The Influence of Mathematical-Instructional Minutes on the Percentage of Proficient and Advanced Proficient Scores in Mathematics on the New Jersey Assessment of Skills and Knowledge for Grades 6-8

Eric Walter Kosek
Seton Hall University, eric.kosek@student.shu.edu

Follow this and additional works at: https://scholarship.shu.edu/dissertations

Part of the Curriculum and Instruction Commons

Recommended Citation
https://scholarship.shu.edu/dissertations/2483
THE INFLUENCE OF MATHEMATICAL-INSTRUCTIONAL MINUTES ON THE PERCENTAGE OF PROFICIENT AND ADVANCED PROFICIENT SCORES IN MATHEMATICS ON THE NEW JERSEY ASSESSMENT OF SKILLS AND KNOWLEDGE FOR GRADES 6-8

Eric Walter Kosek

Dissertation Committee

Gerard D. Babo, Ed.D., Mentor
Pauline F. Anderson, Ed.D.

Submitted in partial fulfillment of the requirements for the degree of Doctor of Education

Seton Hall University

2017
SETON HALL UNIVERSITY
COLLEGE OF EDUCATION AND HUMAN SERVICES
OFFICE OF GRADUATE STUDIES

APPROVAL FOR SUCCESSFUL DEFENSE

Eric Walter Kosck, has successfully defended and made the required modifications to
the text of the doctoral dissertation for the Ed.D. during this Fall Semester 2017.

DISSERTATION COMMITTEE
(please sign and date beside your name)

Mentor:
Dr. Gerard D. Babo 12/12/17

Committee Member:
Dr. Luke J. Steedak 12/12/17

Committee Member:
Dr. Pauline F. Anderson 12/12/17

The mentor and any other committee members who wish to review revisions will sign
and date this document only when revisions have been completed. Please return this
form to the Office of Graduate Studies, where it will be placed in the candidate’s file and
submit a copy with your final dissertation to be bound as page number two.
Abstract

The purpose of this non-experimental, cross-sectional, correlational study was to examine the influence, if any, of mathematical-instructional minutes on academic achievement as measured by the 2014 New Jersey Assessment of Skills and Knowledge (NJ ASK) 6, 7, and 8 mathematics scores. Additionally, the study accounted for other factors that influence student achievement, including selected metrics and variables listed on the 2013-2014 New Jersey School Performance Report. The variable of interest, mathematical-instructional minutes, was obtained via survey from all schools in New Jersey that educated students in Grades 6-8. The survey data were then matched with each responding school’s New Jersey School Performance Report metrics. The unit of analysis was school. Data were run through multiple hierarchical regression models to determine the statistical significance and influence, if any, of mathematical-instructional minutes on NJ ASK 6-8 mathematics scores. The variable of interest, mathematical-instructional minutes, was not a significant predictor of student achievement for the NJ ASK Grades 6 and Grade 7. Mathematical-instructional minutes was a significant predictor of student achievement in Grade 8, accounting for 1.17% of the variance in total Proficient/Advanced Proficient math scores on the Grade 8 NJ ASK. The results of this study demonstrated that the percentage of economically disadvantaged students was the strongest predictor of student achievement, accounting for roughly 36%-65% of the explained variance in mathematics achievement. Percentage of students with a disability was also found to be a significant predictor of student achievement in Grades 6 and Grades 7. Additionally, percentage of students taking algebra was a significant predictor of student achievement in Grade 8.
Acknowledgments

I would like to acknowledge my mentor, Dr. Gerard Babo. I am truly appreciative of your help in the classroom and in the beginning stages of my administrative career. Your sage advice always resonated and kept me grounded. When I shared that I had had a fantastic final interview and was a “shoe-in” on more than one occasion, you replied with a wry smile, “I’m sure you did, but you never know how the other guy did.” Your willingness to help a student, not only academically, but professionally, is truly appreciated. After a debilitating injury, much time off, and loss of focus, your simple words of “Discipline yourself and get it done” inspired me. I wrote down those words in June of 2017. I then disciplined myself and got it done. Thank you, sir.

I would also like to recognize Dr. Pauline Anderson. Thank you for selecting me as your assistant principal, beginning my administrative career. You have allowed me to see the nuanced characteristics of effective leadership and embody the concepts of compassion and perseverance. It is much appreciated. Your unselfishness with your time, humor, wit, and work ethic is unparalleled. It is an honor to work with you and call you friend.

Dr. Luke Stedrak, thank you for being a member of my dissertation committee. I remember meeting you years ago when you first came to Seton Hall University. Your knowledge, gregarious manner, and willingness to help students were appreciated then, and your willingness to be on my dissertation committee is truly appreciated now.

I would also like to thank Dr. Tienken and Dr. Kuchar, whose enthusiasm, wisdom, and practical application of knowledge continue to serve as a reference for me.
I would like to recognize fellow classmates, Dr. Jonathan Moss and Dr. Danielle Sammarone. Thank you for your input during our Seton Hall years, and I wish you the best for the future.

I would also like to thank Mr. Arthur DiBenedetto for serving as a role model for clear-cut logic, judicious reason, and “doing what’s right for kids.” Your succinct approach to problem solving, concise language, and humble disposition are traits that are not only admirable but will serve as a paradigm for me in the years to come.

Last, I would be remiss if I did not thank Ms. Patricia Braitsch. Your knowledge and assistance are truly appreciated and are only exceeded by your selfless giving of your time. Your ability to analyze problems and figure out solutions is equally matched by your benevolence and kindheartedness.
Dedication

I would like to dedicate this dissertation to my parents, Peter and Inge, who many years ago sacrificed and saved so their son could go to college. That initial degree led to an opportunity in education years later that manifested into two more degrees and, ultimately, this doctoral degree. Thank you, Mom and Dad, for giving me your work ethic and an attitude that I can accomplish anything I set my mind to. My parents’ belief that if you start something, you finish it has always resonated with me. That philosophy became the catalyst for diving back into the dissertation process and finishing what I started. It is much appreciated.

I would also like to thank my brother, Peter, whose assistance, patience, and knowledge cannot be overstated. Your expertise on virtually all subjects is top-tier, or in statistics parlance, three standard deviations above the mean. There are few people as intelligent, competent, and humble as you. I thank you for all your help through the years.

Thank you to my sister, Nancy, for having a heart as big as you do. Your compassion and empathy have helped many throughout the years, including me.

I would also like to thank my girlfriend, Michele, for having an inordinate amount of patience and understanding during this entire dissertation process. You have sacrificed much during this doctoral endeavor, and it is truly appreciated. I wish you much success as you embark on your own academic journey.
Table of Contents

Abstract .................................................................................................................. ii
Acknowledgments ..................................................................................................... iii
Dedication .................................................................................................................. v
Table of Contents ...................................................................................................... vi
List of Tables ............................................................................................................. ix

I. INTRODUCTION

Background .............................................................................................................. 1
Statement of the Problem .......................................................................................... 5
Purpose of the Study .................................................................................................. 8
Research Questions .................................................................................................. 8
Null Hypotheses ....................................................................................................... 9
Study Design-Methodology ....................................................................................... 10
Independent Variables ............................................................................................. 10
Dependent Variables ................................................................................................. 11
Significance of the Study .......................................................................................... 12
Limitations ................................................................................................................ 13
Delimitations ............................................................................................................. 14
Assumptions .............................................................................................................. 14
Definitions of Terms ................................................................................................ 15
Organization of the Study ......................................................................................... 20

II. LITERATURE REVIEW

Introduction .............................................................................................................. 22
Literature Search Procedures .................................................................................... 22
Methodological Issues ............................................................................................... 23
Standards for Inclusion ............................................................................................. 24
Theoretical Framework ............................................................................................. 24
High-Stakes Testing .................................................................................................. 26
New Jersey Assessment of Skills and Knowledge ..................................................... 30
New Jersey School Performance Report ................................................................. 37
Student Variables .................................................................................................... 38
  Absenteeism .......................................................................................................... 38
  Student Suspension Rate ....................................................................................... 42
  Limited English Proficient Students ...................................................................... 48
  Economically Disadvantaged Students ................................................................. 52
  Students with Disabilities ...................................................................................... 55
Schools Variables ................................................................................................... 59
  Total School Enrollment ....................................................................................... 59
  Algebra Enrollment ............................................................................................... 61
  Student-Faculty Ratio ............................................................................................ 66
III. METHODOLOGY

Context for the Study......................................................... 96
Research Design......................................................... 96
Restatement of Research Questions.................................. 98
Restatement of Null Hypotheses........................................ 99
Sample/Data Source.................................................... 99
Instrumentation.......................................................... 101
Reliability and Validity................................................ 103
Data Collection.......................................................... 106
Data Analysis............................................................. 108
Summary................................................................. 110

IV. ANALYSIS OF THE DATA

Introduction............................................................... 111
Overarching Research Question...................................... 111
Subsidiary Research Questions...................................... 111
Null Hypotheses........................................................ 112
Purpose of the Study.................................................... 112
Organization of the Chapter......................................... 113
Description of the Sample and Variables........................ 113
Independent Variables and Dependent Variables............... 115
Procedure................................................................. 116
Research Question 1: Statistical Analysis and Results.......... 117
Research Question 2: Statistical Analysis and Results.......... 129
Research Question 3: Statistical Analysis and Results.......... 140
Summary................................................................. 151
V. CONCLUSIONS AND RECOMMENDATIONS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>154</td>
</tr>
<tr>
<td>Purpose</td>
<td>155</td>
</tr>
<tr>
<td>Organization of the Chapter</td>
<td>156</td>
</tr>
<tr>
<td>Research Questions and Answers</td>
<td>156</td>
</tr>
<tr>
<td>Conclusions and Discussion</td>
<td>161</td>
</tr>
<tr>
<td>Recommendations for K-12 Policy and Practice</td>
<td>170</td>
</tr>
<tr>
<td>Recommendations for Future Research</td>
<td>176</td>
</tr>
<tr>
<td>Conclusion Statement</td>
<td>178</td>
</tr>
</tbody>
</table>

REFERENCES.................................................................................. 179

APPENDICES.................................................................................. 198
List of Tables

Table 1. Selected New Jersey School Performance Report Predictor Variables ............... 11
Table 2. Free and Reduced-Price Lunch Eligibility ...................................................... 17
Table 3. Schedule of Content, Day, and Duration of NJ ASK Test for 2014 School Year.. 31
Table 4. The NJ ASK Total Scale Scoring Delineations .............................................. 33
Table 5. NJ ASK Total Points Disaggregated by Mathematics Content Cluster ............ 33
Table 6. Score Differentials for Weekly Math Instructional Hours .............................. 87
Table 7. Literature Review Summary Table ................................................................. 92
Table 8. District Factor Group (Study Sample versus Total Population) ................. 101
Table 9. Cronbach’s Alpha Rating Scale .................................................................. 104
Table 10. NJ ASK 2014 Grades 3-8 Cronbach’s Coefficient Alpha and Standard Error of Measurement .............................................................................................................. 104
Table 11. Data Retrieved from the 2013-14 NJSPR and Google Survey .................. 108
Table 12. Independent/Dependent Variables Included in SPSS v24 Analysis ........... 115
Table 13. Preliminary Simultaneous Regression Grade 6 Mathematics: Dependent/Independent Variables ................................................................. 118
Table 14. Primary Simultaneous Regression for Grade 6 NJ ASK Mathematics ....... 119
Table 15. Grade 6 Mathematics Descriptive Statistics ................................................ 120
Table 16. Simultaneous Regression Model Summary for Grade 6 NJ ASK Mathematics.. 121
Table 17. Simultaneous Regression ANOVA Table for Grade 6 NJ ASK Mathematics... 121
Table 18. Simultaneous Regression Coefficients Table for Grade 6 Mathematics ....... 122
Table 19. Hierarchical Regression for Grade 6 Mathematics ....................................... 123
Table 20. Hierarchical Regression Model Summary for Grade 6 Mathematics .......... 125
CHAPTER I
INTRODUCTION

Background

“In periods of perceived crisis, schools find themselves vulnerable to sociopolitical demands, shifting curriculum priorities giving emphasis to one, while diminishing the other” (Tanner & Tanner, 2007, p. 25). We are in such a crisis, and some will posit that this latest educational crisis has been ever present since the launch of Sputnik in 1957. Despite evidence revealing that the United States of America had the technology to launch a satellite before Russia but did not for fear of starting World War III, the American educational system has been under constant attack and scrutiny ever since (Tienken & Orlich, 2013). In 1983, the National Commission on Excellence in Education published its report, A Nation at Risk, purporting the failures of the American school system. A Nation at Risk called for not only curriculum changes reflecting a more essentialist philosophy but also for many structural interventions, such as increasing learning time, increasing the amount of homework, longer school day, and longer school year (National Commission on Excellence in Education, 1983).

Carson, Huelskamp, and Woodall (1993) countered many of A Nation at Risk’s allegations in Perspectives on Education in America, commonly known as the Sandia Report. The researchers empirically demonstrated that not only were America’s public schools not failing, they were in fact succeeding based on benchmarks such as: graduation rates, SAT scores, high school completion rates, decreased drop-out rates, and completion of college degrees. However, A Nation at Risk remains forever in the educational lexicon and in the minds of American taxpayers, despite being empirically discredited and disingenuously connecting a poor
economy with the American public school system. The evidence-based *Sandia Report* continues to be overshadowed by the rhetoric of *A Nation at Risk* (Tienken & Orlich, 2013).

One debate that repeatedly arises in education is the effective use of time within our public school system. In 1994, The National Education Commission on Time and Learning published a report, *Prisoners of Time*, which again questioned the length of school year, the length of school day, and the length of school periods. It suggested that for the past 150 years, American public schools have been held hostage by the constant variable of time and is still largely controlled by the dynamics of clock and calendar (Education Commission of the States, 2005). The National Education Commission on Time and Learning goes on to state that new uses of time should ensure that schools rely much less on the 51-minute period and that the use of two or more periods should be more common for extended exploration (Education Commission of the States, 2005).

Educational reformers have beseeched public schools to remedy their supposed ineffective use of time. Policy makers equate increasing the length of time a teacher teaches, to improved academic achievement (Ayodele, 2014). Business leaders are critical of public schools because of the purported middle ranks of American students on international tests and the alleged nexus of student academic achievement and economic global competitiveness. Reformers, business leaders, employers, and parents are eager for some sort of intervention for fixing our schools. Adding days to the calendar, year-round schools, extending the school day, and adding instructional time to the school day are all periodically proposed to resolve the problem. Conventional wisdom would suggest a positive association between increased instructional time and academic achievement. However, the empirical research is somewhat sparse (Jez & Wassmer, 2011).
Adding days to the school calendar for a longer school year was one of the structural reform solutions to come out of *A Nation at Risk* (1983) as well as *Prisoners of time* (1994). Educational bureaucrats have turned to commissions and experts to tout this intervention despite scant solid evidence that doing so will improve student achievement (Marcotte & Hansen, 2010; Eren & Millimet, 2007). Although states’ school years range from 160 days in Colorado to 186 days in Kansas, most districts and schools in the United States utilize a school calendar ranging from 170-180 days. The longer school year argument is again predicated on the perception that international students are outperforming their American peers because they have longer school years (Silva, 2007). This viewpoint is endorsed by many policy makers and educational officials, including the United States Secretary of Education, Arne Duncan, who has stated, “Our school day is too short, our week is too short, our year is too short” (Marcotte & Hansen, 2010, p. 53). However, empirical research done at the international level does not show a strong correlation between international achievement test scores and the amount of instructional time (Baker, Fabrega, Galindo, & Mishook, 2004).

Year-round schooling or modified school calendars are also professed to be a structural solution to fixing our public school system. Although the myth of summer break was purportedly based on the rhythm of 19th century farm life, summer vacations actually grew out of 20th century middle class parents, lobbyists for camps, and the tourist industry pressing for students to be with their families for the summer break. By the 1960s and in the post- *Sputnik* era of accountability, policy makers and parents began to voice their concerns over the negative effects of the long summer break on learning (Cuban, 2008).

Ostensibly, the 180-day school calendar was merely a redistribution of days with more evenly spaced instructional days and days off. In most cases, local school boards adopt year-
round schooling because of increased enrollments and crowded facilities in mostly poor communities, not the negative effects of the summer loss (Cuban, 2008). The evidence and research on year-round schooling was found to be negligible; however, there was a small effect size on some students. Students coming from disadvantaged homes or who were struggling academically experienced the greatest gains. However, the authors note, it would be inappropriate to suggest that the current evidence indicates that modified calendars have a significantly positive impact on achievement in the practical sense (Cooper, Valentine, Charlton, & Melson, 2003).

Extending the school day to include more hours has also been proposed to increase student achievement and has shown some degree of success, particularly in urban neighborhood schools such as the for-profit Edison Schools, or the Knowledge is Power Program (KIPP) schools, but extended hours and days are expensive and the results are mixed (Silva, 2007). It is also unclear whether the results of these programs of an increased school day are the causal effects of increased hours or the family dynamics to desire a higher standard of living (Cuban, 2008). However, changing the existing school paradigm of 6.6 hours, 180 days a year and two months off during the summer impacts everyone, from parents to employers and a host of industries that depend on the traditional school year (Silva, 2007).

If extending time in school is cost prohibitive and extending the school year has a negligible effect, educators must improve the time they do have. Extending instructional time in the form of larger “blocks” has also been proposed to increase student achievement. Block scheduling has been defined as “restructuring of the school day into periods longer than the traditional 50 minutes” (Gruber & Onwuegbuzie, 2001, p. 33). Rettig and Canady (2000) support the use of “blocking” as the primary way to give middle school students the flexibility for hands-
on, active learning instead of having to be reshuffled every 40 to 50 minutes. Given the increased demands of accountability, many schools have utilized block scheduling or double periods to increase instructional time in hopes of increased academic achievement, particularly for core academic classes.

The research has been mixed regarding increased instructional minutes or block scheduling and academic achievement. Longitudinal data examined by Mattox, Hancock, and Queen (2005) found middle school math scores increased with the transition from period scheduling to block scheduling. Nichols (2005) concluded that block scheduling resulted in slight Language Arts gains, but these gains were not attained by low-income and minority students. Gruber and Onwuegbuzie (2001) found students receiving block scheduling had lower scores in Language Arts and Math on the Georgia High School Graduation Test (GHSGT). However, there was no statistical difference in grade point average or the writing portion of the GHSGT from students receiving traditional scheduling.

The College Board, which administers the SAT test for high school students, examined advanced placement (AP) scores for U.S. History, English, calculus, and biology and compared students in an extended period (60-minutes plus), a traditional period, and a 4x4 block schedule. Those students who were in the extended classes (60-minutes plus) received the highest grades (Camara, 1998). The effect of extended class time in the form of increased instructional minutes, or blocks, remains a complex subject with inconsistent findings and a need for continued study.

Statement of the Problem

The perceived crisis of the American public school system is that the United States of America is lagging behind our international peers in terms of academic achievement. Educational reformers and economists contend that the economic strength and economic future
of the United States depends on American students outranking their global peers on international tests and academic achievement (Hanushek & Woessmann, 2008). Despite the design flaw of causality by equating the individual student level to a national level, the Hanushek and Woessmann study remains one of the few studies to purport a nexus between international test rankings and economic competitiveness. Their study remains a staple for educational bureaucrats, policy makers, business and civic leaders, presidential commissions, and reformers to tout the decline of the American public school system.

According to Tienken (2008), there is little if any evidence showing a connection between international student achievement and a country’s economic prowess. In fact, there is a negative correlation. One cannot compare the relationship of individual student achievement and the economy and extend this relationship to national level causality (Tienken, 2008). In spite of the validity and reliability of empirical research refuting the reformers’ claims, the alleged mediocrity of the American public school systems continues to be trumpeted, along with purported solutions to solve the perceived crisis. Whether it is lengthening the school day, lengthening the school year, increasing instructional time, or various scheduling possibilities, the prevailing thought is that a structural solution could be the panacea to the perceived lagging of the American educational system.

Student achievement remains the Holy Grail by which individual schools and school districts are judged, locally, nationally, and internationally. There are many factors that influence student achievement. Predictor variables that have proven to be important indicators of student achievement, such as intelligence quotient (IQ) or parent education, are not collected nor reported by the New Jersey Department of Education. The NJDOE transitioned from The New Jersey School Report Card to the New Jersey School Performance Report in school year 2011-
2012. Metrics that were once linked to student achievement are no longer collected nor published. Perhaps yet again we are “shifting priorities giving emphasis to one, while diminishing the other” (Tanner & Tanner 2007, p. 25).

Economically disadvantaged students are still represented in The New Jersey School Performance Report by free and reduced-price lunch percentages. It has been demonstrated many times since the seminal work of Coleman (1966), that socioeconomic status, or poverty, is the largest variable associated with student achievement. According to Sirin (2005), poverty accounts for up to 60% of the variance in standardized tests. Many of the variables listed on the New Jersey School Performance Report are not in our sphere of influence, but allocated, instructional time can be.

With continued emphasis on student achievement, time continues to be a precious commodity. We are now bound by the 180-day school year and length of school day; however, instructional minutes per class is within our sphere of influence. The existing literature on instructional minutes and various period/block configurations has been mixed. Zepeda and Mayers (2006) conducted a meta-analysis of 58 empirical studies and found that high school block scheduling appeared to increase students’ GPA’s but were inconsistent regarding standardized test scores. Although scheduling alternatives and instructional minutes has been extensively researched at the high school level, little research has been done at the middle school level. This is particularly salient because the middle school years sometimes mark a decline in student achievement as students transition through an elementary (house model) to a more transitory, independent model (Freshcorn, 2000).

Mathematics is considered by many as the international language and is often used as a metric when comparing schools, districts, and countries. It seems only prudent that before we
implement structural changes that require funding, we should examine the impact of instructional minutes in the existing classroom to determine how it might influence or interact with achievement. Presently, scant empirical literature exists about the efficacy of instructional minutes on Grades 6, 7, and 8 math achievement. Therefore, it is important to conduct further research to ascertain whether this structural intervention influences student achievement on the New Jersey Assessment of Skills and Knowledge 6-8 Mathematics scores.

