. Is there a significant relationship between students’ ethnicity and their placement in 8th grade Algebra?

Chi-square testing was used to determine if a significant correlation existed between student ethnicity and course placement. It was found that 27% of White students, 27% of Black students, 36% of Hispanic students, and 9% of Multiracial students were enrolled in 8th grade Algebra. Table 10 shows that no significant relationship existed between student ethnicity and their placement in 8th grade Algebra.
Table 10. Course Placement and Student Ethnicity in 8th Grade

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Students N= 92</th>
<th>Enrolled in 8th Grade Algebra</th>
<th>Enrolled in 8th Grade Other Maths</th>
<th>Relative Risk Value</th>
<th>$\chi^2$</th>
<th>Fisher's Exact Test p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>14</td>
<td>3</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>45</td>
<td>3</td>
<td>42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>28</td>
<td>4</td>
<td>24</td>
<td>###</td>
<td>2.84</td>
<td>.3980</td>
</tr>
<tr>
<td>Multi-Racial</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p-value < .05, **p-value < .001

Research Question 6. Is there a significant difference in access to high level math courses between students designated as Academically Gifted and students not-so designated, per grade level?

It was found that all of the 6th grade, 7th grade, and 8th grade students designated as Academically Gifted gained access to advanced courses in 6th grade, Pre-Algebra in 7th grade, and Algebra in the 8th grade. Students in the 6th and 8th grades without the Academically Gifted designation did not gain access to either the advanced courses in 6th grade or Algebra in the 8th grade. However, some students in the 7th grade without the Academically Gifted designation did gain access to Pre-Algebra. Furthermore, chi-square distributions revealed that significant differences existed in the 6th, 7th, and 8th grade for gaining access to high level math between students designated as Academically Gifted and
students designated as not being Academically Gifted. Results can be seen in Tables 11, 12, and 13.

<table>
<thead>
<tr>
<th>Student Designation</th>
<th>Enrolled in 6th Grade Advanced Math</th>
<th>Enrolled in 6th Grade Other Maths</th>
<th>Relative Risk Value</th>
<th>χ²</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academically Gifted</td>
<td>11</td>
<td>0</td>
<td>###</td>
<td>92</td>
<td>p &lt; .0001**</td>
</tr>
<tr>
<td>Not Academically Gifted</td>
<td>0</td>
<td>81</td>
<td>###</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p-value < .05, **p-value < .001

Academically Gifted 7th grade students gained access at a 3.43 higher rate than students without the special designation; see Table 12.

<table>
<thead>
<tr>
<th>Student Designation</th>
<th>Enrolled in Pre-Algebra</th>
<th>Enrolled in 7th Grade Other Maths</th>
<th>Relative Risk Value</th>
<th>χ²</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academically Gifted</td>
<td>13</td>
<td>0</td>
<td>3.43</td>
<td>18.58</td>
<td>p &lt; .0001**</td>
</tr>
<tr>
<td>Not Academically Gifted</td>
<td>1</td>
<td>78</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p-value < .05, **p-value < .001
Table 13.
Advance Course Placement of 8th Grade Subjects (N = 92)

<table>
<thead>
<tr>
<th>Student Designation</th>
<th>Enrolled in 8th Grade Algebra</th>
<th>Enrolled in 8th Grade Other Maths</th>
<th>Relative Risk Value</th>
<th>$\chi^2$</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academically Gifted</td>
<td>11</td>
<td>0</td>
<td>###</td>
<td>92</td>
<td>p &lt; .0001**</td>
</tr>
<tr>
<td>Not Academically Gifted</td>
<td>1</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p-value < .05, **p-value < .001
CHAPTER 5

CONCLUSIONS and DISCUSSION

Findings

The purpose of this study was to determine which 6th grade students of the given North Carolina school district gained access to 8th grade Algebra. In this section we discuss the findings of the study, and where appropriate, place the discussion in the context of Sørensen’s Framework for Organizational Differentiation.

Perhaps the most important finding of the study is that many 6th and 7th grade students predicted to be placed into 8th grade Algebra did not gain access (see Tables 2 and 4). Specifically, more than 60% of 6th grade students did not actually take 8th grade Algebra although they were predicted to do so (Table 2). Additionally, the numbers grew from the number of students who were not predicted to gain access to Algebra and the number of students who did not actually gain access to Algebra despite being predicted for access to the course (Table 3). Furthermore, it was found that 7th grade students predicted to be placed into 8th grade Algebra did not get placed (Table 4). Shockingly, over 90% of the 7th grade students were predicted to gain access to Algebra, however, about 88% of them enrolled in a course other than Algebra (Table 5).