**Purpose of the Study**

The purpose of this study is to examine the influence, if any, of mathematical-instructional minutes on academic achievement as measured by the New Jersey Assessment of Skills and Knowledge 6, 7, and 8 Mathematics scores. In addition, I hope to explain the amount of variance in student test scores for which instructional minutes in Mathematics are responsible for while accounting for other factors that influence student achievement including selected metrics and variables listed on the 2013-2014 New Jersey School Performance Report. The findings of this study will provide board of education members, administrators, and educators with the data to implement policy on a school and district level to create schedules and time configurations that could increase student achievement.

**Research Questions**

The overall research question guiding this study was the following: What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grades 6-8 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?
Subsidiary Research Questions

Research Question 1: What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grade 6 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?

Research Question 2: What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grade 7 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?

Research Question 3: What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grade 8 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?

Null Hypotheses

Null Hypothesis 1: No statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 6 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

Null Hypothesis 2: No statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 7 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

Null Hypothesis 3: No statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 8 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.
Study Design/Methodology

This non-experimental, explanatory, cross-sectional study utilized a correlational design to determine the amount of influence an independent variable (instructional minutes) had on the dependent variable (New Jersey Assessment of Skills and Knowledge Mathematics scores). The independent/predictor variables listed on each school’s performance report were procured through the New Jersey Department of Education (NJDOE). The independent variable of instructional minutes was ascertained via emails to New Jersey middle school administrators to determine how many instructional minutes each school allotted to mathematics instruction. Subject-specific, instructional minutes was the lens used for this research, as allocated time is easier to procure, identify, and measure.

The dependent/outcome variables of the Grade 6-8 New Jersey Assessment of Skills and Knowledge (NJ ASK) Mathematics Proficient/Advanced Proficient (TPAP) scores were also ascertained via the 2013-2014 School Performance Report listed on the NJDOE website. Data were run through multiple hierarchical regression to determine the influence (variance) of the independent variable (instructional minutes) on the dependent variable (NJ ASK 6-8 Mathematics scores) to see if there was a statistically significant relationship between instructional minutes and the NJ ASK 6-8 Mathematics scores.

Independent Variables

The independent variables for this study were derived from the 2013-2014 New Jersey School Performance Report. New Jersey public schools are required to submit information regarding various metrics for their particular school and submit this information to the state of New Jersey Department of Education. The New Jersey Department of Education then publishes these data in a yearly performance report.
Table 1

Selected New Jersey School Performance Report Predictor Variables

<table>
<thead>
<tr>
<th>Student Variables</th>
<th>School Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absenteeism</td>
<td>Length of School Day</td>
</tr>
<tr>
<td>Student Suspension Rate</td>
<td>Instructional Time</td>
</tr>
<tr>
<td>Percentage of Limited English Proficient Students</td>
<td>Total School Enrollment</td>
</tr>
<tr>
<td>Percentage of Economically Disadvantaged Students</td>
<td>Algebra 1 Enrollment</td>
</tr>
<tr>
<td>Percentage of Students with Disabilities</td>
<td>Student-Faculty Ratio</td>
</tr>
</tbody>
</table>

Dependent Variables

The dependent variables in this study were the school Mathematics scores for the New Jersey Assessment of Skills and Knowledge (NJ ASK) for Grades 6 through Grades 8. The unit of analysis for this research study is school. The NJ ASK was given in Grades 3 through Grades 8 for Language Arts and Mathematics. It was also given in Grades 4 and Grades 8 in Science. The assessment was designed to provide information about each student’s achievement, as required by the New Jersey Core Curriculum Content Standards. NJ ASK scores are recorded in three possible categories: Partially Proficient (< 200), Proficient (200-249), and Advanced Proficient (250-300) for all three subjects. Each subject was reported separately; and despite the test makers own admission that the results of the NJ ASK should not be used for high-stakes
decisions or comparisons, the test results are still used in New Jersey for high-stakes decisions such as promotion, retention, and remedial services (Tienken, 2011).

**Significance of the Study**

This study will add to existing research regarding instructional time and student achievement. Public schools have long been criticized for ineffective use of time. Many studies have examined structural interventions such as lengthening the school day and school year, increasing instructional time or using block scheduling, and have obtained mixed results. The influence of instructional time on middle school mathematics achievement is particularly important for students, teachers, and administrators because mathematics continue to be the barometer used for high-stakes decision making. With such high-stakes decision making predicated on the subject of mathematics, it seems extremely prudent to determine the influence of instructional minutes on mathematics so that administrators can schedule classes that deliver the best results.

The existing literature regarding mathematical-instructional minutes at the middle school level is weak and lacks conclusive data. Broader, international studies have found weak or even negative correlations between hours of instruction and student achievement (Baker, Fabrega, Galindo, & Mishook, 2004). It is necessary to further investigate this relationship to determine if in fact this intervention will impact student achievement. Many New Jersey schools have increased subject-specific content time because of increased accountability, despite little if any evidence to support this structural intervention. Information gleaned from this study will provide middle school administrators with additional tools to make informed decisions regarding student scheduling and allocation of instructional minutes in mathematics and determine whether increasing time in the classroom really contributes to the academic achievement of students.
Limitations

Limitations are inevitable in every study and achieving true randomness in schools is extremely difficult, as students in schools are already in formed groups. The relationship between time and learning certainly calls for more rigorous research, particularly research using experimental designs. True empirical research in a randomized setting is difficult in education and the social sciences because of control factors such as human behavior and the constraints of using students in experimental studies. The non-experimental, cross-sectional, explanatory study proposed here, utilizing a correlational design, provides only part of the explanation. It brings with it some limitations, especially the drawback that a correlational design cannot determine cause and effect. The variable of percentage of students taking Grade 8 algebra is also a limitation of this study. Since the unit of analysis was school and student performance is reported at the aggregate level, it is impossible to partition out the specific contribution (TPAP) by those students that took Grade 8 algebra from the overall Grade 8 mathematics performance metric. This limitation could influence the regression models where Grade 8 student mathematics performance was the dependent variable. It is also hoped that in order to mitigate selection bias, our sample is large enough, representative of New Jersey demographics, and accurately depicts the population at large.

A further limitation of the study is that due to the transition from the New Jersey School Report Card to the New Jersey School Performance Report (NJSPR), certain data are no longer collected. Beginning in school year 2011-2012, the New Jersey Department of Education no longer publishes metrics such as student mobility, class ratios, faculty credentials, faculty attendance, and faculty mobility. Despite the omission of these variables from the revised NJSPR, recent research has determined that student mobility was indeed statistically significant,
ranging from 1.0% to 8.1% of the variance in student achievement on the New Jersey Assessment of Skills and Knowledge (NJ ASK) for Grades 6-8 Language Arts and Mathematics (Sammarone, 2014). Faculty credentials were also statistically significant; however, the influence was negligible, explaining only 0.5% of the variance in student achievement on the NJ ASK, Grade 7 Language Arts. However, the unavailability of these metrics and the correlational design of this study are certainly limitations and topics for future research.

Delimitations

The data obtained and analyzed in this study were limited to the subject of mathematics in Grades 6 through 8 in the state of New Jersey because of the lack of empirical research for this particular age group. Time is a complex concept and can be further delineated to include allocated time, engaged time, time-on-task, academic learning time, transition time, and waiting time. Of those, allocated time, or scheduled time, was the categorization used for this research, as it could be more easily procured and quantified. The results of this research reflect only the school year 2013-2014.

Assumptions

It is assumed that all data procured through the New Jersey Department of Education are accurate. This includes all independent/predictor/input variables as well as dependent/output variables (New Jersey Assessment of Skills and Knowledge scores). It is also assumed that all information obtained from fellow administrators in the form of surveys and e-mails regarding scheduling and mathematics instructional minutes is accurate. It is further assumed that the information was correctly recorded by the researcher and transferred accurately into Microsoft Excel and IBM’s Statistical Package for the Social Sciences (SPSS) v24.
Definition of Terms

The terms defined below were obtained from the following sources.

- New Jersey Administrative Statutes (Title 18A Education)
- New Jersey Administrative Code (Title 6A Education)
- New Jersey Assessment of Skills and Knowledge Grades 3-8 
- New Jersey Assessment of Skills and Knowledge NJ ASK 2014 Grades 6, 7, and 8 Parent, Student, and Teacher Information Guide
- New Jersey Department of Education’s website glossary of acronyms and terms
- New Jersey School Performance Report Interpretive Guide
- U.S. Department of Education

**Absence:** Being not present, including the days missed regardless of whether they were determined to be excused or unexcused by the school.

**Achievement Gap:** Title I requires schools to close achievement gaps across several subgroups of students, assuring that each group meets the same benchmarks in proficiency in language arts literacy, mathematics, and science.

**Accountability:** Schools are required to be responsible for progress and achievement for all students and subgroups.

**Algebra Enrollment:** Percentage of students taking algebra, as well as the percentage of those students earning a C or higher, is included as a metric under the Algebra heading in the College and Career Readiness section of the NJSPR.

**Chronically Absent Student:** A student who is not present for 10% of the school year for any reason. Thus, a student who missed 18 school days would be classified as chronically absent
in a 180-day school year. Chronic absenteeism percentage is included as a metric in the College and Career Readiness section of the NJSPR.

**District Factor Grouping (DFG):** A system that provides a means of ranking schools by their socioeconomic status (SES). The grouping designation is based on information available from the census and includes the following: percentage of people in a community with no high school diploma, percentage with some college, occupations, income, unemployment, and poverty. There are eight groupings starting with A (the lowest socioeconomic level) and includes B, CD, DE, FG, GH, I, and J (the highest). The groupings allow comparison of districts with similar profiles for purposes of state aid and assessment information.

**Elementary and Secondary Education Act (ESEA):** The principal federal law enacted in 1965 affected education from kindergarten through high school. ESEA was civil rights law, offering new grants to districts serving low-income students, federal grants for textbooks and library books, funding for special education centers, and scholarships for low-income college students. ESEA offered federal grants to state educational agencies to improve the quality of elementary and secondary education. The No Child Left Behind Act (NCLB) reauthorized ESEA.

**Economically Disadvantaged Students:** The New Jersey Department of Education offers free/reduced-price lunch programs (FRLP) to economically disadvantaged students. FRLP is an indicator of a student’s enrollment in the national school lunch program (free and reduced-price breakfast, lunch, and milk programs) according to the household income guidelines provided by the U.S. Department of Agriculture. Percentage of economically disadvantaged students is included as a metric in the Current Year Enrollment by Program Participation heading under the Demographic section of the NJSPR.
New Jersey students are eligible for free and reduced-price lunch if they meet the following guidelines delineated in the table below (U.S. Department of Agriculture, 2013).

Table 2

*Free and Reduced-Price Lunch Eligibility*

<table>
<thead>
<tr>
<th>People in Household</th>
<th>Free School Meals 130% FPG</th>
<th>Reduced Price Meals 185% FPG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Annual</td>
<td>Monthly</td>
</tr>
<tr>
<td>1</td>
<td>$14,937</td>
<td>$1,245</td>
</tr>
<tr>
<td>2</td>
<td>$20,163</td>
<td>$1,681</td>
</tr>
<tr>
<td>3</td>
<td>$25,389</td>
<td>$2,116</td>
</tr>
<tr>
<td>4</td>
<td>$30,615</td>
<td>$2,552</td>
</tr>
<tr>
<td>5</td>
<td>$35,841</td>
<td>$2,987</td>
</tr>
<tr>
<td>6</td>
<td>$41,067</td>
<td>$3,423</td>
</tr>
<tr>
<td>7</td>
<td>$46,293</td>
<td>$3,858</td>
</tr>
<tr>
<td>8</td>
<td>$51,519</td>
<td>$4,294</td>
</tr>
<tr>
<td>Each additional person</td>
<td>+$5,226</td>
<td>+$436</td>
</tr>
</tbody>
</table>
**Every Student Succeeds Act (ESSA):** Reauthorizes the 50-year-old Elementary and Secondary Education Act (ESEA), the nation’s national education law and longstanding commitment to equal opportunity for all students. ESSA was developed in part to negate NCLB’s prescriptive requirements which became increasingly impracticable for schools and educators. ESSA was signed into law on December 10, 2015, with the goal of fully preparing all students for success in college and careers.

**Instructional Time:** The amount of time per day that a typical student is engaged in instructional activities under the supervision of a certified teacher. Instructional time is included as a metric in the School Climate section of the NJSPR.

**Length of School Day:** The amount of time a school is in session for a typical student on a normal school day. Length of school day is included as a metric in the School Climate section of the NJSPR.

**Limited English Proficient Students (LEP)/English Language Learners (ELL):** The percentage of LEP/ELL students in the school. It is calculated by dividing the total number of students who are in Limited English Proficient programs by the total enrollment. LEP/ELL students are defined as “students whose native language is other than English and who have varying degrees of English proficiency in speaking, reading, writing, or listening and is synonymous with limited English speaking ability.” Percentage of Limited English Proficient Students is included as a metric in the Current Year Enrollment by Program Participation heading under the Demographic section of the NJSPR.

**New Jersey Assessment of Skills and Knowledge (NJ ASK):** The state’s elementary and middle school assessment program covering Grades 3 through 8. NJ ASK is intended to provide
information about student progress toward mastery of the skills specified by the CCSS in Language Arts Literacy and Mathematics at each grade level and Science at Grades 4 and 8.

**No Child Left Behind Act of 2001 (NCLB):** Signed into law on January 8, 2002, it reauthorized the Elementary and Secondary Education Act of 1965 (ESEA), the main federal law regarding K-12 education. The four main pillars of NCLB are accountability, flexibility and local control, enhanced parental choice, and a focus on what works in the classroom. NCLB requires state governments and educational systems to help low-achieving students in high-poverty schools meet the same academic performance standards that apply to all students.

**School Performance Report:** New Jersey public schools are required to submit information regarding various metrics for their particular school and submit this information to the New Jersey Department of Education. The NJDOE then publishes these data in a yearly performance report as a statistical profile to set high standards, measure school progress, and report results to the public each year.

**Student/Faculty Ratio:** Represents the count of students per faculty member in the school. Calculated by dividing the total number of students by the combined full-time equivalents of all faculty, including classroom teachers, guidance counselors, and support personnel. Student/faculty ratio is included as a metric in the School Climate section of the NJSPR.

**Students with Disabilities:** Percentage of students with an Individualized Education Program (IEP), including speech, regardless of placement and programs. This is calculated by dividing the total number of students with IEPs by the total enrollment. Percentage of students with a disability is included as a metric in the Current Year Enrollment by Program Participation heading under the Demographic Information section of the NJSPR.
**Student Subgroup:** The nine student subgroups are Special Education, LEP, Economically Disadvantaged, White, African American, American Indian, Asian/Pacific Islander, Hispanic, and other.

**Suspension Rate:** The percentage of students who were suspended one or more times during the school year. Student suspension percentage rate is included as a metric in the School Climate section of the NJSPR.

**Total School Enrollment:** The count of students who were “on roll” by grade in October of each school year. Total School Enrollment is included as a metric in the Demographic Information section of the NJSPR.

**Organization of the Study**

Chapter I introduced the problem and structural interventions purported to improve public school education. The researcher further delineated structural interventions, including instructional minutes and their relationship to the New Jersey Assessment of Skills and Knowledge Grades 6-8 Mathematics scores. The researcher provided a broad understanding of the problem, the need for the study, and the significance to administrators for education practice and policy.

Chapter II presents an extensive review of the literature regarding instructional minutes and student achievement. The independent variables listed on the New Jersey School Performance Report were also examined as they relate to student achievement.

Chapter III, in combination with Chapter I, explains the design methods and procedures utilized for this study. Data for the independent/dependent variables were collected from the New Jersey Department of Education as well as individual schools.

Chapter IV presents the data along with statistical analysis of the data.
Chapter V details the statistical summary and the data implications for educational and administrative policies. Recommendations and conclusions are drawn from research questions and statistical findings as well as implications for future practice and research.

The study concludes with a comprehensive list of references and appendices supporting the research questions.
CHAPTER II

LITERATURE REVIEW

Introduction

The purpose of this study was to examine the influence, if any, of mathematical-instructional minutes on academic achievement, as measured by the New Jersey Assessment of Skills and Knowledge 6, 7, and 8 Mathematics scores. In addition, I hoped to explain the amount of variance in student test scores for which instructional minutes in Mathematics are responsible while accounting for other factors that influence student achievement. These include selected metrics and variables listed on the 2013-2014 New Jersey School Performance Report.

The overall research question guiding this study was the following: What is the nature of the relationship between instructional minutes in mathematics and the percentage of Proficient and Advanced Proficient scores on the 2014 Grades 6-8 Mathematics section of the New Jersey Assessment of Skills and Knowledge when controlling for student and school variables?

Literature Search Procedures

The overall goal of this literature review was to develop a deeper understanding of the variables that affect student achievement. Utilizing the framework set forth by Boote and Beile (2005), the researcher conducted a comprehensive investigation that included all relevant literature regarding the topics and variables discussed in this study. The search query included literature containing empirical research studies, conceptual articles, dissertations, historical texts, and peer-reviewed journals. Information was procured primarily through electronic, educational databases, including Google Scholar, Education Resources Information Center (ERIC), Education Research Complete (Ebsco Host), Academic Search Premier, ProQuest Education (Proquest), PsycInfo (American Psychological Association), and Seton Hall Dissertations.
Research was not limited to educational databases. Additional searches were executed utilizing Google, Yahoo, Bing, various educational associations/organizations, as well as government databases such as the New Jersey Department of Education and the National Center for Education Statistics. The search query utilized Boolean operators, truncation, and online help to expand or limit the search. The independent variables of Limited English Proficient students, economically disadvantaged students, students with disabilities, absenteeism, student suspension rate, instructional time, length of school day, school enrollment, algebra enrollment, and student-faculty ratio, along with the word achievement, all served as keywords and descriptors to guide the review of the literature. The researcher entered the delineated terms with all conceivable alternate phrasing or synonyms for the search words, as well as all permutations, variations, sequences, omissions, and sequences of keywords and phrases to yield maximum results.

**Methodological Issues**

True experimental research is difficult, if not unviable, within the realm of the social sciences and education because of confidentiality concerns and the impracticality of effectively designing and conducting the study. As such, the researcher must depend upon non-experimental and quasi-experimental designs when conducting studies predicting student achievement. The researcher uncovered many inconsistent findings when perusing the literature. These included emphasis on correlational design, lack of effect size and other pertinent data, non-longitudinal design, and inconsistent terminology. These non-scientific studies often yielded mixed results. The majority of studies predicting student achievement did demonstrate some significant relationships but were correlational in design and therefore could not predict cause and effect. The recent research pertaining to subject-specific instructional minutes was limited in scope and amount.
Standards for Inclusion

The standards for studies included in the literature review are the following:

1. Peer-reviewed research including empirical studies, data-based research articles, journal reviews, syntheses of existing research and dissertations
2. Policy reports with educational theory and/or empirical research
3. Anecdotal, experientially-based periodical publications
4. Experimental/non-experimental research with control groups, quasi-experiments, case studies, and meta-analyses
5. Quantitative, qualitative, and mixed-method design studies
6. Historical texts, books, and seminal works regarding student achievement
7. Federal/state government and professional educational association reports
8. Studies conducted within the last 30 years, unless considered a seminal or important work by other researchers and scholars, that focused on student achievement
9. Non peer-reviewed research and literature were utilized to gain additional perspective of student achievement.

Theoretical Framework

This research study examined school and student inputs to determine the influence, if any, of mathematical-instructional minutes on academic achievement as measured by the New Jersey Assessment of Skills and Knowledge 6, 7, and 8 Mathematics scores. The production function theory served as the theoretical framework and was the lens through which this research study was viewed. Pigott, Williams, Polanin, and Wu-Bohanon (2012) stated that the production function theory is an often-utilized theoretical framework for analyzing school inputs and student outputs. This theory is based on the premise that an increase in student or school inputs will
result in an increase in output (student achievement). This framework has been used in many educational studies beginning with the seminal work of Coleman (1966). In this research study, the inputs of school and student variables were investigated to determine their effect on the output (NJ ASK 6-8 Mathematics scores).

There are many variables that influence student achievement. The variables that are listed by the New Jersey School Performance Report (NJSPR) are just one way to categorize some of the metrics that measure student and school performance. The NJSPR has two distinct categories; student variables (socioeconomic status, attendance, etc.) and school variables (length of school day, instructional time, etc.). These input variables were listed in Table 1: Selected New Jersey School Performance Report Predictor Variables under the Independent Variables section in Chapter 1.

The student and school input variables influence student achievement in various degrees. The variables listed in the New Jersey School Performance Report are inputs according to the production function theory. In its most basic terms, the production function theory relates the output of a production process (NJ ASK) to educational inputs (SES, attendance, instructional time, etc.) to determine efficiency; in this case, proficiency on the NJ ASK.

Many of the input variables are beyond the control of those involved in education. However, policy makers, educational bureaucrats, and administrators can manipulate at least one of the inputs: time. Adding instructional time is predicated by the simple belief: More time in school should result in more learning and increased student performance. Time can be manipulated in the form of school day, school year, or school period. Time can be further delineated to include allocated time, engaged time, time-on-task, academic learning time, transition time, and waiting time (Berliner, 1990). This study focused on allocated time, or the
amount of time designated for instruction. Some researchers have found that students who had more instructional time had increased achievement (Walberg, 2011; Lavy, 2010; Patall, Cooper & Allen, 2010; Barro & Lee 2001; Jackson, 1985; Phillips, 1985). Conversely, some have posited that increased instructional time had negligible results regarding student achievement (Slavin & Davis, 2006; Baker, Fabrega, Galindo, & Mishook, 2004; Aronson, Zimmerman, & Carlos, 1999; Levin & Tsang, 1987; Karweit, 1983).

This study will add to the empirical evidence regarding the influence of the input variables listed on the New Jersey School Performance Report on the output variable of academic achievement (New Jersey Assessment of Skills and Knowledge scores). The input/output model and production function theory, which undergirds this study, enabled statistical analyses through the Statistical Package for the Social Sciences (SPSS) v24. It also allowed the researcher to determine the influence of mathematical-instructional time on academic achievement as measured by the NJ ASK scores.

**High-Stakes Testing**

With continued emphasis on accountability and improving student achievement, high-stakes testing continues to be the mechanism of choice when measuring student outcomes and school achievement. Regardless of the name of the test or type of test, high-stakes testing has overwhelmingly been selected as the means to determine school progress, teacher efficacy, student promotion or retention, and eligibility for high school graduation (Thurlow & Johnson, 2000). The seminal report *A Nation at Risk* brought a renewed sense of urgency to address the purported deficiencies of the U.S. public schools and its solution of “twin goals of equity and high quality schooling” (National Commission on Excellence in Education, 1983).
In 2002, The No Child Left Behind Act (NCLB) was signed into law and declared that all students would be taught effectively. States, districts, schools, and teachers would be accountable for every student. In order to ensure accountability, students would be assessed on standardized tests. Schools would be responsible for student achievement as measured by their standardized scores, which would determine whether a student was proficient in language arts and mathematics. Public schools were required to establish benchmarks for their aggregate population as well as sub-populations (economically disadvantaged students, students with a disability, and English Language Learners). Schools that did not make annual yearly progress were required to take corrective action to remedy the situation (Martin, 2012).

The No Child Left Behind Act (NCLB) aggressively expanded the role of the federal government and at the same time curtailed local control over educational matters. NCLB raised the stakes with a rigorous accountability system decreeing all students reach 100% academic proficiency by school year 2014 (Bump, 2005). The impetus for getting schools compliant with this new mandate was funding. In order for states to receive Title 1 funds, schools needed to benchmark goals for annual yearly progress to get all students, regardless of their demographic or sub-group to grade level by 2014 (USDOE, 2002). Educators experienced immense pressure to have students pass standardized tests. Teachers often infused test-taking techniques into their lessons, sped through the curriculum, drilled students and taught to the test (Reich & Bally, 2010). Recent educational legislation such as the Every Student Succeeds Act (USDOE, 2015), or federal inducements such as Race to the Top (USDOE, 2009) continue to encourage states to evaluate teachers utilizing a state approved teacher evaluation system that includes students’ test scores. This nexus promotes the view that students’ high-stakes test results are the direct consequence of specific teachers’ instruction (Martin, 2012).
Martin (2012) examined school proficiency rates on No Child Left Behind (NCLB) mandated assessments for middle school students in Washington, D.C., to ascertain what non-instructional factors affect student test scores. The District of Columbia Comprehensive Assessment System is a high-stakes, NCLB mandated assessment used to assess students in Grades 3 through 8 and Grade 10 in reading and math in the public schools of Washington, D.C. Student scores are determined using cut scores and are considered below basic, basic, proficient, and advanced. Pursuant to Schochet and Chiang (2010), Martin posited that contextual factors, such as economically disadvantaged, students with a disability, and English Language Learners, would influence the results of the high-stakes assessment.

The researcher collected data from 70 public schools in Washington, D.C., that served Grades 6 through 8. Data included proficiency scores for total population, economically disadvantaged students, students with a disability, and English Language Learners. Subtracting these subgroups from the total population of the school, the researcher deduced three new subgroups: students not economically disadvantaged, students without a disability, and non-English Language Learners. Regression analyses were performed to test for significant relationships between each of the subgroups, variables, and total populations. The researcher disaggregated and compared mean proficiency rates between the groups (Martin, 2012).

Disaggregation of the data revealed that students who were not in one of the annual yearly progress (AYP) defined subgroups, economically disadvantaged students (ED), students with a disability (SWD), and English Language Learners (ELL), had higher proficiency scores, with a higher measure of statistical significance than their AYP defined counterparts. Average school District of Columbia Comprehensive Assessment System (DCCAS) proficiency rates by subgroup yielded the following scores in reading: ED = 42.66%, non-ED = 51.9%, n = 56, \( p = \)
SWD = 15.7%, non-SWD = 40.12%, n = 46, p = < 0.0001; ELL = 38.52%, non-ELL = 57.74%, n = 14, p = < 0.0001. Average school DCCAS proficiency rates by subgroup also yielded the following scores in mathematics: ED = 46.85%, non-ED = 53.89%, n = 56, p = 0.028; SWD = 21.96%, non-SWD = 52.72%, n = 46, p = < 0.0001; ELL = 47.49%, non-ELL = 58.69%, n = 14, p = < 0.073 (no significant difference) (Martin, 2012). Statistical analysis revealed that students in one of the AYP defined subgroups (ED, SWD, ELL) had consistently lower proficiency rates, with a higher measure of statistical significance than students who were not in one of the “challenged” groups (Martin, 2012). The one exception was mathematics scores for the ELL students, which was not statistically significant compared to their non-ELL peers. Pursuant to Abedi (2004), mathematics is perhaps a content area where language proficiency is less of a contextual factor.

Schools were also examined by their neighborhood cluster delineated by family income. The researcher examined the relationship between average family income of the neighborhood and test scores. Utilizing data provided by the Urban Institute (2011), the mean annual income of the neighborhood ranged from $41,510 to $288,541. The researcher performed a regression analysis and discovered a very statistically significant correlation between the two variables. The F-statistic was less than 0.0001 for both reading and math, concluding that the neighborhood of a school and family income are considerable factors when determining proficiency in scores (Martin, 2012).

The underpinnings of Public Law 107-110, The No Child Left Behind Act are misguided. Utilizing student proficiency scores as indicators of instructional quality negates the impact of student background factors and challenges on high-stake test scores (Welner, 2005). The key provision, as noted in NCLB, that the same annual target rates are to be set for total school
population as well as all subgroups (economically disadvantaged students, students with a
disability, and English Language Learners) is inherently deficient. The one-size-fits-all model,
high-stakes assessment, single-method quantification, denies the very significant contextual
factors of the outside world. These social inequities should be acknowledged, understood, and
accounted for when developing high-stakes testing and holding educators and students
accountable as NCLB has inadvertently done (Hershberg, 2005; Jennings & Corcoran, 2009).

New Jersey is not immune to the allure of inducements offered by the federal government
in the accountability, legislation, and high-stakes testing era. In return for federal funds and
under the latest reauthorization of the Elementary and Secondary Education Act (ESEA) and the
Every Student Succeeds Act (ESSA), the New Jersey Department of Education (NJDOE) rates
public school teachers, compares student achievement, and rates each school on attainment of
progress targets. Under ESSA, and in exchange for Race to the Top (RTTT) funding, the NJDOE
implemented a teacher evaluation system that correlates to student test scores in the form of
student growth percentiles. Accountability measures also include graduation and attendance
rates. District and school performance metrics including participation, graduation rates, and
attendance rates are used for accountability and reported to districts annually in the form of
ESEA Accountability Profiles (NJDOE, 2015a).

New Jersey Assessment of Skills and Knowledge

As a result of the Elementary and Secondary Education Act and No Child Left Behind
requirements, the New Jersey Department of Education (NJDOE) developed statewide
standardized assessments of Grades 3 through 8 as well as high school. New Jersey Assessment
of Skills and Knowledge (NJ ASK) is the state’s elementary and middle standardized school
assessment program, covering Grades 3 through 8 (NJDOE, 2014a). The NJDOE, along with
the New Jersey Office of State Assessments, coordinates, plans, schedules, and directs all NJ ASK activities. Measurement Incorporated is the contractor for the test and is responsible for all aspects of the development of the test materials and psychometric support. The 2014 NJ ASK is intended to provide information about student progress toward mastery of the skills specified by the Common Core State Standards in Language Arts Literacy and Mathematics at each grade level, and Science at Grades 4 and 8 (NJDOE, 2014a). All sixth, seventh, and eighth grade NJ public school students are required to take the assessment, unless they are participating in the Alternate Proficiency Assessment because of a severe cognitive disability (NJDOE, 2014a).

Seventh and eighth grade students took the 2014 New Jersey Assessment of Skills and Knowledge over four mornings from April 28, 2014, through May 1, 2014. Sixth grade students took the examination over four mornings from May 5, 2014, through May 8, 2014. Students in Grades 6 and 7 are tested in two content areas (Math, Language Arts) over four days. Students in Grades 8 are tested in three content areas (Math, Language Arts, Science) over four days (NJDOE, 2014a).

Table 3

*Schedule of Content, Day and Duration of NJ ASK Test for the 2014 School Year*

<table>
<thead>
<tr>
<th>Grade 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Language Arts, Day 1</td>
</tr>
<tr>
<td>English Language Arts, Day 2</td>
</tr>
<tr>
<td>Mathematics, Day 1</td>
</tr>
<tr>
<td>Mathematics, Day 2</td>
</tr>
<tr>
<td>Grade 7</td>
</tr>
<tr>
<td>--------------</td>
</tr>
<tr>
<td>English Language Arts, Day 1</td>
</tr>
<tr>
<td>English Language Arts, Day 2</td>
</tr>
<tr>
<td>Mathematics, Day 1</td>
</tr>
<tr>
<td>Mathematics, Day 2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade 8</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>English Language Arts, Day 1</td>
<td>1 hour, 45 minutes</td>
<td></td>
</tr>
<tr>
<td>English Language Arts, Day 2</td>
<td>2 hours, 15 minutes</td>
<td></td>
</tr>
<tr>
<td>Mathematics, Day 1</td>
<td>2 hours, 13 minutes</td>
<td></td>
</tr>
<tr>
<td>Science, Day 1</td>
<td>2 hours</td>
<td></td>
</tr>
</tbody>
</table>

This study utilized only the Mathematics portion of the New Jersey Assessment of Skills and Knowledge (NJ ASK) for further examination. The skill areas for Grades 6 and 7 Mathematics include ratios/proportional relationships, the number system, expressions/equations, geometry, and statistics/probability. The skill areas for Grade 8 Mathematics include the number system, expressions/equations, functions, geometry, and statistics/probability. The NJ ASK 6, 7, and 8 Mathematics assessment consists of multiple choice questions and extended/short constructed-response questions. Calculators are permitted on Day 2 for sixth and seventh graders. In Grade 8, calculators are permitted on the last three sections of the test. A Mathematics reference sheet, ruler, and protractor are also permissible (NJDOE, 2014a).

The New Jersey Assessment of Skills and Knowledge scores are reported as total scale scores and categorized in content clusters as noted in Table 4 and Table 5 below (NJDOE, 2015b).
Table 4

**NJ ASK Total Scale Scoring Delineations**

<table>
<thead>
<tr>
<th>Partially Proficient</th>
<th>100-199</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proficient</td>
<td>200-249</td>
</tr>
<tr>
<td>Advanced Proficient</td>
<td>250-300</td>
</tr>
</tbody>
</table>

Table 5

**NJ ASK Total Points Disaggregated by Mathematics Content Cluster**

<table>
<thead>
<tr>
<th>Math Content Cluster</th>
<th>6th grade</th>
<th>7th grade</th>
<th>8th grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expressions/Equations</td>
<td>14</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>Geometry</td>
<td>7</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Number System</td>
<td>14</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Ratio/Proportion</td>
<td>8</td>
<td>8</td>
<td>*</td>
</tr>
<tr>
<td>Statistics/Probability</td>
<td>6</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Functions</td>
<td>*</td>
<td>*</td>
<td>10</td>
</tr>
<tr>
<td>Total Points</td>
<td>49</td>
<td>49</td>
<td>49</td>
</tr>
</tbody>
</table>

Measurement Incorporated (MI) is also in charge of scoring all test items and distributing score results to the New Jersey Department of Education (NJDOE), districts, schools, and students. Students that score Partially Proficient are below the New Jersey standard of minimum proficiency and may need additional instructional supports. Although these minimum proficiency levels or cut scores have been accepted by the NJDOE, the manufacturer of the test, MI, cautions state education agencies from using the data to make high-stakes decisions. This
could be due to the degree (margin) of error potentially present in the test score, or the conditional standard error of measurement (CSEM).

The conditional standard error of measurement (CSEM) separating Proficient from Advanced Proficient students on the 2014 New Jersey Assessment of Skills and Knowledge (NJ ASK), Grades 6 through 8 Mathematics section, ranges from plus/minus 2.79-3.22 (NJDOE, 2015b). The number of students potentially harmed by misinterpretations of score results from CSEM and then labeling students *not proficient* is especially troubling (Tienken, 2011). Despite this conspicuous omission, administrators continue to be encouraged to make data-driven decisions based on the results of standardized tests (Booher-Jennings, 2005). Despite the technical flaws, CSEM, and the test manufacturer’s caution in using the test results for comparison purposes, the 2014 NJ ASK Grades 3-8 Technical Report asserts that interpretation and use of test score data has been supported by empirical evidence (NJDOE, 2015b).

The New Jersey Department of Education published student statewide results in the form of the 2014 New Jersey Assessment of Skills and Knowledge Executive Summary. The metrics and performance indicators as they relate to Mathematics, grade level and subgroups are listed below.

**Grade 6 NJ ASK**

The 6th grade Mathematics section was given on May 7, 2014, and May 8, 2014. Of the 102,513 students enrolled, 101,075 students received valid scale scores in Mathematics (NJDOE, 2014b).

**Collective results.** 44.1% of students scored in the Proficient range; 35.2% scored in the Advanced Proficient range. The mean scale score in Mathematics was 229.0.
**Economic status.** 65.2% of economically disadvantaged students scored at or above Proficient. 88.0% of non-economically disadvantaged students scored at or above Proficient.

**Special education (SE).** 36.7% of SE students scored at the Proficient level; 10.0% scored in the Advanced Proficient range. The mean scale score in Mathematics for SE students was 194.9.

**Current Limited English Proficient (LEP).** 42.8% of current LEP students scored at or above Proficient (32.9 Proficient; 9.9 Advanced Proficient). The mean scale score in Mathematics for current LEP students was 192.1.

**Former Limited English Proficient (LEP).** 65.8% of former LEP students scored at or above Proficient (47.5 Proficient; 18.2 Advanced Proficient).

**Gender.** 81.5% of female students scored at or above Proficient (44.7 Proficient; 36.8 Advanced Proficient) compared to 77.3% of male students (43.6 Proficient; 33.7 Advanced Proficient).

**Ethnicity.** Percentage of Partially Proficient students ranged from 41.3% for African-American students to 4.9% for Asian students—a gap of 36.4% between lowest and highest achieving groups (NJDOE, 2014b).

**Grade 7 NJ ASK**

The 7th grade Mathematics section was given on April 30, 2014, and May 1, 2014. Of the 104,245 students enrolled, 102,797 students received valid scale scores (NJDOE, 2014c).

**Collective results.** 41.6% of students scored in the Proficient range; 25.2% scored in the Advanced Proficient range. The mean scale score in Mathematics was 215.9.
Economic status. 47.5% of economically disadvantaged students scored at or above Proficient; 78.0% of non-economically disadvantaged students scored at or above Proficient.

Special education (SE). 24.0% of SE students scored at the Proficient level; 5.4% scored in the Advanced Proficient range. The mean scale score in Mathematics for SE students was 178.9.

Current Limited English Proficient (LEP). 23.6% of current LEP students scored at or above Proficient (18.6 Proficient; 5.0 Advanced Proficient). The mean score in Math for current LEP students was 174.5.

Former Limited English Proficient (LEP). 45.0% of former LEP students scored at or above Proficient (35.7 Proficient; 9.4 Advanced Proficient).

Gender. 67.4% of female students scored at or above Proficient (43.4 Proficient; 24.0 Advanced Proficient) compared to 66.1% of male students (39.8 Proficient; 26.3 Advanced Proficient).

Ethnicity. Percentage of Partially Proficient students ranged from 58.2% for African-American students to 10.0% for Asian students—a gap of 48.2% between lowest and highest achieving groups (NJDOE, 2014c).

Grade 8 NJ ASK

The 8th grade Mathematics section was given on April 30, 2014. Of the 104,616 students enrolled, 103,034 students received valid scores (NJDOE, 2014d).

Collective results. 35.9% of all students scored in the Proficient range; 35.6% scored in the Advanced Proficient range. The mean scale score in Mathematics was 225.2.
**Economic status.** 53.6% of economically disadvantaged students scored at or above Proficient; 81.5% of non-economically disadvantaged students scored Proficient or Advanced Proficient.

**Special education (SE).** 24.5% of SE students scored at the Proficient level; 8.1% scored in the Advanced Proficient range. The mean scale score in Mathematics for SE students was 182.9.

**Current Limited English Proficient (LEP).** 32.2% of current LEP students scored at or above Proficient (22.1 Proficient; 10.2 Advanced Proficient). The mean scale score in Mathematics for current LEP students was 184.6.

**Former Limited English Proficient (LEP).** 57.4% of former LEP students scored at or above Proficient (35.7 Proficient; 21.7 Advanced Proficient).

**Gender.** 72.7% of female students scored at or above Proficient (38.3 Proficient; 34.4 Advanced Proficient) compared to 70.3% of male students (33.5 Proficient; 36.8 Advanced Proficient).

**Ethnicity.** Percentage of Partially Proficient students ranged from 53.2% for African-American students to 7.6% for Asian students—a gap of 45.6% between lowest and highest achieving groups (NJDOE, 2014d).

**New Jersey School Performance Report**

Beginning school year 2011-12, the New Jersey Department of Education published school performance data via the New Jersey School Performance Report (NJSPR). The NJSPR replaces the long running (17 years) New Jersey School Report Card (NJSRC). Included from the NJSRC is test score data, instructional time, length of school day, student suspension rate, student/staff ratio, and enrollment data (students with disabilities/students with limited
English proficiency). Additionally, metrics such as economically disadvantaged students, chronic absenteeism, and students taking algebra are included in the NJSPR. The NJSPR presents these metrics to assess a school’s yearly performance, peer comparisons, state comparisons, as well as absolute performance targets to present a comprehensive picture of overall school performance (NJDOE, 2015c).

The New Jersey School Performance Report (NJSPR) is published annually by the New Jersey Department of Education. It was developed with input from multiple stakeholders and designed to present information to parents and educators on how well a school is performing. As part of New Jersey’s accountability system and in accordance with the Elementary and Secondary Education Act (ESEA), the No Child Left Behind Act, and the Every Student Succeeds Act, the NJSPR was created to focus on metrics that are indicative of college and career readiness (NJDOE, 2015c). The ESEA Flexibility Request requires that the New Jersey Department of Education distribute accountability reports by way of the NJSPR. These profiles provide data on the aforementioned metrics, as well as graduation rate, student participation in assessments, and performance of each subgroup within the school. Educators, parents, and community members can use these metrics to see how a child is doing relative to the school, state, and peer communities in order to identify a school’s strength and address areas needing improvement (NJDOE, 2015c).

**Student Variables**

**Absenteeism**

The New Jersey Department of Education (NJDOE) defines an absence as being not present and includes the days missed regardless of whether the school determined them to be excused or unexcused. A chronically absent student is one who was not present for 10% or more
of the total days possible for that individual. Hence, a student who was absent 18 days of a 180-day school year would be deemed chronically absent. The NJDOE stresses that an indicator of future academic success and achievement is regular school attendance. As such, chronic absenteeism percentage is included as a metric in the College and Career Readiness section of the New Jersey School Performance Report (NJSPR) The NJSPR delineates the percentage of students who were absent in each category: 0 absences; 1 - 5 absences; 6 - 10 absences; 11 - 15 absences; more than 15 absences (NJDOE, 2015c).

School attendance is a commonly researched variable when examining student achievement. Reasonable judgment would posit that poorer attendance rates would result in poorer achievement. Researchers in the Minneapolis Public School systems discovered that students that were absent 20% of the time scored 20 points lower than those who attended every day (Hinz, Kapp, & Snapp, 2003). Alanis (2000) studied the academic performance of Grade 5 Limited English Proficiency students in Texas. He discovered that students who had failed the Grade 5 English test had missed more school days on average in Grades 1 through 5 than those students who passed the test.

Lamdin (1996) investigated student academic achievement through the lens of the production function theory, or more appropriately for education, the input-output model. Student attendance was the input. The output was the standardized test data from the Baltimore Public School System. The sample consisted of 97 elementary (K-5) schools in Baltimore, Maryland. The dependent variable was aggregate student performance on the California Achievement Test in reading and mathematics. Lamdin explored independent variables such as socioeconomic status, free/reduced lunch, race, and pupil-teacher ratio. However, for the purpose of this study, only the independent variable of student attendance is discussed. Utilizing a regression analysis
model, Lamdin found that the coefficient of student attendance was positive and statistically significant \((p < 0.05)\) in all nine of the specifications and statistically significant \((p < 0.01)\) eight of the nine times. The results suggest that the average level of attendance has a positive influence on student performance and that higher average levels of attendance correlated to a positive influence on student performance in mathematics and reading (Lamdin, 1996).

Parke and Kanyongo (2012) analyzed the effect of mobility and attendance on student achievement. The sample consisted of 80 inner-city schools and approximately 32,000 students during the 2004-05 school year. The attendance-mobility variable was collected per district data classification but was delineated by four distinct categories: stable attenders; stable non-attenders; mobile attenders, and mobile non-attenders. Stable students were those who stay in the same school for the whole year. Mobile students were defined as students that transfer at least once during the school year. Attenders were those students who were absent less than 5% of the school year; non-attenders were those who were absent more than 5%.

The impact on mathematics achievement was conducted via a two-factor analysis of variance (ANOVA) for each grade. The independent variables were attendance-mobility and ethnicity. The dependent variable was the scaled score on the Pennsylvania System of School Assessment. Descriptive statistics were also included because of their practical application to educators. The factorial ANOVA allowed for exploring the main effect of attendance-mobility and ethnicity on achievement. Two-factor analysis of covariance (ANCOVA) was also conducted to ascertain whether the ANOVA results remained consistent after removing the covariates.