Another important finding of the study is that all 6th grade students taking advanced courses, all students taking Pre-Algebra in the 7th grade, and all 8th grade Algebra students had certified teachers (see Tables 6, 7 and 8). In contrast 7th grade students in other math
courses were not always exposed to certified teachers in comparison to students in 7th grade Pre-Algebra were always exposed to a certified teacher (Table 7). Furthermore students in 8th grade other maths were not always exposed to certified teachers. Additionally it was not clear how many, if any of the students that were enrolled in the others maths courses were projected to be in 8th grade Algebra.

With regard to Sørensen’s (1969) framework, we find evidence of the inclusive dimension in this study. In particular, we found that each student was assigned a certified teacher, which was consistent with Sørensen’s definition of inclusive. All of the students in the study had certified teachers with the exception of one 7th grade class (Table 7). Research by Darling-Hammond, Holtzman, Gatlin, & Heilig, (2005) suggest that students taking courses with certified teachers succeed at higher rates. Therefore, the evidence suggests that having certified teachers is important to student success.

No significant relationship between gender and course placement and ethnicity and course placement were found. However, a significant relationship did exist between Academically Gifted students and course placement (Tables 11,12, and13). It is important to note that students designated as Academically Gifted gained access to the best mathematics courses.

Additionally, Academically Gifted students demonstrate characteristics of a system of high Scope and low Rigidity (mobility). The Academically Gifted students do not change groups. Few students transfer from the lower track to the Academically Gifted track and even less transfer from the Academically Gifted track to the lower track. Furthermore, in our study we could not clearly identify AG students that were not predicted to gain access to 8th
grade algebra but received access even if they were not predicted to do so. This influence may be positive or negative. Schools having groups of students with high Scope are often seen in LEAs with relatively small populations like the one in this study.

Discussion of the Findings

The significance of students’ placements into 8th grade Algebra is a critical component to students’ overall success in mathematics. The research indicates that students who gain access do significantly better in high school and go to college at a higher rate (Bottoms & Cooney, 2008; Callahan, 2005; Kelly, 2007; Kelly, 2009; Stone, 1998; Schweiker-Marra & Pula, 2005). In the school district studied two-underling problems as it relates to students gaining access affect students course taking patterns. The specific problems that we discovered were students that qualified being denied access to rigorous mathematics course and students with special designations always gaining access to the best courses.

The assignment procedures used to assign students directly links back to the assignment procedure dimension in Sørensen’s (1969) framework. In agreement with Sørensen (1969), we find that students were being divided into groups based on selection criteria that the district had in place. The assignment procedure produced was supposed to be based on a prediction model of previous academic performance. In turn, what we found was that students were not gaining access according to the assignment procedure. Therefore, it was unclear how the students were actually being assigned. We were not able to determine if the grouping were homogenous or heterogeneous ability groupings based on the evidence from this study.
Reviewing the study, we noticed that student gender did not have a significant impact on 8th grade Algebra placement. Female and male students had the same chances of being placed into 8th grade Algebra. Ethnicity did not play a significant factor in course placement. Students had the same chances of being place into 8th grade Algebra without regard to ethnicity. We expected ethnicity and gender to have an impact, however since all of the enrollment data was evenly spread among the groups it became clear that they would have little to no effect.

Students that have the Academically Gifted special designations in the study always gained access to 8th grade Algebra, which was consistent with Kelly’s (2007, 2009) findings. The problem with this is that students did not always perform at an Academically Gifted level. Kelly (2009) discovered evidence that suggested that Academically Gifted students gain access to the best mathematics course even if, their past academic performance was indicated placement in other math courses. This means that students who have the Academically Gifted designation still gain access even if their performance no longer warrants the designation. What this creates is unlimited access to the most rigorous courses for these students, which is a good thing. However, this keeps others deserving students out because the Academically Gifted programs have limits on the number of students that they can accommodate. Therefore, our research supports the conclusion that students need to be treated like Academically Gifted students when it comes to course placement, since in our study Academically Gifted students always gained access to the best mathematics courses (Tables 11, 12 and 13). This will give all students a better opportunity to gain access to the rigorous courses that sometimes eluded them (see Table 3).
Certified teachers play a significant role in students gaining access to 8th grade Algebra. Looking back over this study, we find that students who had certified teachers gained access to 8th grade Algebra at significantly higher rates than students who did not have teachers who were certified (Table 6,7,8). It was also concluded that a strong relationship exists between certified instructor and student course enrollment. In this study, certified teachers have a significant impact on student success. The students’ success with certified teachers makes a case for always using certified teachers because students are prepared and gain access to rigorous mathematics courses when under their teaching. Additionally, this finding is consistent with studies done by Darling-Hammond, Berry, & Thoreson (2001) and Darling-Hammond, Holtzman, Gatlin, & Heilig (2005) and support the need and significance of teacher education programs.