The researchers concluded that the attendance-mobility and ethnicity variables had a significant effect on math scores \((p < 0.001)\) on the 8th grade Pennsylvania System of School
Assessment (PSSA). Tukey analysis demonstrated that the mean scores of stable attenders ($m = 1332$) were noticeably higher than the three other categories: mobile attenders ($m = 1228$), stable non-attenders ($m = 1193$), and mobile non-attenders ($m = 1160$). Ethnicity and attendance-mobility had no significant interaction ($p > 0.01$), indicating that White and Black students have similar score patterns across the four categories of attendance-mobility. Results from the 11th grade PSSA mathematics scores also demonstrated a significant difference in mean scores. Stable attenders ($m = 1360$) were significantly higher than the three other categories: mobile attenders ($m = 1256$), stable non-attenders ($m = 1175$), and mobile non-attenders ($m = 1078$). Results from this study demonstrated that for both ethnicities, the two highest mean mathematics scores occurred in the two attendance categories (Parke & Kanyongo, 2012).

Roby (2004) also explored the relationship of student attendance and student achievement. Roby examined schools in Ohio that housed Grades 4, 6, 9, and 12 and their respective results on the Ohio Proficiency tests. Student achievement was compared with school-wide attendance averages to determine if a positive correlation exists between the two. The researcher utilized the Pearson’s correlation statistic ($r$) to determine the relationship between student achievement and attendance for those grades and their respective building student averages.

The author acquired data from the Ohio Department of Education for the 1999 school year. It included school building test proficiency and attendance averages for 3,171 Ohio schools. The number of schools ($N$) analyzed for each grade level were as follows: fourth grade ($n = 1,946$), sixth grade ($n = 1,292$), ninth grade ($n = 711$) and 12th grade ($n = 691$). The strength or degree of the relationship between the two variables was measured by the correlation coefficient (Pearson’s $r$). The correlation coefficients for fourth grade ($r = 0.57$), sixth grade ($r = 0.57$),
0.54), and 12th grade \((r = 0.55)\) demonstrate moderate positive relationships between student achievement and student attendance. The ninth grade demonstrated the strongest positive relationship \((r = 0.78)\). The percentage of variance \((R^2)\) held in common between student achievement and attendance was 32% for the fourth grade, 29% for the sixth and 12th grade, and 60% for the ninth grade.

Roby’s study submits there is a statistically significant relationship between student attendance and achievement in Ohio Grades 4, 6, 9, and 12. The correlation between student attendance and student achievement is moderate in Grades 4, 6, and 12, and there is a strong correlation in Grade 9 (Roby, 2004).

**Student Suspension Rate**

Suspension rates in the United States have doubled since the 1970s. Almost three million students were suspended from school in 2010 (Losen & Gillespie, 2012). Increasingly, authoritarian and intrusive discipline approaches, combined with zero tolerance policies, have markedly influenced student suspension rates (Simon, 2007). Despite being denounced as ineffective or unproductive (American Psychological Association, 2008), student suspensions remain part of the disciplinary continuum in American schools. Student suspension is also a potential discipline consequence practiced in New Jersey. The New Jersey Department of Education (2015c) defines student suspension rate as “the percentage of students who were suspended one or more times during the school year.”

The academic sector and popular media often denounce the practice and question its use as both a behavioral deterrent and its impact on student achievement. Many have deemed the practice of suspension, either in-school or out-of-school, as an ineffective deterrent, unproductive in modeling appropriate behavior and useless in supporting a safe school climate (Skiba &
Peterson, 2000). Morrison, Anthony, Storino, and Dillon (2001) found that students with suspensions had lower grade point averages than those who did not. Rausch and Skiba (2004) determined that out-of-school suspensions were negatively associated with school achievement, even after controlling for poverty rate, ethnicity, total school size, and location.

Arcia (2006) assessed the use of suspensions as a disciplinary measure and the impact on academic achievement. The study examined the achievement status of suspended students with matched counterparts of non-suspended students for a period of three years. Data was derived from a large, urban school district in Miami-Dade County, Florida. Student ethnic subgroups consisted of 58% Hispanic, 29% Black, 10% White, and 3% other races. The sample for this study consisted of students \((n = 49,327)\) who were suspended at least once in the academic years of 2001-02, 2002-03, 2003-04, and their non-suspended matched counterparts \((n = 42,809)\). Sample groups were matched on grade, gender, race, free/reduced lunch status, and proficiencies on Florida’s reading competency test.

Students were categorized by suspension history. Differences between groups were tested with ANOVAs, and significant differences were tested with Tukey’s post hoc. Students who were suspended had lower average reading achievement scores than those students who were not. Students without suspensions achieved a mean reading achievement score of \((m = 1,554)\), while their suspended counterparts achieved a mean reading achievement ranging from \((m = 1,338)\) to \((m = 1,440)\), depending on the amount of days of suspension. The difference in achievement scores increased in proportion to the number of days suspended (Arcia, 2006).

ANOVA indicated significant differences between the groups in year one \((F = 1,087.45, df = 4, 89798, p < 0.0001)\) and persisted through year 3 \((F = 2,028.14, df = 4,921.32, p < 0.001)\). Tukey’s HSD post hoc test confirmed that all groups were statistically significant \((p < 0.001)\). Findings
from this study indicate a discernible association between suspension rates and reading achievement (Arcia, 2006).

Losen and Martinez (2013) gathered data from over 26,000 middle and high schools in the United States. They estimate that over two million students, or one out of nine, were suspended during the 2009-2010 school year. Research has suggested that a student who was suspended once has double the likelihood of dropping out. Students who were never suspended had a 16% chance of dropping out, while their peers who were suspended had a 32% chance of dropping out (Balfanz & Byrnes, 2013). Fabelo, Thompson, Plotkin, Carmichael, Marchbanks, and Booth (2011) maintain that higher suspending schools derived no increase in achievement; however, those schools do experience an increase in dropout rates.

Morris and Perry (2016) researched the impact of race, ethnicity, suspension rates, and socio-demographic variables on reading and mathematics achievement. The researchers utilized data from the Kentucky School Discipline Study and Measure of Academic Progress (MAP) test scores. The sample was drawn from one school system which included 17 schools, 16,248 students, Grades 6 through 10, totaled 25,221 observations, and covered a three-year period. The gender makeup for the sample was 49% female and 51% male. The ethnic subgroups consisted of 59% White, 25% Black, 10% Latino, 4% Asian, and 3% other. Students qualifying for free or reduced-price lunch represented 48% of the population.

The Kentucky School Discipline Study (KSDS) sample was somewhat similar to the national percentages found in the United States Department of Education (USDOE, 2007) Household Education Survey Program. Suspension rates (22%) were the same for the KSDS and the USDOE. Patterns of suspension rates between local (KSDS) and national (USDOE) samples yielded the following data: Black student suspensions (KSDS = 42%, USDOE = 43%), Latino
student suspensions (KSDS = 26%, USDOE = 22%), Asian student suspensions (KSDS = 4%, USDOE = 11%), female student suspensions (KSDS = 18%, USDOE = 15%), and male student suspensions (KSDS = 26%, USDOE = 28%).

Descriptive statistics revealed that 12% of public school students will receive an out-of-school suspension in any given year. Measure of Academic Progress (MAP) reading scores ($m = 220.21, SD = 17.49$) and MAP math scores ($m = 231.33, SD = 19.6$) varied across the sample. The first set of models examined the influence of socio-demographic variables: race, ethnicity, family structure, special education, and free/reduced lunch on out-of-school suspension rates. The results from the mixed-effects, logistic regression models demonstrated that Black students are 7.57 times more likely to be suspended than White students ($p < 0.001$). Latinos are 2.39 times as likely to be suspended as Whites ($p < 0.001$). However, Asian students were less likely than Whites to be suspended ($r = .20; p < 0.001$). Students who qualify for free/reduced lunch are 6.36 times as likely to be suspended as those who do not qualify for it ($p < 0.001$). Students who receive special education services are 3.19 times as likely to be suspended as those who do not receive services ($p < 0.001$). When the family structure variable is introduced to one of the hierarchical models, students with two parents are 56% less likely to be suspended than those with only one parent or guardian ($p < 0.001$).

In the second set of analyses, the researchers examined the influence of suspensions, free/reduced lunch, special education, race, ethnicity, gender, and family structure on academic achievement in reading and math. The dependent variable was the performance on the math and reading section of the Measure of Academic Progress (MAP) tests. The addition of the suspension variable demonstrated that out-of-school suspension was significantly related to academic achievement. The proclivity for a student to be suspended is associated with decreases
in reading achievement (Morris & Perry, 2016). Students who were suspended each year of the study were predicted to have a MAP score 15 points lower than students who were never suspended ($\beta = -15.05, p < 0.001$). This accounts for nearly a one standard deviation decrease in academic achievement. Student suspension was also associated with significantly lower achievement on end-of-year reading evaluations ($\beta = -1.01, p < 0.001$) when compared to the same student’s non-suspension years (Morris & Perry, 2016). Decreased academic achievement was evidenced in all successive models, including the addition of several socio-demographic variables, including ethnicity, family structure, special education, and free/reduced lunch ($\beta = -8.61, p < 0.001$), ($\beta = -1.10, p < 0.001$), ($\beta = -8.37, p < 0.001$) and ($\beta = -1.10, p < 0.001$).

Morris and Perry (2016) also concluded that out-of-school suspension is associated with decreases in math achievement. Students who were suspended each year of the study were predicted to have a Measure of Academic Progress math score 16 points lower than students who were never suspended ($\beta = -16.21; p < 0.001$). This equates to a nearly one standard deviation decrease in academic achievement. Student suspension was also associated with significantly lower achievement on end-of-year mathematics assessments years ($\beta = -0.56; p < 0.05$) when compared to the same student’s non-suspension years. Decreased academic achievement was evidenced in all successive models, which included the addition of the socio-demographic variables of ethnicity, family structure, special education, and free/reduced lunch ($\beta = -9.40, p < 0.001$), ($\beta = -0.60, p < 0.05$), ($\beta = -9.11, p < 0.001$) and ($\beta = -0.60, p < 0.05$).

Morris and Perry (2016) focused on the differences in math achievement between suspended and non-suspended students for the third set of analyses. The researchers predicted Measure of Academic Progress math scores over a two-year period with three measures in time: zero or baseline, one year, and two years. A student who was never suspended was predicted to
have a six-point increase ($m = 228 - 234$) in academic progress. Students suspended once ($m = 225$) and students with two years of suspension ($m = 220$) had lower baseline scores than those students that were never suspended ($m = 228$). Hence, students with just one suspension ($m = 225$) began with a three-point deficit to those students who were never suspended ($m = 228$). This deficit grew to nine points between the one-suspension group ($m = 225$) and non-suspension group ($m = 234$) by year two. The one-suspension group experienced no significant growth in math achievement. Students with two years’ suspension ($m = 220$) began with an eight-point deficit to those students who were never suspended ($m = 228$). This deficit grew to eleven points between the two-year suspension group ($m = 223$) and non-suspension group ($m = 234$) by year two. Interestingly, students with two years’ suspension did demonstrate modest growth ($m = 3$) during the two-year study ($m = 220 - 223$). These findings put forward that when lower-performing students are suspended, it places them at even greater risk of academic decline (Morris & Perry, 2016).

Suspension from school has a significant effect on student achievement. Those students who have been suspended score significantly lower on end-of-year tests than those who have not been. Additionally, students who have been suspended perform worse in the years they were suspended, opposed to the years they were not. The effects of student suspension are long lasting, potentially setting up a trajectory of poor achievement for years to come (Morris & Perry, 2016). Despite evidence that suspension is significantly associated with lower achievement and that zero tolerance policies and suspensions do not enhance school climate (American Psychological Association, 2008), schools continue to be enamored with the strict disciplinary policies of suspension (Hoffman, 2014).
Limited English Proficient Students

High standards and accountability have long been the hallmark for obtaining federal funding for education. The Elementary and Secondary Education Act, its reauthorization as the No Child Left Behind Act, and presently the Every Student Succeeds Act have always included performance requirements for student subgroups. Limited English Proficient Students, or synonymously English Language Learners, are the fastest growing subgroup and are defined by New Jersey Department of Education as “students whose native language is other than English and who have varying degrees of English proficiency in speaking, reading, writing, or listening and is synonymous with limited English speaking ability” (N.J.A.C. 6A, 2017).

Nationally, students identified as Limited English Proficient (LEP) increased 57% during the years of 1995 to 2009. The percentage increase for LEP students is six times higher than the average 10% growth rate for the regular student population (Flannery, 2009). The achievement gap between LEP students and non-LEP students still exists and is particularly high with those LEP students with high language demands (Strickland & Alvermann, 2004). State assessments consistently demonstrate that LEP students are 20-30 percentage points less proficient than their non-LEP peers. The language demands faced by LEP students can significantly affect accurate measurement because for them, tests measure both achievement and language ability (Abedi & Dietel, 2004).

Based on the American Community Survey (2006), of the 53 million students ages 5 through 17 years old, 20.3% spoke another language at home and 5% had difficulty with English (Kominski, Shin, & Marotz, 2008). Evidence suggests that English Language Learners (ELL) with Limited English Proficiency (LEP) are more likely to drop out of school than their English-speaking peers (Sheng, Sheng, & Anderson, 2011). English proficiency is a leading cause for
the ELL student to drop out. English language capacity is directly related to student academic performance and grade promotion. The National Assessment of Educational Progress affirms that ELL students have scored lower in mathematics and reading than non-ELL students on a consistent basis (National Center for Educational Statistics, 2015).

English Language Learners are more prone to live with a low-income, less educated family than their English-speaking peers. Pursuant to Sirin’s (2005) meta-analytic literature review, socioeconomic status of a student’s family is one of the strongest correlates of academic performance. These low-income families had an 8.9% dropout rate versus 5.2% for middle-income families (Laird, Cataldi, Kewal-Ramani, & Chapman, 2008).

Another key factor affecting English Language Learners’ (ELL) achievement is the cultural divide between school and home. Differences including teaching methods, behavioral expectations, and the relationship between teacher-student increase the chance for the ELL student to drop out and not achieve (Carrasquillo & Rodriguez, 2002). The sum of being economically disadvantaged, limited English proficient, and having a different cultural background places the ELL student at the greatest risk of dropping out of school (Sheng, Sheng, & Anderson, 2011).

Abedi (2004) analyzed the disaggregated data for Limited English Proficiency (LEP) students required for the No Child Left Behind Act (NCLB) in terms of school annual yearly progress (AYP). Abedi asserts that inconsistent LEP classifications, smaller LEP populations, lack of LEP subgroup stability, measurement of AYP instruments for LEP students, LEP baseline scores, and LEP cutoff points all threaten the validity of school annual yearly progress (Abedi, 2004). States use different LEP classification methods or do not have enough LEP students for any meaningful analyses. The LEP subgroup is fluid. Students move out as they
attain English proficiency, thereby leaving the group even lower performing. Standardized tests are constructed for native English speakers and have lower reliability and validity for LEP students (Abedi, Leon, & Mirocha, 2003). Schools with higher percentages of LEP students have lower baseline scores, making progress goals much more challenging. Last, NCLB makes AYP more challenging, as higher scores in math (less language demand) are negated when viewed through a conjunctive model in which students have to be proficient in all content areas (Abedi, 2004).

To demonstrate the impact of language on content assessments, Abedi (2004) studied the performance of Limited English Proficient (LEP) and non-LEP students in Grade 3 (LEP = 996, non-LEP = 13,054); Grade 6 (LEP = 726, non-LEP = 12,628); and Grade 8 (LEP = 692, non-LEP = 11,792). Performance differences were noted in terms of effect sizes. Results were consistent across all three grade levels. Reading effect sizes were 0.18 for third grade, 0.24 for sixth grade, and 0.22 for eighth grade. According to Cohen (as cited in Ravid, 2005), these effect sizes are medium. Math analytical effect sizes were 0.15 for third grade, 0.18 for sixth grade, and 0.15 for eighth grade. These effect sizes were less significant than the effects for reading. Math calculation effect sizes were 0.07 for third grade, 0.09 for sixth grade, and 0.09 for eighth grade. The effect sizes for math calculation were smaller than math analytical and much less than the effect sizes for reading. The average effect size for the three grades were 0.213 for reading, 0.160 for math analytical, and 0.083 for math calculation. The smaller the effect size, the less the performance gap between LEP and non-LEP students. The results suggest that the largest difference between the groups was in reading (highest language demand) and the smallest in math calculation (lowest language demand).
Abedi (2004) goes on to assert that the test items on the Stanford Achievement Test may suffer from lower reliability for Limited English Proficient (LEP) students than their Fluent English Proficient (FEP) and English only counterparts. Reliability for test items in math, language, science and social science were analyzed for internal consistency using Cronbach’s coefficient alpha. Alpha coefficients were highest for the English-only group \( n = 180,000, (\alpha = 0.805) \); lower for the FEP group \( n = 38,000, (\alpha = 0.784) \); and lowest for the LEP group \( n = 53,000, (\alpha = 0.530) \). Among the LEP students, the alpha coefficients differed substantially across content areas. However, in math, where language may not impact performance as significantly, the alpha coefficient was 0.802 for LEP students and 0.898 for both English-only and FEP students. Thus, language comprehension introduces another source of possible error for the LEP students that might not affect their English-speaking peers (Solano-Flores & Trumbull, 2003).

Abedi, Courtney, and Leon (2003) state that when a Limited English Proficient (LEP) student makes progress in math and reading, he or she is reclassified as Fluent English Proficient (FEP) and no longer in the LEP subgroup. Therefore, the LEP subgroup will always be low and hardly make academic progress. This instability was demonstrated in their study involving a combination of approximately 14,000 LEP students from four U.S. cities over a period of seven semesters. It covered Grade 9 to Grade 12, for the time period of Fall 1996 to Fall 1999. Students who were reclassified to FEP were compared with those who remained LEP in their median percentile math and reading scores. All students were classified as LEP in Grade 9 (Fall 1996). Median percentile scores for this group were 12 \( (n = 13,989) \) in reading and 21 \( (n = 14,151) \) in math. After each semester, students who made sufficient progress were reclassified as FEP. In spring of 1997, the scores for the LEP group \( (n = 13,255) \) remained about the same in reading \( (Mdn = 12) \) and math \( (n = 13,402, Mdn = 20) \), but the FEP students demonstrated much
greater achievement in reading \((n = 659, Mdn = 21)\) and math \((n = 674, Mdn = 32)\) than those who were still classified as LEP (Abedi, Courtney, & Leon, 2003).

Subsequent semesters would also demonstrate significant differences between the Limited English Proficient (LEP) students and Fluent English Proficient (FEP) students. In the fall of 1997, the scores for the LEP group \((n = 8,300)\) were lower in reading \((Mdn = 8)\) than the FEP group \((n = 1313, Mdn = 15)\). However, math scores remained about the same for both LEP \((n = 8,456, Mdn = 21)\) and FEP groups \((n = 1,324, Mdn = 30)\). Later semesters yielded similar results with the gap widening between the LEP students and the FEP students. In the last semester, LEP students \((n = 3,809)\) achieved a median reading score of \(Mdn = 7\), as compared to a score of \(Mdn = 18\) for FEP students \((n = 3685)\). Math scores remained fairly consistent in the last semester with LEP students \((n = 3,885)\) having a math score of \(Mdn = 20\), compared to a score of \(Mdn = 31\) for FEP students \((n = 3,712)\). The data suggested the gap between LEP and FEP is significant, and language proficiency is a strong determinant on test performance, putting LEP students at a severe disadvantage when compared to their native English speaking and fluent English proficient peers (Abedi, Courtney, & Leon, 2003).

**Economically Disadvantaged Students**

Socioeconomic status (SES) is an often employed variable when conducting educational research. SES is often represented as a composite measure quantifying parental education, family-income levels, and parental occupation (Willingham, 2012). Economically disadvantaged students, or those students who receive free or reduced lunch, are often used as a barometer to gauge a student’s socioeconomic status when conducting quantitative educational research (Harwell & LeBeau, 2010). Economically disadvantaged students are represented in the New Jersey School Performance Report as enrolled in the national school lunch program (NJDOE,
The free and reduced-price lunch program (FRLP) provides no or low-cost breakfast, lunch, and milk programs based on household income guidelines provided by the U.S. Department of Agriculture. New Jersey students are eligible for FRLP if their families meet the household income thresholds delineated in the Definition of Terms section in Chapter One.

Equal educational opportunities were quickly becoming a regularly debated topic in the United States by the early 1960s. The Civil Rights Act of 1964 directed the United States Office of Education to begin an inquiry to determine the inequity or lack of educational opportunities for individuals because of race, color, religion, or national origin. James S. Coleman headed a team of researchers that examined data over a two-year period that included 4,000 schools, 60,000 teachers and 570,000 students. The result was the 1966 seminal study, *Equality of Educational Opportunity*, or informally, the Coleman Report.

Coleman investigated scores of variables that may affect academic achievement. An extensive array of student, teacher, school, family, race, and demographic variables were examined. Coleman concluded that no particular school variable had a measurable impact on student achievement. The only variable or characteristic that had a measurable impact on student academic achievement was the social class or socioeconomic status (SES) of the student’s family (Coleman, Campbell, Hobson, McPartland, Mood, Weinfeld, & York, 1966). The Coleman Report confirmed what most educators and social scientists have speculated; there is a strong correlation between SES and academic accomplishment. In fact, the most powerful predictor of school performance is SES. The higher the SES of the family, the greater the student’s achievement becomes (Coleman et al., 1966). Coleman posited that individual academic success was predicated upon a school’s social composition. Furthermore, student success was most influenced by their classmates’ social class, status, and background rather than by their race.
Coleman et al., 1966). Coleman affirmed, “Schools bring little influence to bear on a child’s achievement that is independent of his background and social context” (Coleman et al., 1966, p. 325).

Children from low socioeconomic (SES) households typically develop academic skills more slowly than their higher SES peers (Morgan, Farkas, Hillemeier, & Maczuga, 2009). Caldas and Bankston (2001) added to this research and examined individual student academic achievement through the lens of both family measures of SES status and peer SES status. Data were procured through the Louisiana Department of Education; the sample consisted of 42,014 tenth graders. The dependent variables were math and language arts scores from the Louisiana Exit Exam. Regression analysis was utilized to clarify the effect of family poverty/social status and peer poverty/social status on student achievement. Results indicated the highest correlation ($r = 0.606$) between minority race and percentage minority in the school. This suggests a strong propensity for students to attend a school with same race peers. The second strongest association was between students that qualified for free/reduced lunch and students who took the Louisiana Exit Exam and qualified for free/reduced lunch ($r = 0.475$). This indicates a strong association that underprivileged students attend schools with peers who were similarly poor (Caldas & Bankston, 2001).

Poverty status did have a statistically significant negative effect on academic achievement ($\beta = -0.069$). However, poverty was strongly and negatively related to minority race ($\beta = -0.314$). If a student is at the poverty level, academic achievement tends to decrease, regardless of race. Last, family social status had a moderately positive impact ($\beta = 0.171$) on academic achievement. The effect of peer socioeconomic status (SES) on achievement was significant and considerable and only slightly less than an individual’s own family socio-
economic status. Thus, Caldas and Bankston (2001) concluded that attending school with peers from a relatively high family social status makes a strong and significant contribution to academic achievement, independent of a student’s own SES status or race.

Sirin (2005) performed a comprehensive meta-analysis on the relationship between socio-economic status (SES) and academic achievement. The researcher reviewed studies \((n = 58)\) between the years of 1990 and 2000 that comprised of 6,871 schools and over 100,000 students. The researcher devised the meta-analytic review to assess the degree of the relationship between SES and academic achievement (Sirin, 2005). The study was also designed to examine how SES and achievement are related by methodological characteristics, student characteristics, and if there were any change in correlation in SES and achievement since White’s 1982 study. Sirin concluded that family SES at the student level is one of the strongest correlates of academic performance, surpassed only by SES at the school level. The student-level, fixed effects model had an average effect size of 0.28, with a 95% confidence interval of .28 to .29, and it was significantly different from zero \((z = 91.75, p < .001)\). The aggregated-level, fixed effects model had an average effect size of 0.67, with a 95% confidence interval of .66 to .67, and it was significantly different from zero \((z = 147.56, p < .001)\). Sirin’s study reflects a medium association between SES and academic achievement at the student level and a large association at the school level (Sirin, 2005). Sirin avows that the academic success of a school is largely influenced by the socioeconomic status of a student’s family (Sirin, 2005).

**Students with Disabilities**

In the era of high-stakes testing and accountability, standardized tests measuring student achievement continue to be the most ubiquitous instrument to measure student progress. The most common type of standard assessment is the norm-referenced type designed to measure
individual student performance to a representative national sample. These types of assessments are purported to be the most efficient and relatively objective, but often prove inadequate in measuring the progress of students with disabilities (Thurlow & Johnson, 2000). The New Jersey Department of Education records students with a disability as the percentage of students with an Individualized Education Program, but does not further disaggregate the data for the New Jersey School Performance Report (NJDOE, 2015c).

Under the No Child Left Behind Act (NCLB), the same annual targets are required for sub-groups, including students with a disability, as the total school population (USDOE, 2002). The very notion of standardized testing and its premise of homogeneity and reliability seem to conflict with the concept of a disability (Thurlow, Quenemoen, Altman, & Cuthbert, 2008). Students with a disability (SWD) are by and large performing two years behind their peers. Under NCLB and in order to make annual yearly progress (AYP), students with a disability would have to perform even better than their non-disabled peers, which seems especially absurd given their disability (Eckes & Swando, 2009). Abedi (2009) asserts that students with a disability score significantly lower than their non-classified, general education peers. The very fact that students have a disability and their proficiency target rates are equally responsible as general education students for schools making (AYP) seems to be at odds with the term “special education.”

Gronna, Jenkins, and Chin-Chance (1998) investigated the performance of students with disabilities utilizing the norm-referenced Stanford Achievement Test (SAT) in the state of Hawaii for Grades 3, 6, 8, and 10. The genesis for this study was the desire to gather data demonstrating that special education services were helping students with disabilities achieve academically. Acknowledging the issues of assessing special needs students via the large-scale
norm-referenced SAT test, the authors developed local norms and subgroup norms to augment national norms and be more representative of the tested population. Local norms were based on the notion that local students were significantly different from the national normative group. Subgroup norms were developed from the premise that members of a subgroup (special needs students) perform differently from the population as a whole and that it would be beneficial to ascertain how subgroup members scored in relation to their subgroup peers (Brown & Bryant, 1984). Disaggregating the data allowed comparison of test scores of students with disabilities to similar students and expanding the conventional comparison of the student with a disability to a national norm (McGrew & Thurlow, 1996).

The researchers analyzed the scores of students who were classified as either specific learning disability (SLD), emotional impairment (EI), speech-language impairment (SLI), or mild mental retardation (MIMR) and their non-disabled peers. The authors compared their performance to the national norm, generated local and subgroup norms to augment comparison, and determined longitudinal performance of the special education groups and their nondisabled peers. The sample consisted of students from the years 1992-1996 and included 62,252 third graders, 59,964 sixth graders, 55,477 eighth graders, and 46,902 tenth graders without disabilities who were assessed utilizing the Stanford Achievement Test (SAT). Concurrently, 6,427 third grade, 6,589 sixth grade, 4,923 eighth grade and 4,283 tenth grade students with disabilities took the SAT. Data were further disaggregated to include subgroup norms to include the special education categories ($N = 24,595$), MIMR ($n = 1,124$), SLD ($n = 11,647$), EI ($n = 1,537$), and SLI ($n = 6,904$).

A one-way analysis of variance (ANOVA) utilizing post hoc Bonferroni procedure was used to compare the special education students to their non-disabled peers. ANOVA was
calculated at each grade level with a significance level of \( p < .05 \). The independent variable was the category of disability or non-disability, and the dependent variable was total reading scaled scores (R) and total mathematics scores (M) on the Stanford Achievement Test. All four subgroups of special education had lower mean total scaled scores in reading and mathematics than their local non-disabled peers and the national normative sample (Gronna et al., 1998).

However, a longitudinal analysis of the third to sixth grade cohort revealed differences in scaled scores in both reading (R) and mathematics (M) for the special education categories. Students with Specific Learning Disability (SLD) (+ 62 R / + 69 M), Emotional Impairment (EI) (+ 58 R / + 63 M) and Mild Mental Retardation (MIMR) (+ 56 R / + 73 M) demonstrated higher increases in scaled scores than the national norm (+ 41 R / + 46 M) and their nondisabled peers (+ 51 R / + 59 M). Special education students in the sixth to eighth grade cohort performed almost identically to their nondisabled peers and slightly lower than the national norm group (Gronna et al., 1998). Scaled score increases were SLD (+ 22 R / + 29 M); EI (+ 21 R / + 26 M); MIMR (+ 22 R / + 29 M); the national norm (+ 24 R / + 44 M) and their nondisabled peers (+ 22 R / + 27 M). Finally, the mean scores increased again in the eighth to tenth grade cohort in every category except MIMR. Scaled score increases were SLD (+ 16 R / + 21 M); EI (+ 12 R / + 20 M); MIMR (+ 9 R / + 19 M), compared with the national norm (+ 12 R / + 20 M) and their nondisabled peers (+ 15 R / + 20 M).

The researchers concluded that when standardized test data are further disaggregated by subgroups, valuable information can be garnered. In this particular study, students with specific disabilities, in specific grade cohorts, often demonstrated greater academic improvement than typical students. Results of this study suggest that students with disabilities seem to be meeting
or exceeding the progress of their local nondisabled peers and the national sample (61.1%) of the
time (Gronna et al., 1998).

**School Variables**

**Total School Enrollment**

The New Jersey Department of Education quantifies school size/total enrollment as the
count of students who were “on roll” by grade in October of each school year (NJDOE, 2015c). Education reformers have espoused the virtues of small schools for over 20 years. The United States Department of Education’s Small Learning Communities (SLC) has earmarked grants to school districts to improve achievement through reductions in school size (NCLB, 2002). Smaller schools are purported to facilitate a greater connectivity and camaraderie among students, which is associated with higher achievement, higher graduation rate, and a higher likelihood to attend college (Cotton, 1996). The assumption is that these favorable relationships, or connectedness, improve student performance via socio-emotional support or improved social capital (Lin & Erikson, 2008).

Carolan (2012) studied the influence of social capital and school size on mathematics achievement. The researcher analyzed data from the National Center for Education Statistics (NCES), utilizing the 2002 Educational Longitudinal Study (ELS). The 2002 ELS tracked a nationally representative cohort of students ($N = 9,647$) in public high schools ($n = 579$) from Grade 10 through Grades 12. Independent variables were delineated by the following categories: demographic variables, highest math course taken, social capital variables and school size. The dependent (outcome) variable was the Grade 12 math score on the ELS mathematics assessment. The researcher delineated school size as small (< 600 students), moderate (600-999 students), moderately large (1000-1599 students), and large (> 1599 students).
The researcher employed hierarchical linear regression models to assess the relationship among measures of social capital, school size, and all other student/school level variables on the Grade 12 math score of the ELS mathematics assessment. For the purpose of this section, only the results from the school size variable are discussed. Of the six models generated from the regression analysis, Model 2 served as the baseline estimate of the school size effect. Contrary to conventional wisdom, as well as the research of Cotton (1996) and Lin and Erikson (2008), the coefficient for small high schools was negative and significant ($\beta = -2.18, z = -2.31, p = 0.021$). Equally compelling was that the coefficient for small schools was negative and statistically significant when demographic co-variates were included in two additional models (Model 3: $\beta = -2.76, p < 0.05$, Model 5: $\beta = -2.90, p < 0.05$). The researcher concluded that any structural reform that includes the dimension of school size could benefit from additional scrutiny (Carolan, 2012).

Applying the production function approach, Lamdin (1995) examined the effect of school size on academic achievement. The researcher procured the data via a 1990 report by the Baltimore Citizens Planning and Housing Association (BCPHA). Empirical analysis included descriptive statistics of the school and students, school size, and student achievement on standardized tests. The sample consisted of elementary schools ($n = 97$) in a single school district, Grades K-5, in Baltimore, Maryland. The dependent variable was student achievement on the California Achievement Test (CAT) in the spring of 1989. The independent variables were teacher/pupil ratio, professional/pupil ratio, expenditure per pupil, percentage free lunch, percentage minority and school size. In this section, only the results of school size are discussed. Descriptive statistics revealed a minimum of 180 students per school and a maximum of 1,422
students per school, representing a range of 1,242. The mean school size was 469.1. The median school size was 444.0 with a standard deviation of 172.2.

Lamdin used multiple regression analysis and production function analyses to examine the relationship between the school input (school size) and output measure (math and reading performance on the California Achievement Tests). The results of the study indicated that the coefficient on the variable of school size was negative for all conditions and never statistically significant. In fact, the absolute value of the \( t \)-ratio never exceeded -1.46 and was less than one in 11 of the 18 conditions. The researcher concluded that school size does not have a discernible effect on student achievement (Lamdin, 1995).

Debates over school size are between the positive and negative aspects of large versus small schools. Contrary to Carolan (2012) and Lamdin (1995), Coleman (1988) proposed that one of the primary mechanisms through which smaller schools benefit students is the theory of social capital, or that smaller schools promote more favorable relationships. Small school advocates state that smaller schools have greater communication among stakeholders, while large schools can take advantage of specialized resources, classes, and teachers (Fowler & Walberg, 1991).

**Algebra Enrollment**

The New Jersey Department of Education (NJDOE) asserts that an indicator of future academic success and subsequent college and career readiness is challenging, rigorous course work (NJDOE, 2015c). As such, the NJDOE New Jersey School Performance Report includes the percentage of eighth graders who enrolled in Algebra I, as well as the percentage of those students who earned a C or higher, as one of their college and career readiness metrics.
The concept of utilizing academic data to improve student achievement and closing achievement gaps is common in educational decision making. Foley, Mishook, Thompson, Kubiak, Supovitz, and Rhude-Faust (2008) identify pre-algebra and algebra enrollment as one of these academic indicators. Success in algebra presents opportunities in advanced math, college preparatory courses, higher college attendance rates, and higher college graduation rates. Adelman (2006) goes on to add that students who had taken Algebra II in high school were twice as likely to attain a bachelor’s degree versus those students who had not taken the course. Algebra II is also associated with job readiness and higher earnings once the student has joined the workplace (Achieve, 2008). Evan, Gray, and Olchefske (2006) emphasize the middle school years as the beginning of the trajectory for advanced math courses and a gateway to a bachelor’s degree. Evan et al. (2006) go on to suggest a relationship between the number of eighth grade students taking algebra and global competitiveness, urging for an increase in eighth-grade algebra enrollment.

Algebra continues to be one of the central themes in K-12 mathematics. The National Council of Teachers of Mathematics (NCTM) identifies algebra as being not only a graduation requirement in many schools but a gateway to higher mathematics courses (NCTM, 2000). Eighth-grade students who study algebra are more likely to take higher-level mathematic courses and attend college than those who do not study it (Atnada, 1999). Algebra enrollment is especially relevant for minority students, as it has been demonstrated to be a vital ingredient in higher mathematics courses and future success in college (Moses & Cobb, 2001).

McCoy (2005) researched the effect of the demographic variables gender, ethnicity, socioeconomic status (SES), and attitude on eighth-grade algebra achievement. The researcher randomly sampled four classes of eighth-grade algebra students from a large southern urban-
suburban school district. The random sample \( n = 107 \) of students completed a questionnaire, pre-test and post-test. The questionnaire included the demographic variables of gender, ethnicity, and socioeconomic status. SES was measured approximately by utilizing a parent’s highest level of education. The Fennema-Sherman Mathematics Scales (1976) questionnaire was also administered to students to assess their attitudes toward mathematics. The researcher utilized a modified 36-item, 5-point Likert-type scale that included the subtests of Confidence in Using Mathematics, Perceived Usefulness of Mathematics, and Mathematics Anxiety. The subtests had reliabilities of 0.93, 0.88, and 0.89, respectively. Results of the attitudes toward mathematics scale ranged from 36 to 180. The North Carolina State End-of-Course (EOC) Algebra 1 test was the first dependent variable. Test results were scaled from 1 to 100. The second dependent variable was The North Carolina State End-of-Grade (EOG) Test for eighth grade. This standardized assessment included all subjects, and scores ranged from 200 to 300.

The researcher analyzed the independent variables of gender, ethnicity, socioeconomic status (SES), and attitude utilizing an analysis of variance (ANOVA) to determine the effects on the dependent variables, end-of-course score and end-of-grade score. The researcher also performed a second analysis utilizing a \( t \) test to assess to compare pre- and post-attitude scores. ANOVA results for the Algebra End-of-Course test revealed two significant main effects: SES, \( F(1, 89) = 6.997, p < 0.05 \); and ethnicity, \( F(1, 89) = 81.628, p < 0.05 \). Gender and attitude were not significant. ANOVA results for the End-of-Grade Test for eighth grade revealed three significant main effects: SES, \( F(1, 90) = 9.298, p < 0.05 \); ethnicity, \( F(1, 90) = 62.785, p < 0.05 \); attitude, \( F(1, 90) = 3.162, p < 0.05 \). Once more, gender was not significant. Data analysis also revealed that post-attitude scores towards mathematics were significantly lower than pre-attitude scores. Subtest analysis revealed the following: Confidence in Using Mathematics, \( t(91) \)
Perceived Usefulness of Mathematics, \( t (91) = 4.165, \ p < 0.01 \); Mathematics Anxiety, \( t (91) = 6.369, \ p < 0.01 \); total attitude score, \( t (91) = 6.676, \ p < 0.01 \). Students demonstrated a significantly more negative attitude towards mathematics after the algebra class (McCoy, 2005).

Congruent to the research of Peng (1995) and the National Council of Teachers of Mathematics (1998), the results of this study demonstrated that ethnicity and socioeconomic status (SES) had a significant effect on algebra achievement on the North Carolina state assessments. Data analysis also suggested that students’ attitude towards mathematics changed. Perhaps there was the issue of mathematic avoidance, but the negative attitude changes were significant. The results of this study are important to educators and administrators to help determine why some students develop a negative attitude toward mathematics and what variables may impact algebra achievement. The data derived from this study could help educators navigate the influence of these variables, allowing students not only to achieve in algebra, but also enjoy it (McCoy, 2005).

Spielhagen (2006) examined the outcomes of students taking algebra in eighth grade versus the traditional eighth grade mathematics curriculum and their influence on student performance, achievement, and attainment. According to district policy, students gain entry into Grade 8 Algebra by demonstrating proficiency on the district’s Grade 7 algebra prognosis tests. However, this test was given only to students already in the advanced track who had taken enriched, elementary math courses. Teachers \( n = 36 \) indicated inequities in the algebra selection process, with occasional noncompliance of this district-approved prognosis test in favor of their own judgment because of teacher belief the test was outdated. Essentially, if a student was not on the advanced track because of prior enriched math courses or denied the opportunity
to take the Grade 7 algebra prognosis test because of teacher subjectivity, students were excluded from taking algebra in eighth grade.

Utilizing a mixed-methods design, the researcher examined the mathematics tracking policy of a large southeastern suburban school district. Students \( n = 2,634 \) were either offered Grade 8 algebra or Grade 8 mathematics. Achievement for each group was interpreted via performance on standardized tests. Attainment was computed by student enrollment in subsequent math courses. Data revealed an inverse relationship between the socioeconomic status (SES) of a school and the number of students taking Grade 8 algebra (Spielhagen, 2006). In other words, the schools with the most free/reduced lunch students also had the least number of students taking algebra in eighth grade.

The main research question undergirding the study was the following: What difference did studying algebra in eighth grade make in student achievement and attainment? Student achievement was assessed utilizing three outcome measures: state standardized algebra test (Grade 8 or Grade 9); pre-placement Stanford mathematics test score (Grade 7); post-placement Stanford mathematics test score (Grade 8). As expected, the students taking Grade 8 algebra outperformed their peers from Grade 8 mathematics on the Stanford Grade 8 Mathematics assessment. However, the two groups’ test scores were closer in range and overlapped considerably on the state standardized algebra test. Grade 8 algebra students demonstrated a mean score of 446.4 \((SD = 58.2)\), while Grade 9 algebra students demonstrated a mean score of 401.9 \((SD = 28.8)\). The standard deviations revealed the lower level performers in the Grade 8 algebra group were the same as the upper level performers in Grade 9 not in the early algebra group. Additional analysis utilizing multiple regression techniques indicate that participation in Grade 8 algebra had only a marginal impact on predicting performance on the Stanford Grade 8
Mathematics Assessment (Spielhagen, 2006). The results of this study are congruent with the research of Gamoran and Mare (1989), who concluded that most of the differences in math achievement come from pre-existing differences among students, not the tracks those students are on.

Limiting access to Grade 8 algebra did not increase performance in either of the tracking groups (Grade 8 algebra/Grade 8 mathematics). In fact, the overlap of achievement between the two groups suggests that the school tracking policy prevents some students who may have succeeded from taking algebra. The critical benefit of studying algebra in Grade 8 is the long-term exposure to subsequent math courses. Most of the Grade 8 mathematics cohort followed a traditional three-year math sequence of Algebra 1, Geometry, and Algebra 2 (62%) in 11th grade, whereas the Grade 8 algebra students (77%) were enrolled in the more advanced mathematics courses such as Trigonometry (41%), Mathematics Analysis (26%) and Advanced Algebra (10%) in 11th grade. Spielhagen (2006) concluded that restricting access to Grade 8 Algebra did not significantly impact academic performance. It did, however, impact the students’ mathematical course trajectory. Schools cannot do much about the socioeconomic status of their populations, but they can control the powerful factors of access and equity to positively affect student achievement (Spade, Columbia, & Vanfossen, 1997).

**Student-Faculty Ratio**

The student-to-staff ratio represents the count of students per faculty member in the school (NJDOE, 2015c). It is calculated by dividing the total number of students by the combined full-time equivalents of all faculty including classroom teachers, guidance counselors, and support personnel. Student to faculty ratio is not synonymous with class size; however, some researchers have posited that it has been used to abate class size (Underwood & Lumsden, 1994).
Achilles (1999) makes a clear distinction between class size and pupil-teacher ratio (PTR). Achilles defines class size as the number of students who regularly appear in the teacher’s classroom and for whom that teacher is responsible. PTR is obtained by dividing the total number of students at that school by the total number of professionals who work at the school. These professionals could be administrators, coordinators, special educators, counselors, media persons, etc. Depending on the school, PTR could also be calculated to include non-certified staff, instructional aides, custodians, and cafeteria workers. Achilles remarks that a small PTR is a badge of honor for a school, but the truly expensive private schools advertise small classes. Achilles contends that the difference between PTR and class sizes in the United States often exceeds 10 students per classroom (Achilles, 1999). Lowering student-teacher ratio, in the sense of reducing actual class size, has improved virtually all student outcome measures and has been apparent since Tennessee’s Student Teacher Achievement Ratio (STAR) project in 1990 (Finn, Suriani, & Achilles, 2007).

The Student Teacher Achievement Ratio (STAR) was perhaps one of the last true education experiments involving children. The STAR project was a statewide, longitudinal, randomized experiment. The major goal was to examine how early class size research could improve education. STAR consisted of 79 schools in 46 Tennessee school districts. It included over 11,600 students and 1,000 teachers randomly selected over a four-year period (1985-1989). Students were randomly assigned to small (S) classes \( m = 15 \), or placed into one of the control groups, which were denoted as regular (R) classes \( m = 25 \), either with one teacher or a teacher with an instructional aide (RA). Students were placed into these groups when they entered the public school system (Word, Johnston, Bain, Fulton, Zaharias, Achilles, Lintz, Folger, & Breda, 1990).
Teachers were also randomly assigned to one of these class environments for each year the experiment continued. Each school having a small class also had one or both of the regular classes. The experimental in-school design controlled for school and district variables. Researchers identified comparison schools ($n = 21$), based on key variables, that were not participating in the study but were within the Student Teacher Achievement Ratio (STAR) district. The researchers collected achievement data from both the comparison schools and the STAR schools. Students in smaller classes had more positive participation than students in regular classes (Word et al., 1990).