Conclusion

In conclusion, our research clearly indicates that a cyclical problem exist with students gaining access to the most rigorous mathematics. Students do not gain access to 8th grade Algebra because of placement policy procedures were not appropriately implemented. Not implementing the placement policy procedures maintains the status quo that satisfies this LEA that has limited resources. In turn, this leads to student-limited access to rigorous mathematics.

Based on the findings of this research, students that have certified teachers have a tendency to take more rigorous mathematics courses. We should not underestimate the importance of certified math teachers in the classroom. However, the lack of certified math teachers and limited economic resources give districts like the one in this study a challenge to
employee certified teachers and retain them. By offering the most rigorous courses to all students it forces teachers to be prepared to meet the challenges of teaching all students of various ability levels. Clearly, having certified teachers goes a long way to addressing this issue.

It’s important to observe that Sørensen’s (1969) framework was in operation for the LEA in this study. The Vertical Differentiation and Horizontal Differentiation were present in the form of students’ stratifications into courses by age, and then, by ability. The Inclusiveness dimension was present for students who were participants of the Academically Gifted programs. However, this was just the opposite for students who were not in the Academically Gifted program but were predicted to gain access to 8th grade Algebra. Such students were excluded from the most rigorous math courses. Per Sørensen’s framework, the LEA had a written Assignment Procedure for student placements that indicated that students are placed into 8th grade Algebra based of academic merit. Unfortunately, the research findings indicate that the Assignment Procedure was not implemented appropriately. The Scope of the cohorts in this study was high in that students stayed together over their years in middle grades and the Rigidity in this study was very low because students did not change cohorts once they were assigned to a cohort.

Significantly, in our study, a large number of the students should have gained access to 8th grade Algebra. However, the school only had one course of 8th grade Algebra. As a result, only students designated as the best of the best received access to the course. This meant that many deserving students were left out. It is unclear why qualifying students did not gain access to 8th grade Algebra and why more 8th grade Algebra courses were not taught.
We speculate that economics, and parents/students being unaware of the importance of enrolling in rigorous mathematics course are factors. But, the greatest factor is the inappropriate use of the placement prediction models.

**Limitations of the Study**

This study has some significant limitations that have affected the research in an adverse way. This study encountered several data collection problems, which greatly reduced the size and overall usefulness of this study. We lacked a large sample size because of the size of the school district. A larger sample size would have given us the ability to make a strong case for generalize ability for our study.

Additionally, this study lacked a source of multiple academic measures of student academic ability. What is meant by multiple academic measures is that students have more than one way to be assessed academically outside of standard testing. The data itself was a limitation in this study because one of the items collected were students’ End of Grade scores as the only measure of academic ability. Students were only measured for Algebra access through achievement on the End of Grade. The flaw in this is that the models used to place students only take into account the students’ End of Grade scores from the previous and current year.

**Recommendations**

Students’ placement in 8th grade Algebra should be a standard practice for all middle schools. We suggest from our findings that the bar should be set higher. In addition, two specific recommendations would make this study better and will make it more generalizable to a larger population.
Recommendation 1. The study population was very small. In order to make more generalizable conclusions, it is recommended that a larger, sample size be used. This will make the findings of the study more comparable to other school districts and will have more of a cross section of what the other school districts’ 8th grade Algebra enrollment practices are. This will provide the field and school administrators a better view of how students gain access.

Recommendation 2. The study could have benefited greatly from a dataset that had more criteria variables. Some of the criteria that would help this study are things like free/reduced lunch data, parent educational levels, teacher certification types, and the schools where the teachers receive their certifications. Rich datasets with criteria variables as the one suggested would provide a more comprehensive view of the types of students who gain access to Algebra, and what their parents’ socioeconomic profiles are.

Recommendation 3. Further research should be done to determine what affects certified teachers have on student Algebra placement in the 8th grade. Our study suggests that a strong relationship may exist between students’ placement and teacher certification. However, due to the limitations in our study we did not feel that our evidence was strong enough to suggest that the relationship definitely exists.

Recommendation 4. Lastly, principals, superintendents, and teachers should be interviewed to determine what placements procedures are actually used, and why so many students who should be are not enrolling in Algebra in eighth grade.
REFERENCES


http://www.ncpublicschools.org/accountability/reporting/abc/2002-03/10-20rule


North Carolina Department of Public Instruction. (2010, August). *North Carolina Department of Public Instruction.* Retrieved August 2010, from Course and Credit requirements: www.ncpublicschools.org/curriculum/graduation