The Tennessee Student Teacher Achievement Ratio (STAR) project of class size and student achievement can be synthesized down to a pithy, declarative statement: Smaller is better! A brief synopsis of the long-term, experimental research of the project reveals why class size is an important variable when discussing student achievement, student well-being, and teacher benefits. STAR discovered significant benefits to smaller classes ($m = 15$), including the following:

- Surpassed students in regular ($m = 25$) classes in all cognitive measures. Results persisted up to Grade 8
- Increased achievement scores in all tested areas
- Achievement test score gap between White and non-White pupils was smaller
- Fewer discipline issues
- Students were more engaged and participatory
- Fewer grade retentions

The STAR project also ascertained that instructional aides had little effect on student achievement (Word et al., 1990).
Rodriguez and Elbaum (2014) examined student-teacher ratio and schools’ efforts to engage parents of students receiving special education services. A total of 265 schools were examined. Schools reported a minimum of 11.39 student-teacher ratio and a maximum of 25.54 student-teacher ratio. The independent variable was student-teacher ratio; the dependent variable was the Schools’ Efforts to Partner with Parents’ Scale (SEPPS). A regression analysis was utilized. It was discovered that the strongest predictor of parents’ perceived school engagement efforts was student-teacher ratio ($b = -13.57$), $t (259) = -5.85$, $p < 0.001$. Although these findings are impressive, this study calculated student-teacher ratio as the number of students divided by the number of teachers, not staff, as delineated by the New Jersey School Performance Report. This variation in formula would suggest much different results had the number of staff been utilized.

Employing the production function model, Boozer and Rouse (2001) considered the effects of pupil-teacher ratio (PTR) rather than school’s average class size as they explored the implications and variations of class size. They hypothesized that since most researchers lack class size data, PTR, albeit a rough proxy, is often used. The researchers hypothesized that PTR is perhaps less than or equal to the average class size because of teacher allocation within each school. In order to investigate and measure the impact of PTR and average class size, the researchers relied on two data sets: a random survey of 500 New Jersey teachers and the National Education Longitudinal Survey (NELS) of 1992. These surveys were then merged with the data procured from the New Jersey Department of Education as well as the National Center for Education Statistics (NCES).

Utilizing regression statistical analysis, the researchers ascertained that although pupil-teacher ratio (PTR) and average class size are correlated, the correlation was low (New Jersey
survey, \( r = 0.13 \) and (National Education Longitudinal Survey, \( r = 0.26 \)). Their findings were congruent with the findings of Rosen and Flyer (1994) in that the pupil-teacher ratio is uniformly smaller than the average class size. The researchers continued to assess the effects of PTR, utilizing statistical regression analysis on eighth grade and tenth-grade test score gains while controlling for school/family characteristics. Boozer and Rouse (2001) concluded that pupil-teacher ratio had essentially no effect on average test score gain (0.017; \( n = 748; R^2 = 0.03 \)). However, students in schools with larger than average class sizes had significantly smaller test gains (-0.048; \( n = 748; R^2 = 0.05 \)). The researchers’ findings are congruent with Achilles (1999), who maintains that class size influences student outcome positively, while pupil-teacher ratio does not.

**Instructional Time**

**Introduction**

The topic of instructional time has been examined and debated throughout the history of education in the United States. The Committee of Ten bemoaned the alleged downward trajectory of American education because of the perceived notion of ineffective use of time (Mackenzie, 1894). Thorndike’s seminal educational research agreed that “duration” was indeed a significant and potent variable of the learning process (Thorndike, 1913). In its seminal report, *A Nation at Risk*, The National Commission on Excellence in Education (1983) called for substantially more time in school if American students were to compete in a global economy.

In 1994, federal legislation established The National Education Commission on Time and Learning to analyze the relationship between time and learning in American public schools. The final report, *Prisoners of Time*, noted that of the three large concerns stated in *A Nation at Risk*, expectations, content, and time, time reform remained a stalled initiative. The commission
asserted that student learning “remains a prisoner of time” under the current school calendar and school day (USDOE, 1994). More recently, in a speech to the Hispanic Chamber of Commerce, President Obama questioned the amount of time American students spend in school and called upon the nation “to rethink the school day to incorporate more time . . . whether during the summer or through expanded-day programs” (Obama, 2009).

Fueled by international comparisons of student achievement, purporting that American students are lagging behind their international peers and spend less time in school, the quality and quantity of American education remains a highly debated topic. Effective use of instructional time continues to be a topic of interest when seeking to improve student achievement. Legislators, academics, and parents have beseeched schools to remedy their supposed ineffective use of time. The association between time and student achievement seems simple: More time in school equals improved student achievement. However, the relationship between time and learning is neither direct nor straightforward (Silva, 2007). With continued emphasis on the effective use of time and its potential educational implications, numerous structural time-based interventions have been proposed. The researchers, however, hold a much different perspective from most legislators, policy makers, and bureaucrats, who still view instructional time as the panacea to what ails education.

**Length of School Day**

The seminal report, *Prisoners of Time*, by the United States National Education Commission on Time and Learning (1994) argued that that unless students are afforded more time in school, many will be unable to attain the high expectations of educational excellence. The commission refers to the typical school day and year as too rigid and too short. It goes on to deem the American school day as “the unacknowledged design flaw in American education”
(Education Commission of the States, 2005). Levin (1984) cautions that adding time to the length of the school day may result in diminished student effort because of fatigue. The length of the school day is established via guidelines adopted by the state and is regulated by local educational agencies. The NJDOE defines length of school day as “the amount of time a school is in session for a typical student on a normal school day” (NJDOE, 2015c).

The National Center for Education Statistics (2012) surveyed schools, principals, and teachers, utilizing the *Schools and Staffing Survey* (SASS). It provided descriptive data and a variety of statistics, including a national database for time differences within the American school system. The average number of hours in a typical school day is 6.8 hours, with a range of .6 hours (36 minutes) separating the 25th and 75th percentile. This represents an increase of .2 hours (12 minutes) from school year 1999-2000.

Although SASS statistics are valuable in ascertaining daily and weekly hours, researchers need to continue to disaggregate the data to determine how students are actually spending their instructional days throughout the year. Beyond the data of the school day length is the impact of the effort to increase learning time on student performance. Linking SASS data with figures from the National Assessment of Educational Progress (NAEP) might shed light on the relationship between operational time and student outcomes (Farbman, Kolbe, & Steele, 2015). Extending the school day increases instructional time only when the newly extended time is devoted to instruction and not testing, student breaks, or extra-curricular activities (Levin, 1984).

The Virginia Department of Education (VDOE) (1992) investigated strategies to improve student learning by examining the relationship between time and student achievement. The Virginia Department of Education reviewed previous literature and empirical research pertaining to an extended school day, an extended school year, and year-round schooling in order to
maximize instructional time. The VDOE found mixed results regarding each of the time configurations. Increasing the school day did seem to benefit students with disabilities and at-risk students. However, the research expressed that simply extending the school day or school year would not result in appreciable student learning; focus should remain on quality of instruction, not quantity. In addition, similar to the research of Levin (1984), the VDOE discovered that increasing the length of the school day may have negative results due to student fatigue.

Hossler, Stage, and Gallagher (1988) expressed concern over the abundance of correlational data and lack of a controlled study using experimental design that could directly measure the impact of instructional time on student achievement. In large part, this is due to the complexity of the many factors that influence student achievement in addition to any school initiatives that might be taking place. The ability to separate out the influence of one variable, time, is extremely challenging. The researchers conclude that increasing instructional time has modest positive effects on learning. However, the relationship between time and achievement is not strong. Increasing instructional time does not guarantee an increase in engaged time. and policy makers should not expect large gains to materialize from increasing the length of the school day or school year.

**Extended School Day**

According to Kolbe, Partridge, and O'Reilly (2012), more than seven hours of school, per pay is deemed an extended day. The share of public schools with seven or more hours a day has grown from 31.4% in 2003-04 to 40.7% in 2011-12 (Bitterman & Goldring, 2013). In the 2011-12 school year, schools ($n = 2373$) that offered extended day ($> 7$ hours) had more time for math, social studies, and science at the third-grade level ($p < 0.05$). This was also true in eighth grade, with the additional subject of English, making all four core subjects statistically significant ($p <$
0.05) compared with non-extended day schools. Third-grade students received on average an additional 1.2 hours of instruction per week, while eighth grade students received an additional 1.4 hours of instruction per week. Schools having an extended day (> 7 hours) also offered more gifted and talented programs (81.1% versus 64.1%), added time for academic assistance (64.9% versus 62.2%), and college credit (89.9% versus 85.4%) than did non-extended day (< 7 hours) schools (Farbman et al., 2015). Data indicated that the number of schools with an extended day (> 7 hours) has grown to over 40% and has been able to increase instructional time for core subjects and expand various academic programs. Schools that have an extended day are more likely to serve low-income and minority students and provide these students with additional opportunities to learn (Farbman et al., 2015).

Increasing the length of the school day to include more hours for disadvantaged students appears to address some of the achievement gaps in poorer neighborhoods. The Knowledge is Power Program (KIPP) is a network of public, mostly charter, schools that serve low-income communities. KIPP students spend at least 50% more time in school than their regular public school peers and demonstrate strong academic gains. KIPP cites more time as one of its core operating principles. However, a recent evaluation of the KIPP program credited its success to extended hours but also credited the impact of strict discipline, rigorous classes, and strong academic culture (David, Guha, Lopez-Torkos, Wang, & Woodworth, 2008).

Adelman, Haslam, and Pringle (1996) performed a case study comprising 14 schools across the United States. The schools involved in the case study implemented various time configurations in order to improve student achievement. One middle school in Boston, Massachusetts, extended the school day to 7.5 hours. Subsequently, student achievement on the reading section of the Massachusetts Basic Skills Test increased from 77% to 90% over a three-
year period. Utilizing the same case study, the researchers also examined two elementary schools in New Orleans, Louisiana, that extended the school year to 220 days. Despite the additional days added to the school calendar, student performance remained low. The authors posit that program planning implementation and management may have been a factor in both studies.

Despite evidence that increasing learning time offers no guarantee of improved achievement, and the results are mixed at best, policy makers and legislators are still enamored with time as a lever of school reform. Increased learning time manifesting into extended school days is dauntingly expensive and has prevented many efforts. Fiscal calculations estimate that a 10% increase in time would require a 6-7% increase in cost expenditure (Silva, 2007). A plan to extend instructional time by 30% for Massachusetts’ students would have required a 20% increase in funding, or approximately $1,300.00 per student (Farbman & Kaplan, 2005).

Extended School Year

An extended school year is defined as having more than 180 days of instruction (Kolbe, Partridge, & O’Reilly, 2012). The data suggest a steady increase in the length of the school day, but little or no increase in the number of instructional days. According to the National Center for Education Statistics (2012), over the last 12 years the average length of the school year was 179 days, with a range of four days separating the 25th and 75th percentile. The percentage of schools having less than 181 days increased to 85.2% in 2012, compared to 83.6% in 2008. School leaders have typically added time to the school day rather than add days to the school calendar in response to the need for more learning time. Adding days to the school calendar is typically more cost prohibitive than extending the school day in terms of transportation, utilities, maintenance, and additional staffing (Silva, 2007). Erin and Millimet (2008) investigated the differences in the
length of the school year across the United States and found weak evidence that longer school years improve reading and math achievement.

Marcotte and Hansen (2010) contend that American students spend less time in school than foreign students and that the school year has basically remained unchanged over the last 100 years. Although the length of the school year is a choice variable, most schools in the United States adhere to a 180-day school calendar. The researchers suggest that extending time in school would likely raise student achievement. The authors reference the studies of Hansen (2008), Marcotte and Hemelt (2008), Jacob and Lefgren (2004), Rivkin (2005), and Krueger (1999) to augment their conclusion that the estimated effect of adding ten instructional days ($r = 0.15$) exceeds that of repeating a grade ($r = 0.13$), having a better teacher ($r = 0.11$), or reducing class size ($r = 0.09$) when predicting standardized math scores.

Marcotte and Hansen (2010) provide compelling evidence of the effect of the length of the school year on test scores. The researchers examined student performance on state exams in Maryland and Colorado schools when there were frequent cancellations due to snow. They compared the performance of same schools during the snow years versus the milder winters. Although school cancellation days were made up, they were made up after the spring testing dates. Both states yielded similar results of additional instructional days. The authors posited that ten days of added instruction increased student math performance by roughly 0.2 $SD$. In essence, for every day the school was closed, the number of students passing the math assessments decreased by 1/3 to 1/2 of a percentage point. Similar results were obtained from Hastedt (2009), which revealed that ten days of school closures reduced math and reading performance on the Virginia Standards of Learning Exams by the same magnitude ($SD = 0.2$) that was discovered in the Maryland and Colorado study (as cited in Marcotte & Hansen, 2010).
Sims (2008) analyzed the relationship between length of school year and academic achievement utilizing data from Wisconsin schools. The impetus for the study came from legislation requiring schools to begin the school year after September 1. Expanding the school year resulted in a small, statistically significant increase on the mathematics scores of the Wisconsin Knowledge and Concepts Examination in fourth, eighth, and tenth grades. However, the extended school year did not influence language arts or reading scores. The researchers noted that the extended school year seemed to benefit minority students and those from rural communities.

A proposal from the Minnesota school superintendents to extend the school year 25 days was projected to cost the state $750 million dollars annually. The proposal was quickly deemed unfeasible, both fiscally and politically (Silva, 2007). Finally, increasing the school year to the extent that was called upon in A Nation at Risk, from 180 to 210 days, would by most estimates exceed tens of billions of dollars annually. The National Education Commission on Time and Learning estimated that increasing the school year to 200 days would cost between $34.4 and $41.9 billion annually (Silva, 2007). Moreover, these estimates are fiscally obsolete and cost today would be significantly higher.

**Year-Round Schools**

It is a widely held belief that the school-year calendar is based on 19th century agrarian society, where harvesting and planting chores accounted for summer breaks. In fact, student summer vacations grew from early 20th century middle-class parents lobbying their local school boards for children to be home with their families during that time (Cuban, 2008). This hiatus from academics, or summer break, inevitably led to students losing ground academically. One of
the solutions to limit the academic loss and curtail the effect of two months’ summer vacation was to eliminate the summer break in the form of year-round schooling.

Year-round schools (YRS) are an example of modified school calendars. The school days remain constant, but summer break is eliminated and the school year is interspersed with frequent breaks. Year-round schools are typically utilized to negate overcrowding of students and to reduce the negative academic effects of the summer break. Year-round schedules were adopted as early as 1906 in Gary, Indiana. In 2006, approximately 3,000 (3.3%) of the nation’s 90,000 public schools utilized a year-round schedule (Cuban, 2008). Most local school boards adopted the year-round schedule not for academic concerns, but because increased enrollment lead to overcrowded schools.

Cooper, Valentine, Charlton, and Melson (2003) synthesized the research regarding year-round schools and academic achievement. Proponents for year-round schools posit that learning is lost during the summertime and review periods are necessary at the start of the new school year. This summer loss is especially problematic for students with special needs or English language learners. Opponents of year-round schools state that simply shifting the schedule does not negate the bigger instructional and curricular challenges these students face and that more frequent breaks pose even more opportunities for students to forget what they learned.

Cooper et al. (2003) state that the evidence for and against year-round schools was poor. However, the researchers were able to extrapolate some conclusions from the research. The summer learning loss, or “summer slide,” affects all students regardless of any socio-demographic or intelligence attribute. The difference in the levels of learning loss, however, is tied to socioeconomic levels. Cooper et al. (2003) go on to state that in 62% of the districts studied, schools on a year-round calendar outperformed those districts on a traditional calendar.
The effect size was very small ($d = 0.04$) however. Economically disadvantaged students and academically struggling students seemed to experience the greatest academic gains. Elementary students also experienced more academic gains than did high school students ($d = 0.09$). The authors concluded that despite the small, positive academic gains evidenced in year-round schools, from a practical vantage point, year-round schools do not seem to have a substantial positive impact on academic achievement (Cooper et al., 2003).

Palmer and Bennis (1999) conducted a meta-analysis ($n = 33$) on the relationship between year-round schooling and academic achievement. The researchers noted statistically significant positive effects in 75\% ($n = 27$) of the studies. The authors discovered that 85\% of the associations in reading and 82\% of the associations in math demonstrated significant positive effects. Although the majority of the studies involved elementary students, the researchers posited that students in year-round schools performed as well, if not better, than traditionally-scheduled students.

Year-round schools seem to positively impact the academic achievement of lower-income students. Pennington (2006) states that the summer vacation and break in academic time impacts lower socio-economic students disproportionately more than their advantaged peers. Over time, the summer break and loss of academic instruction expanded the achievement gap between lower-income students and their middle-class peers (Cooper, Nye, Charlton, Lindsay, & Greathouse, 1996). Silva (2007) advances that lower-income students are less likely to have educational resources similar to their middle-class peers and benefit more from increased instructional time.

**Block Scheduling—Traditional Scheduling**

The National Education Commission on Time and Learning (1994) purported that the
United States education system had an inherent design flaw in the teaching and learning process: the use of time. The Commission stated new uses of time and various time configurations, including the concept of block scheduling, should be explored. Block scheduling, essentially two periods or more, allow the student extended learning time for complex topics, in-depth studies, or laboratory experiences (Rettig & Canady, 2000). Cawelti (1994) defines block scheduling as part of the instructional day being organized into blocks of time greater than 60 minutes, enabling a variety of instructional activities and teaching methods.

The existing literature on the benefits of block scheduling has been mixed. Deuel (1999) examined the impact of block scheduling on student achievement and learning environment in Florida. The sample consisted of 22 public high schools and included data on 49,829 students during the school years of 1994-95 and 1996-97. Ten schools utilized block scheduling; 12 schools used a traditional-period day. The populations of both groups were demographically similar. Randomly selected teachers and counselors were given a survey to ascertain their perceptions about the success of block scheduling. Teachers stated that block scheduling enabled more diverse teaching strategies and varied learning activities. Eighty percent of teachers said they preferred the block schedule and 40% stated they experienced less stress at school.

The researcher examined student attendance, suspension rates, and student behavior data between the two groups. Attendance and suspension rates remained similar between the two groups, but teachers and principals reported improved student behavior and conduct with the block-scheduled students. There was a discernible improvement in promptness, behavior, and general school climate. Students in block-scheduled schools also earned higher grades than their traditionally scheduled peers. However, this improvement in performance was not evidenced on
standardized assessments. Deuel (1999) posited that block scheduling may positively impact student-teacher relationships, improve school climate, and improve students’ grades.

Mattox, Hancock, and Queen (2005) conducted a five-year longitudinal study examining the mathematics achievement scores of five middle schools as they transitioned from traditional scheduling to block scheduling. Teachers stated that the new block schedule allowed for new instructional strategies, yielding increased academic performance. Increased academic performance subsequently led to enrollment in more advanced mathematics courses. The researchers noted that mathematics scores did not significantly increase during the block transition year. However, subsequent years demonstrated a significant increase in scores, with effect sizes of 0.21 to 0.73 (Mattox et al., 2005).

In another study, Gruber and Onwuegbuzie (2001) examined the impact of block scheduling and traditional scheduling on the Georgia High School Graduation Test (GHSGT). The sample consisted of two groups of high school students. One group of students graduated in 1997 using a traditional period schedule. The other group graduated in 2000 using a block schedule. The researchers deemed the two groups alike in regard to school and socio-demographic attributes. There was no statistically significant difference between the scores of the two groups on the writing portion of the GHSGT. However, students using a traditional-period schedule demonstrated statistically significantly ($p < 0.01$) higher scores in language arts ($d = 0.34$), mathematics ($d = 0.52$), social studies ($d = 0.51$), and science ($d = 0.46$). The researchers concluded that block scheduling does not have a positive association on academic achievement.

Zepeda and Mayers (2006) conducted an analysis of 58 empirical studies and found mixed results, omitted key data, weak methodologies, and an over-representation of recent block
schedule implementations. Of the 58 studies, 12 focused on the effects of block scheduling on student learning; eight employed quantitative analysis. The meta-analysis revealed an almost equal dispersal between the studies regarding the performance scores of students in traditional schedules versus their block-scheduled peers. Overall, the researchers found evidence suggesting that block scheduling increased student grades, grade-point averages, and improved school climate. The findings, however, were inconsistent regarding the influence of block scheduling on standardized assessment scores and attendance (Zepeda & Meyers, 2006).

**Instructional Time**

Ever since *A Nation at Risk* recommended increasing learning time to combat America’s perceived public school crisis, policy makers and educational decision makers alike have explored how to increase learning time via a longer school day, longer school year, or alternative scheduling (National Commission on Excellence in Education, 1983). Misgivings that American schools are not providing a quality education for students stem from international comparisons of student achievement, which show American students seemingly lagging behind their international counterparts. Some of these international studies also put forward that American students spend much less time in school than those in countries that outperform the United States. The ostensible correlation of time and achievement reinforces the common belief that more is better. Conventional wisdom would assume that if the school year, school day, or school period were longer, students would learn more. However, the association between time and learning is neither direct nor simple. Rather it is extremely complex, and achievement results are very much dependent upon how that time is used (Aronson, Zimmerman, & Carlos, 1999).

The NJDOE defines instructional time as “the amount of time that a typical student is engaged in instructional activities under the supervision of a certified teacher” (NJDOE, 2015c).
The critical word in this definition is “engaged.” Researchers have a propensity to focus on allocated time because quantity is easier to identify and measure than quality. Measuring engaged time requires subjective judgments of how time is used and what “engaged” actually means. Moore and Funkhouser (1990) describe allocated time as the total amount of time in the school year, school day, or school period. When deducing a more refined measure of time such as engaged time or academic learning time, one must systematically observe classrooms and precisely calculate the amount of time spent on various activities, which vary by classroom, teacher, and student.

The effective use of time within our public school system was re-examined in 1994 when The National Education Commission on Time and Learning (NECTL) published its report, *Prisoners of Time*, which again questioned the length of the school year, the length of the school day, and the length of school periods (Education Commission of the States, 2005). With the continued emphasis on student achievement, time continues to be a precious commodity. The basic premise of time reform is simple: more time in school equals more learning and higher student achievement (Silva, 2007). Barro and Lee (2001) agree that more time in school improves math and science test scores. However, this basic reasoning is much more complex than it seems.

School time could be conceived as three factors on a continuum. Allocated time is assigned time for instructional and non-instructional activities. Engaged time is when the student is engaged in learning tasks by participating in learning activities. Finally, academic learning time is when learning actually occurs or when an instructional activity is aligned with a student’s readiness to learn (Aronson et al., 1999; Karweit, 1989; Huit, 2005). Many studies investigating the relationship between instructional time and achievement utilize allocated time. It is less
complicated to procure, much easier to quantify, and easier to measure than engaged or academic learning time.

Ayodele (2014) was able to investigate the influence of student-engaged time and teacher instructional time on student achievement. The researcher examined the composite effect of teacher instructional time, student-engaged time, and numerical ability on chemistry achievement. The researcher utilized an ex-post facto descriptive survey design because of the spur-of-the-moment observations required for the study. The sample consisted of 90 students, randomly selected from six secondary schools. The research instruments were tested for reliability and included time-on-task observation instrument ($\alpha = 0.670$), chemistry achievement test ($\alpha = 0.730$), and numerical ability test ($\alpha = 0.844$). Data were analyzed using multiple regression techniques to determine the relationship between the independent variables (teacher instructional time, student-engaged time, and numerical ability) and the dependent variable (chemistry achievement scores).

The composite effect of teacher instructional time (TIT), student-engaged time (SET), and numerical ability (NA) contributed significantly to the prediction ($r = 0.807$) of chemistry achievement, contributing 63.9% to the variance of the dependent variable. However, the beta coefficient for TIT ($\beta = -0.042$) had a $t$-value that is not statistically significant ($p > 0.05$). Conversely, SET ($\beta = 0.334$) and NA ($\beta = 0.570$) have significant $t$-values ($p < 0.05$) and can therefore be used to predict chemistry achievement, with NA contributing most to the prediction (Ayodele, 2014). Teacher instructional time had no statistically significant effect on chemistry achievement ($t = 0.523$). This is congruent with the research of Slavin and Davis (2006) that postulated there is little relationship between instructional time and students’ achievement because the length of instructional time tells us the quantity but not the quality of instruction.
Baker, Fabrega, Galindo, and Mishook (2004) examined the relationship between instructional time and student achievement. The researchers explored the amount of time various countries allotted towards math, science, language, and civics instruction. The researchers analyzed three data sets from international assessments between 1999 and 2000. The Programme for International Student Assessment (PISA, 2000) included 32 countries, 6,638 schools, and 97,384 students. The Trends in International Math and Science Survey (TIMSS, 1999) included 38 countries, 6,515 schools and 180,696 students. The International Study of Civic Education (CIVED, 1999) included 28 countries, 4,137 schools, and 93,882 students. The combination of all three assessments provided analysis for 52 countries. The assessments included data relating to the number of weeks in a school year, classes in a week, and minutes in a class. This information enabled the researchers to extrapolate the amount of time students spent in each subject area.

According to the Programme for International Student Assessment (PISA, 2000), the United States provided 993 hours of instructional time per year for each student. Mexico had the most instructional hours (1144), whereas Greece had the least number of hours (788). The international mean for the 32 countries was 948 hours. The amount of time given to math, science, or reading did not seem to correlate to total instructional hours. The United States required 3.49 hours of math instructional time per week, which was almost identical to the international mean of 3.41 hours ($SD = 0.83$). The correlation between yearly total instructional hours and yearly instructional hours in mathematics is weak ($r = 0.081$) for ninth grade and ($r = 0.026$) for tenth grade. Additionally, the researchers discovered no significant association at the cross-national level between average national achievement and subject instructional hours (Baker et al., 2004). Ostensibly, more hours of math class do not result in better achievement scores.
The authors proceeded to analyze the effect of total instructional time within nations by comparing total instructional hours to math, science, and civics achievement. The variance in achievement was only slightly related to total instructional hours. The within-nation relationship between total instructional time and math achievement is weak or non-existent in most countries. Data indicated both positive correlation ($r = 0.09$, $0.8\%$ variance) and negative correlation ($r = -0.12$, $1.4\%$ variance) between math achievement and total hours of instruction depending on the country (Baker et al., 2004). Similarly, the relationship between total instructional time and science achievement at the national level is also weak. Data revealed both positive correlation ($r = 0.13$, $2.0\%$ variance) and negative correlation ($r = -0.18$, $3\%$ variance) between science achievement and total hours of instruction. Last, data suggested the mean correlations between total instructional time and civics is higher than between math and science, with positive correlation ($r = 0.26$, $7\%$ variance) and negative correlation ($r = -0.10$, $1\%$ variance) between civics achievement and total hours of instruction (Baker et al., 2004).

Finally, the researchers investigated the relationship between the hours of subject-specific instruction and subject-specific achievement in math, science, and civics and found weak associations. In math, the average statistically significant correlation ($r = \pm 0.14$) accounted for $2.2\%$ of the variance between math achievement and math instructional time. In science, the average statistically significant correlation was $r = 0.23$, accounting for $5\%$ of the variance between science achievement and science instructional time. In civics, six countries demonstrated a negative correlation ($r = -0.23$, $6\%$ of the variance) between instructional hours and civics achievement while two countries demonstrated a positive association ($r = 0.30$, $9\%$ of the variance). The researchers concluded that increasing the hours of instruction yielded an average variance ranging from $0.8\%$ in math, to $7.0\%$ in civics (Baker et al., 2004).
Despite the small correlations uncovered between instructional time and academic achievement, a positive bi-variate relationship between instructional hours per week in math class and math scores was observed in Greece, Russia, Hungary, Japan, and the United States and is represented in the table below (Baker, Fabrega, Galindo & Mishook, 2004).

Table 6  
Score Differentials for Weekly Math Instructional Hours

<table>
<thead>
<tr>
<th>Country</th>
<th>Exceeds</th>
<th>Fewer than</th>
<th>Score differential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greece</td>
<td>5.8 hours</td>
<td>3.8 hours</td>
<td>70 points</td>
</tr>
<tr>
<td>Russia</td>
<td>3.6 hours</td>
<td>2.6 hours</td>
<td>38 points</td>
</tr>
<tr>
<td>Hungary</td>
<td>3.2 hours</td>
<td>2.7 hours</td>
<td>54 points</td>
</tr>
<tr>
<td>Japan</td>
<td>4.2 hours</td>
<td>3.3 hours</td>
<td>74 points</td>
</tr>
<tr>
<td>United States</td>
<td>4.2 hours</td>
<td>2.5 hours</td>
<td>46 points</td>
</tr>
</tbody>
</table>

The researchers concluded that although the correlation between instructional time and academic achievement was small for most countries, some countries did experience a considerable gain in achievement scores from increased subject-specific instruction, supporting the research of Smith (2000), Larsen (1989), and Stevenson (1983).

In spite of the positive bi-variate relationship between instructional hours and math scores in certain countries, the overall correlations uncovered between instructional time and academic achievement are non-existent or small (±). The researchers posit that perhaps instructional time is so dependent on its relationship to curriculum and instructional quality that it becomes significant only in connection with more primary resources in the input process. The authors
ultimately conclude that instructional time is a very simple resource probably not warranting much policy attention (Baker et al., 2004).

Jez and Wassmer (2011) investigated the relationship between school-year learning time and standardized assessment scores from a diminution vantage point. The study manifested from a possible decrease in California state funds that would have reduced the school year by seven days in 2012. The researchers equated the possible loss of seven school days to 2,520 minutes of lost instructional time. The researchers procured a quasi-random sample \((n = 310)\) of elementary schools during the school year 2005-2006. The authors calculated average teaching minutes at each school by proportionately averaging the minutes, at all grade levels, to produce one weighted measure for instructional minutes.

The variable of interest (instructional minutes), along with other social, school, and student inputs, were entered into a regression analysis to ascertain the impact on the dependent variable, the California Academic Performance Index scores (API). The API was a compilation for California’s standardized assessment scores for elementary students. The researchers utilized regression analysis to ascertain how one minute of average teaching time impacts total students’ scores \((T)\) on the API. The authors also utilized this technique in a separate model to calculate the performance of economically disadvantaged (ED) students. Model results revealed an \(R^2\) of 0.84 for the total scores model \((T)\), indicating that 84% of the variance in API total scores could be predicted from the independent variables. Model results also revealed an \(R^2\) of 0.51 for the economically disadvantaged model \((ED)\), indicating that 51% of the variance in API economically disadvantaged scores could be predicted from the independent variables. Although not the variable of interest, the attribute of year-round school was statistically significant \((p <\)
0.05), raising the total school API score \((m = 18.43)\). Economically disadvantaged students’ scores also seemed to benefit from year-round schedules \((m = 24.39; p < 0.01)\).

The researchers determined that one additional minute in instructional time was statistically significant \((p < 0.01)\) and correlated to an increase of 0.0031 in total school API score \((T)\) and an increase of 0.0042 in the economically disadvantaged population \((ED)\). Based on the proposed loss of seven school days, or 2,520 minutes, the regression coefficients of 0.0031 and 0.0042 represent an expected loss of 7.8 points \((T)\) and 10.6 points \((ED)\), respectively. These point losses represent a 1.0% \((T)\) and 1.5% \((ED)\) reduction in average scores. The authors added that the results may not seem large but likened the effect to other statistically significant, positively associated variables, such as the number of college-educated parents diminishing by 6% or fully credentialed teachers dropping 6.8%. Jez and Wassmer (2011) caution policy makers in reducing instructional time as a means to reduce costs and concluded that allotted instructional time had a statistically significant, positive impact on academic achievement, affecting the neediest students the most.

Cotton (1989) performed a comprehensive review of 57 studies analyzing the relationship between time and learning. The researcher then identified 30 studies within that review that measured allocated time \((\text{required time in class})\) and student achievement. Cotton found a strong relationship between academic learning time \((\text{time when learning actually occurs})\) and achievement. Conversely, the author discovered no statistically significant association between allocated time and achievement. Similarly, Aronson, Zimmerman, and Carlos (1999) concluded there is little or no relationship between allocated time and student achievement, some relationship between engaged time \((\text{time-on-task})\) and achievement; but a larger association between academic learning time and achievement. The previous researchers’ findings stand in
stark contrast to the historical call for more effective use of time with longer school periods, longer school days, or a lengthened school year (National Commission on Education Excellence, 1983).

In 1894, the Committee of Ten lamented that a boy needed to attend school for 11 years, while just 50 years earlier, a boy could receive the same education in eight years. “It is no wonder the greater amount of work accomplished in the German and French schools than in the American schools” (Mackenzie, 1894). As it has throughout history, the debate over the effective use of time will surely be revisited countless times, as international comparisons are made and the political winds continue to shape the educational landscape.

Conclusions

In order to decipher which variables listed on the New Jersey School Performance Report (NJSPR) had an impact on student achievement, a comprehensive literature review was performed. Each variable listed on the NJSPR was examined in relation to student achievement. The attribute of instructional time was further delineated and researched to include length of school day, extended school day, extended school year, year-round schools, and block scheduling to give the researcher comprehensive insight into the primary variable of interest—time. Instructional time permutations were also examined through the lens of student achievement.

The literature review was guided by the input/output model, or the production function theory (Coleman, 1966; Bowles, 1970; Hanushek, 2008). The inputs of student and school variables were examined in relation to the output of student performance, achievement, and attainment. Many of the input variables are beyond the control of those involved in education.
Coleman (1966) concluded that no particular school variable had a measurable impact on student achievement; only socioeconomic status had a measurable impact on student achievement.

However, policy makers and educational bureaucrats continue to debate at least one of these variables: time. Adding instructional time is predicated by the simple notion: More time in school should result in more learning and increased student performance. Students who spend more time studying learn more (Walberg, 2011; Lavy, 2010; Barro & Lee, 2001; Jackson, 1985). This study focused on subject-specific time designated for instruction.

This research will add to the empirical evidence regarding the influence of mathematical instructional time and the input variables listed on the New Jersey School Performance Report in relation to academic achievement. The production function theory, which undergirds this study, enabled statistical analyses and allowed the researcher to determine the influence of subject-specific, mathematics instructional time on academic achievement as measured by the NJ ASK scores.

Synopsis of Literature Review

High-Stakes Testing

Under federal and state guidelines, schools are responsible for the achievement of all students as measured by their standardized assessment scores. High-stakes tests continue to be the instrument of measure when determining student performance and school achievement. High-stakes testing determines school progress, teacher efficacy, student proficiency in subject matter, student promotion or retention, and graduation from high school.

New Jersey Assessment of Skills and Knowledge (NJ ASK)

NJ ASK was the state’s elementary and middle school assessment program for Grades 3 through 8. Its central goal was to assess student achievement results on the mastery of skills
specified by the CCSS in Language Arts Literacy and Mathematics at each grade level; Science in Grades 4 and 8.

**New Jersey School Performance Report (NJSPR)**

The NJSPR consists of individual statistical profiles of all public schools in New Jersey. They are comprised of student, school, faculty, and performance metrics aimed to present a complete picture of school performance.

**Table 7**

*Literature Review Summary Table*

<table>
<thead>
<tr>
<th>Absenteeism</th>
<th>Studies revealed a moderate to strong positive relationship between attendance and achievement. Students with better attendance had greater academic achievement. It is expected that higher attendance rates will result in higher performance on the NJ ASK.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspension</td>
<td>Research studies indicated a negative association with school achievement. Students with more suspensions had decreased student performance, lower GPA, and diminished achievement scores. It is projected that higher suspension rates will negatively influence NJ ASK scores.</td>
</tr>
<tr>
<td>Limited English Proficient Students (LEP)</td>
<td>The literature concluded that LEP students were less proficient than their non-LEP peers. LEP students scored lower in math and reading. They were more apt to drop out than their non-LEP or FEP peers. It is anticipated that the LEP subgroup will have lower achievement rates than their non-LEP peers on the NJ ASK.</td>
</tr>
<tr>
<td>Economically Disadvantaged</td>
<td>Socioeconomic status (SES) was one of the strongest predictors of student achievement. Achievement was positively associated with higher SES levels.</td>
</tr>
<tr>
<td>Students</td>
<td>The higher the SES of the students’ family, the greater the academic achievement. It is highly probable that SES will be responsible for the most variance in achievement scores on the NJ ASK.</td>
</tr>
<tr>
<td>------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Students with Disabilities</td>
<td>Research asserted that SWD scored significantly lower than their non-classified peers. It is expected SWD will have lower scores and more difficulty reaching NCLB subgroup proficiency targets on the NJ ASK than their non-disabled peers.</td>
</tr>
<tr>
<td>(SWD)</td>
<td></td>
</tr>
<tr>
<td>Total School Enrollment</td>
<td>The research on school size is wide-ranging. The results included research favoring smaller schools as well as school size having little influence on student achievement. School size is predicted to have little, if any, influence on academic achievement.</td>
</tr>
<tr>
<td>Algebra Enrollment</td>
<td>Algebra enrollment was positively associated with achievement. Students enrolled in algebra generally outperformed their non-algebra peers. It is anticipated that algebra enrollment will positively impact achievement on the NJ ASK.</td>
</tr>
<tr>
<td>Student-Faculty Ratio</td>
<td>Research is mired with ambiguous jargon. Terms included: pupil-teacher ratio, pupil-faculty ratio, student-staff ratio, and class size. Smaller class size had a significant positive effect on student achievement, whereas student-faculty ratio had no effect on achievement. It is predicted this variable will have little influence on achievement.</td>
</tr>
<tr>
<td>Length of School Day (LOSD)</td>
<td>Average LOSD is 6.8 hours. Studies on LOSD produced mixed results in relation to student learning. Longer school days seemed to benefit low-income students by providing additional time to learn and also helped narrow</td>
</tr>
</tbody>
</table>
achievement gaps. The correlation between length of school day and academic achievement was not strong. It is predicted to have little influence on achievement.

**Extended School Day (ESD)**
ESD (> 7 hours) offered more programs and time for academics. Results were mixed. Extending the school day had a positive association with disadvantaged students, students with disabilities, and at-risk students. ESD improved achievement gaps in poorer neighborhoods.

**Extended School Year (ESY)**
ESY (> 180 days) raised student achievement, but effect sizes were small and cost was prohibitive. Positive, statistically significant increases in math scores were evidenced. ESY benefited minority students and students from rural communities the most.

**Year-Round Schooling (YRS)**
YRS experienced positive, academic gains. However, the effect size was very small. Lower-income, academically struggling, and elementary students experienced the greatest academic gains.

**Block-Traditional Scheduling**
Advantages of block scheduling (> 60 minutes) as opposed to traditional scheduling has been extremely mixed. Schedules yielded inconsistent findings regarding the effect on student achievement in terms of student grades, grade-point averages, assessment scores, and attendance.

**Instructional Time**
Association between time and learning is complex. Research on instructional time produces mixed results. Studies found smaller relationships between allocated time and student achievement, slightly larger relationships between engaged time and achievement, and larger relationships between academic-learning time and achievement. Mixed results and the lack of quality, subject-
specific research on this topic warrant additional study. It is predicted that
positive associations may develop from increased mathematical instructional
time.
CHAPTER III

METHODOLOGY

Context for the Study

The purpose of this quantitative study was to examine the influence, if any, of mathematical-instructional minutes on academic achievement as measured by the New Jersey Assessment of Skills and Knowledge (NJ ASK) 6, 7, and 8 Mathematics scores. In addition, I hoped to explain the amount of variance in student test scores for which instructional minutes in mathematics are responsible while accounting for other factors that influence student achievement, including selected metrics and variables listed on the 2013-2014 New Jersey School Performance Report. The existing literature on instructional minutes and student achievement has been mixed, and scarce empirical literature exists about the efficacy of instructional minutes on Grades 6, 7, and 8 math achievement. The findings of this study will add to the existing literature, providing administrators, educators, and board of education members with the data to implement policy on a school and district level to create schedules and time configurations that could increase student achievement.

Research Design

Educational researchers and other social scientists often utilize non-experimental research because of difficulties with control factors, random assignments, human behavior, and treatment of experimental/control groups. This non-experimental, explanatory, cross-sectional study employed a correlational design to determine the amount of influence an independent variable (instructional minutes) had on the dependent variable (New Jersey Assessment of Skills and Knowledge Mathematics scores). Correlation can be utilized to explain relationships between variables in prediction studies (Ravid, 2005). The correlational design also enabled the
researcher to ascertain the strength, or degree of correlation, between the variables and student achievement.

The researcher utilized this correlational design at one point in time: The 2014 New Jersey Assessment of Skills and Knowledge test. A two-tiered research approach was utilized for this study. First, a simultaneous regression model was applied to specific variables listed on the New Jersey School Performance Report as well as school-specific instructional minutes in mathematics. If the researcher has a small set of predictors and no prior notion about which variables will create the best prediction equation, simultaneous regression is the best statistical method to employ (Leech, Barrett, & Morgan, 2011).

The independent/predictor variables listed on each school’s Performance Report, as well as school-specific mathematics instructional minutes, were entered into the simultaneous regression model. The researcher was able to determine which variables were statistically significant and the strength, if any, and direction of their correlation with the percentage of students who scored Proficient and Advanced Proficient on the Mathematics section, Grades 6-8, of the New Jersey Assessment of Skills and Knowledge test. The dependent/outcome variables of the Grade 6-8 New Jersey Assessment of Skills and Knowledge (NJ ASK) Mathematics Proficient and Advanced Proficient scores were also ascertained via the 2013-2014 School Performance Report listed on the New Jersey Department of Education website and entered into the same model.

The results of the simultaneous regression allowed the researcher to determine the correlation coefficients and apply those variables that were statistically significant and had the strongest beta-coefficients in a hierarchical regression model. The hierarchical method is preferred when the researcher has an idea about the order in which he or she wants to enter
predictors. Utilizing the hierarchical approach allowed the researcher to see how each new variable influenced the previous prediction model (Leech et al., 2011). Additionally, a hierarchical approach was used to determine if instructional minutes contributes a “value-added” effect to school performance on the mathematics section of the 2014 NJ ASK.

Data were run through simultaneous/hierarchical regressions to determine the influence (variance) of the independent variable (instructional minutes) on the dependent variable (New Jersey Assessment of Skills and Knowledge 6-8 Mathematics scores) to see if there was a statistically significant relationship between instructional minutes and the NJ ASK 6-8 Mathematics scores.

**Restatement of Research Questions**

The overall research question guiding this study was the following: What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grades 6-8 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?

**Research Question 1:** What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grade 6 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?

**Research Question 2:** What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grade 7 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?

**Research Question 3:** What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the
2014 Grade 8 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?

**Restatement of Null Hypotheses**

**Null Hypothesis 1**: No statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 6 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

**Null Hypothesis 2**: No statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 7 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

**Null Hypothesis 3**: No statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 8 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

**Sample/Data Source**

The data for this study came directly from a work-related assignment to find out how many minutes other schools were allotting for mathematical instruction. As an assistant principal of a middle school, I was given the duty to research how other schools in the surrounding counties were scheduling their Grades 6, 7, and 8 Mathematics classes. A copy of this directive can be found in the Appendices section of this study under the heading, Appendix A. The motivation to ascertain this information was due in part to a recent decrease of instructional minutes in mathematics because of a new rotating schedule as well as teachers’ concerns that the decrease of instructional time would negatively impact student performance. The underpinnings of this study grew out of potential scheduling alternatives to possibly alleviate these concerns.

The middle school was located in northern New Jersey in a school district that was designated “FG” in District Factor Grouping. It contained 529 students and 52 teachers.
Economically disadvantaged students represented 16.3% of the student population and students with a disability accounted for 17%. There were no Limited English Proficiency students. Schoolwide performance on the 2014 NJ ASK Math was 77% Proficient/Advanced Proficient (TPAP). No Child Left Behind math progress targets, including subgroups, were 100% attained. Of the 16% of students taking algebra, 95% achieved a “C” or better. This was the mathematical environment in which this study commenced.

Instructional time in mathematics decreased from 300 minutes a week in 2013-2014 to an average of 262 minutes a week in 2014-15 due to a new rotating schedule. The average weekly loss of 38 minutes, or 13% of instructional time due to the new schedule design, became the impetus to verify how other schools in the state of New Jersey schedule mathematics for their students in Grades 6, 7, and 8, to determine if there was a correlation between instructional minutes and academic achievement. Although originally tasked with the work-related assignment to ascertain how schools in surrounding counties were scheduling their Grades 6, 7, and 8 mathematics classes, the researcher believed that a state-wide perspective could provide an even deeper analysis for potential decision making.

According to the 2014 New Jersey Department of Education School Directory, there were 2,351 public schools in the state of New Jersey. Of those, 958 schools educated students in Grades 6, 7, or 8 in District Factor Groups A through J for the school year 2013-2014. For the purpose of this school-related organizational project, now research study, all grade configurations (K-6, K-8, 5-6, 5-8, 6-8, 7-8, and 7-12) were considered in developing the sample for this study. The list of 958 schools, as well as principal e-mail addresses, were obtained by downloading the New Jersey Public School Directory and excluded all schools that did not include Grades 6, 7, or 8. Of the 958 principals polled, 234 principals responded, providing a
response rate of 24.4%. The sample for this study is the 234 schools that responded to the e-mail. Each school served as the unit for analysis for this study and all data are reported in the aggregate. Table 8 demarcates the total number of schools educating students in Grades 6, 7, or 8 in New Jersey, as well as responding schools that served as the sample for this study by District Factor Group (NJDOE, 2014f).

Table 8

*District Factor Group (Study Sample versus Total Population)*

<table>
<thead>
<tr>
<th>DFG</th>
<th>Sample DFG n¹ =</th>
<th>Sample Response n¹/234</th>
<th>Population DFG n² =</th>
<th>Population % n²/958</th>
<th>Response Rate by DFG n¹/n²</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>29</td>
<td>12.39%</td>
<td>208</td>
<td>21.71%</td>
<td>13.94%</td>
</tr>
<tr>
<td>B</td>
<td>26</td>
<td>11.11%</td>
<td>124</td>
<td>12.94%</td>
<td>20.97%</td>
</tr>
<tr>
<td>CD</td>
<td>19</td>
<td>8.12%</td>
<td>106</td>
<td>11.07%</td>
<td>17.93%</td>
</tr>
<tr>
<td>DE</td>
<td>37</td>
<td>15.81%</td>
<td>135</td>
<td>14.09%</td>
<td>27.41%</td>
</tr>
<tr>
<td>FG</td>
<td>30</td>
<td>12.82%</td>
<td>120</td>
<td>12.53%</td>
<td>25.00%</td>
</tr>
<tr>
<td>GH</td>
<td>32</td>
<td>13.68%</td>
<td>98</td>
<td>10.23%</td>
<td>32.65%</td>
</tr>
<tr>
<td>I</td>
<td>50</td>
<td>21.37%</td>
<td>135</td>
<td>14.09%</td>
<td>37.03%</td>
</tr>
<tr>
<td>J</td>
<td>11</td>
<td>4.70%</td>
<td>32</td>
<td>3.34%</td>
<td>34.38%</td>
</tr>
<tr>
<td>Total</td>
<td>234</td>
<td>100%</td>
<td>958</td>
<td>100%</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Instrumentation**

The instrumentation used for the collection of study data was two-fold. First, to ascertain school-specific, weekly instructional minutes in mathematics, an e-mail was sent to New Jersey principals of schools that educated students in Grades 6, 7, or 8. The e-mail (Appendix B) contained a link to a survey (Appendix C) that had the following four scheduling questions:
1. How many minutes a day did students receive mathematics instruction in 6th grade?

2. How many minutes a day did students receive mathematics instruction in 7th grade?

3. How many minutes a day did students receive mathematics instruction in 8th grade?

4. Is there any type of rotation involved in the schedule to ascertain weekly instructional minutes?

Principals were able to respond to the scheduling survey questions by means of Google Forms. A survey design allowed the researcher to ascertain a numeric description of the scheduling trends of a sample and generalize to the population (Creswell, 2009). The survey included principal name, principal e-mail address, school name, school district, instructional minutes in math for applicable grades, and possible scheduling rotations to determine weekly instructional minutes.

Second, the mathematics assessment instrumentation for this study came from Measurement Incorporated, the test makers of the New Jersey Assessment of Skills and Knowledge (NJ ASK). Individual school level Proficient/Advanced Proficient (TPAP) scores on the NJ ASK were ascertained via the 2013-2014 School Performance Report listed on the New Jersey Department of Education website. The NJ ASK was given in Grades 3-8 for Language Arts/Mathematics and also in Grades 4 and 8 in Science. The NJ ASK was designed to assess each student’s knowledge of the prescribed New Jersey Core Curriculum Content Standards as required by New Jersey Administrative Code 6A: 8-4.
New Jersey Assessment of Skills and Knowledge (NJ ASK) scores are recorded in three possible categories: Partially Proficient (< 200), Proficient (200-249), and Advanced Proficient (250-300) for all three subjects. The NJ ASK contains content clusters within each subject area of mathematics, language arts, and science. The content clusters for mathematics are numbers and numerical operations, geometry and measurement, patterns and algebra, and data analysis, probability, and discrete mathematics.

**Reliability and Validity**

The New Jersey Assessment of Skills and Knowledge was administered to students in Grades 3-8 for the last time in April and May of 2014. Measurement Incorporated developed the criterion-referenced test, scored the test, and served as a liaison between local school districts and the New Jersey Department of Education. The NJDOE is required under federal law to ensure that all instruments used for measuring student achievement and school accountability be deemed reliable (NJDOE, 2015a). Reliability is defined as the level of consistency of an instrument and the degree to which the same results are attained when the instrument is used with the same persons or groups (Ravid, 2005). Cronbach’s coefficient alpha is frequently used in educational and psychological research and is the index of reliability used in NJ ASK Grades 3-8 and reported in the NJ ASK Grades 3-8 Technical Report. Reliability coefficients such as alpha should be over .70 when used to assess the internal consistency reliability of multiple scale items (Leech et al., 2011). Commonly used guidelines for evaluating alpha scores are delineated in the table below (George & Mallery, 2003).
Table 9

*Cronbach’s Alpha Rating Scale*

<table>
<thead>
<tr>
<th>Cronbach’s Alpha</th>
<th>Internal Consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 0.90</td>
<td>Excellent</td>
</tr>
<tr>
<td>0.80 - 0.89</td>
<td>Good</td>
</tr>
<tr>
<td>0.70 - 0.79</td>
<td>Acceptable</td>
</tr>
<tr>
<td>0.60 - 0.69</td>
<td>Questionable</td>
</tr>
<tr>
<td>0.50 - 0.59</td>
<td>Poor</td>
</tr>
<tr>
<td>&lt; 0.50</td>
<td>Unacceptable</td>
</tr>
</tbody>
</table>

The NJ ASK 2014 Grades 3-8 Technical Report listed Cronbach’s coefficient alpha and standard error of measurement for all grade levels used in this study and are listed below.

Table 10

*NJ ASK 2014 Grades 3-8 Cronbach’s Coefficient Alpha and Standard Error of Measurement*

<table>
<thead>
<tr>
<th>Grade Level &amp; Subject</th>
<th>Cronbach coefficient alpha</th>
<th>Standard Error of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 6 Math</td>
<td>.92</td>
<td>3.05</td>
</tr>
<tr>
<td>Grade 7 Math</td>
<td>.92</td>
<td>3.07</td>
</tr>
<tr>
<td>Grade 8 Math</td>
<td>.93</td>
<td>3.06</td>
</tr>
</tbody>
</table>

Validity is referred to as the degree to which an instrument measures what it is supposed to measure, allowing the researcher to make specific inferences and interpretations using the test scores (Ravid, 2005). Validity relies on “careful test construction, adequate score reliability, appropriate test administration and scoring, accurate score scaling, equating, standard setting,
and careful attention to fairness for all examinees” (American Educational Research Association, 1999, p. 17). The New Jersey Assessment of Skills and Knowledge 2014 Grades 3-8 Technical Report acknowledges that given the empirical evidence available, the uses of the scores are by and large substantiated (NJDOE, 2015a).

Content validity ensures that the items to be answered are an adequate sample of the content to be tested so that inferences can be made (Ravid, 2005). Two questions are vital in the evaluation of content validity: Is the definition of the content domain adequate and appropriate? Does the test provide a sufficient interpretation of the content domain it is intended to measure? (Baker & Linn, 2002).

New Jersey Administrative Code 6A: 8-3 and Code 6A: 8-4 requires districts to align all curriculum to the Core Curriculum Content Standards (CCCS), ensure that teachers provide instruction according to the CCCS, ensure student performance is assessed in each content area, and provide teachers with opportunities for professional development that focuses on the CCCS (New Jersey Administrative Code, 2014). Sufficient content representation is vital because the tests must provide an indication of student progress toward achieving the knowledge and skills identified in the NJ state standards. The New Jersey Department of Education asserts that content domains defined in the CCCS are accurately represented by utilizing a test blueprint and a careful test construction process. New Jersey performance standards, as well as the CCCS, are included in the writing of multiple-choice and constructed-response items and constructed-response rubric development (NJDOE, 2015a).

According to the New Jersey Department of Education, Measurement Incorporated followed statistical and content specifications to make sure that the 2014 New Jersey Assessment of Skills and Knowledge is valid. The primary statistical targets used for the NJ ASK test
assembly were \( p \)-value estimates. \( P \)-values measure how well the items discriminate among test takers and are related to the overall reliability and test difficulty.

Construct validity is the degree to which a test measures and provides precise information about abstract traits or characteristics, such as intelligence, that cannot be measured directly (Ravid, 2005). Essentially, is what was purported to be measured, actually being measured? The New Jersey Assessment of Skills and Knowledge (NJ ASK) was designed to assess students in Math, Language Arts, and Science, utilizing essay, open-ended responses, and multiple-choice questions. The NJ ASK 3–8 are scaled utilizing raw score points, item response theory, and performance standard level (based on scale-score cuts). Performance scores indicate that a student has performed at the Partially Proficient, Proficient, or Advanced Proficient level in a specific content area.

**Data Collection**

The list of 958 schools, as well as principal e-mail addresses, were obtained by downloading the New Jersey Public School Directory and excluding all schools that did not include Grades 6, 7, or 8. The researcher then sent the principals of those 958 schools that educated students in Grades 6, 7, or 8 an e-mail (Appendix B) to determine school-specific, weekly instructional minutes in mathematics. The e-mail contained a link for a self-administered, online, scheduling survey via Google Forms (Appendix C). The survey included school name, principal e-mail address, school district, instructional minutes in mathematics for applicable grades, and possible scheduling rotations to determine weekly instructional minutes. This information was automatically recorded in Google Forms as each participant completed his or her survey. The researcher transferred the data from Google Forms into Microsoft Excel. The total response rate or sample for this study consisted of 234 public schools, in all district factor
groups, in all counties in the state of New Jersey that educated students in Grades 6, 7, or 8 and is delineated in Table 8 in the Sample/Data Source section of this study.

Data also came from each participating school’s New Jersey School Performance Report. New Jersey public schools are required to submit information regarding various metrics for their particular school and submit this information to the state of New Jersey Department of Education. The NJDOE then publishes these data in a yearly performance report. Beginning school year 2011-2012, the New Jersey Department of Education no longer published metrics such as student mobility, class ratios, faculty credentials, faculty attendance, and faculty mobility. According to the NJDOE, the discontinued metrics suffered from low data quality (NJDOE, 2015b). The New Jersey School Performance Report has three distinct performance areas: academic achievement, college and career readiness, and student growth. A school’s performance is benchmarked against other peer schools that are educating similar students, against statewide outcomes, and against state targets to build upon a school’s strengths and identify areas for improvement (NJDOE, 2015b).

The New Jersey Department of Education (NJDOE) published individual school performance reports and archived school-specific data in Microsoft Excel format for a comprehensive School Performance Report database for school year 2013-2014. Participating schools in this study were identified by name under the school header tab on the NJDOE 2013-14 Performance Report Database. County, district, and school codes and grade span were also listed under the school header tab and served as the origin for the initial spreadsheet. A variety of sorting options were implemented to further include all applicable variables into an Excel workbook. The results of New Jersey Assessment of Skills and Knowledge 6, 7, and 8 Mathematics scores were also obtained from the New Jersey School Performance Report and
added into the Excel spreadsheet. Percentages of students deemed Proficient and Advanced Proficient were combined and delineated (TPAP).

All demographic data and NJ ASK test results data were procured from the school year 2013-2014. Variables ascertained from the 2013-2014 New Jersey School Performance Report and Google Instructional Minutes survey were merged, reconciled, aligned for each participating school, and are reflected below.

Table 11

*Data Retrieved from the 2013-14 NJSPR and Google Survey*

<table>
<thead>
<tr>
<th>Student Variables</th>
<th>School Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absenteeism</td>
<td>Length of School Day</td>
</tr>
<tr>
<td>Student Suspension Rate</td>
<td>Instructional Time</td>
</tr>
<tr>
<td>Percentage of Limited English Proficient Students</td>
<td>Total School Enrollment</td>
</tr>
<tr>
<td>Percentage of Economically Disadvantaged Students</td>
<td>Algebra 1 Enrollment</td>
</tr>
<tr>
<td>Percentage of Students with Disabilities</td>
<td>Student-Faculty Ratio</td>
</tr>
<tr>
<td></td>
<td>Mathematics Time</td>
</tr>
</tbody>
</table>

**Data Analysis**

Statistical data analysis for this study was completed using the IBM Statistical Package for the Social Sciences (SPSS) v24. Data recorded, verified, and formatted in Microsoft Excel was imported into SPSS. The unit of analysis examined in this research study is individual schools and reported in the aggregate. This study was initiated to determine the influence, if any, of mathematical instructional minutes on academic achievement as measured by the New Jersey Assessment of Skills and Knowledge (NJ ASK) 6, 7, and 8 Mathematics scores.
Simultaneous regression is a technique used for prediction and is based on the assumption that the predictor/independent variables and the criterion/dependent variables correlate with each other; the higher the correlation, the more accurate the prediction. Simultaneous regression allowed the researcher to determine the impact and significance, if any, of each independent variable on the dependent variable (NJ ASK Mathematics score). It also allowed the researcher to measure the dependent variable (NJ ASK Mathematics scores) on a continuous scale (interval). The predictor (independent variables) were also measured on a continuous scale (interval).

The researcher chose simultaneous regression because the number of schools that participated in the study \( (n = 234) \) substantially exceeded the number of predictor variables. This provided samples large enough to determine statistical significance. Field (2009) suggested sample size of the overall model be \( 50 + 8(k) \), with “\( k \)” representing the number of predictor variables to posit that samples were large enough to determine statistical significance. There were up to 11 predictor variables used in this study, therefore \( 50 + 8(11) = 138 \) would provide a sample robust enough to generate an effect size of .50 at the 95% confidence level.

The researcher also chose simultaneous regression because it is a powerful statistical tool that attempts to explain relationships and associations. Its use was predicated upon the notion that the researcher had no assumptions which variable would generate the best prediction equation. Based on the results of the simultaneous regression models for Grades 6, 7, and 8, independent variables that were determined to be statistically significant \( (p < .05) \) were utilized for successive hierarchical regression models. Hierarchical regression enables the researcher to see if each new variable adds anything new to the prediction model (Leech et al., 2011). The researcher built separate, successive, hierarchical regression models to test the effects of specific
predictors independent of the influence of other variables. Statistically significant variables were added to see if they would predict the dependent variable (NJ ASK Math scores) better than the previous model. This was determined by $R^2$ change and the statistical significance of the $R^2$ change.

Field (2009) also provided a formula $(104 + k)$ for predictive power utilizing hierarchical linear regression. Based on Field’s formula and the 11 independent variables used in the study, a sample of 115 participants was needed to provide sufficient predictive power. The researcher’s sample consisted of 234 schools, providing ample power to attain a large effect size of .50 at the 95% confidence level. The size of the sample ($n = 234$) enabled the researcher to generalize the results to all schools with enough power utilizing the statistical methods of simultaneous regression and the hierarchical regression method. The statistical findings are presented in Chapter IV.

**Summary**

This chapter described the context of the study, the research design, research questions, sample, instrumentation, data collection procedures and data analysis that were used in this study. This research study specifically examined the nature of the relationship between instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grades 6 through 8 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables. The quantitative data collected were analyzed using the IBM Statistical Package for the Social Sciences (SPSS) v24.
CHAPTER IV
ANALYSIS OF THE DATA

Introduction

This research study was conducted utilizing a non-experimental, explanatory, cross-sectional, correlational, quantitative design to determine the influence of school and student variables, specifically mathematical-instructional time, on student achievement in Grades 6, 7, and 8, as measured by Mathematics scores on the 2014 NJ ASK. This study sought to explain the strength and direction of the relationship between mathematical-instructional minutes and student performance in Grades 6, 7, and 8 based upon data procured from the 2014 New Jersey School Performance Report, the 2014 Grades 6-8 NJ ASK and School Survey results. The overarching research question, subsidiary questions, and null hypotheses are listed below.

Overarching Research Question

The overall research question guiding this study was the following: What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014, Grades 6-8 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?

Subsidiary Research Questions

Research Question 1: What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grade 6 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?

Research Question 2: What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the
Research Question 3: What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grade 7 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?

Null Hypotheses

Null Hypothesis 1: No statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 6 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

Null Hypothesis 2: No statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 7 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

Null Hypothesis 3: No statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 8 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

Purpose of the Study

The purpose of this study was to examine the influence, if any, of mathematical-instructional minutes on academic achievement as measured by the New Jersey Assessment of Skills and Knowledge 6, 7, and 8 Mathematics scores. In addition, I hoped to explain the amount of variance in student test scores for which mathematical-instructional minutes are responsible while accounting for other factors that influence student achievement, including selected variables listed on the 2013-2014 New Jersey School Performance Report. Previous studies have
focused on the influence of total instructional time on academic achievement, but there is a lack of research on the impact of subject-specific (mathematics) instructional time on student achievement. This study will add to the existing research of the influence of instructional time on student achievement. The findings of this study will provide board of education members, administrators, and educators with the data to implement policy on a school and district level to create schedules and time configurations that could impact student achievement.

**Organization of the Chapter**

This chapter delineates how the research data were collected, analyzed, and reported. The results are reported by each research question and its corresponding hypothesis. The author first used the Statistical Package for the Social Sciences (SPSS) software, v24 to provide descriptive statistics of the sample. Second, the researcher utilized more advanced statistical methods, including inferential statistics, such as simultaneous regression and hierarchical regression to delve deeper into the data in an attempt to answer the research questions. Finally, the researcher scrutinized the SPSS data outputs to answer the research questions and decide whether to accept or reject the null hypotheses.

**Description of the Sample and Variables**

The data for this study were derived from a work-related assignment to ascertain how many minutes other schools were devoting to math instruction. The motivation to find out this information was due in part to a decrease of instructional time in mathematics. The underpinnings of this study grew out of potential scheduling alternatives to possibly alleviate these concerns.

The researcher identified 2,351 public schools in the state of New Jersey by downloading the New Jersey Public School Directory and excluded all schools that did not include Grades 6,
7, or 8. The list of 958 schools that educated students in Grades 6, 7, or 8 for the school year 2013-2014 were sent an e-mail (Appendix B) to determine school-specific, weekly instructional minutes in mathematics. The sample for this study was the 234 schools that responded to the e-mail, which represents a survey response rate of 24%. “School” served as the unit of analysis for this study and all data were reported in the aggregate. Table 8 in Chapter 3 demarcated the responding schools that served as the sample for this study. This information provided by obliging principals was automatically recorded in Google Forms and transferred into Microsoft Excel.

Sample data also came from each participating school’s 2013-2014 New Jersey School Performance Report (NJSPR). The NJDOE published individual school performance reports and archived school specific data in Microsoft Excel format for a comprehensive School Performance Report database for school year 2013-2014. Participating schools in this study were identified by name under the school header tab on the NJDOE 2013-14 Performance Report database. County, district, and school codes and grade span were also listed under the school header tab and served as the origin for the initial spreadsheet. Utilizing the NJSPR database, the tabs of enrollment, school climate, chronic absenteeism, algebra, and assessment were sorted by county, district, and school codes to include all schools that responded to the survey regarding instructional minutes. A variety of sorting options were implemented to further include all applicable variables into an Excel workbook. The dependent variable of the New Jersey Assessment of Skills and Knowledge 6, 7, and 8 Mathematics scores was also obtained from the 2013-2014 NJSPR under the assessment tab and added into the Excel spreadsheet. Percentages of students deemed Proficient and Advanced Proficient were combined and delineated (TPAP).
Independent Variables and Dependent Variables

In researching the variables that influence academic achievement, the literature substantiated that certain predictor variables influence student academic achievement more than others. As such, the data analysis focused on the seven variables that are most responsible for influencing academic achievement. They are socioeconomic status, students with a disability, limited-English proficiency, absenteeism, suspension rates, school size, and algebra enrollment (Grade 8). The variable of student/faculty ratio was omitted because it is often a misleading statistic and not accurate (Achilles, 1999). The variables of length of school day and full-day instructional minutes were left out because of the potential multicollinearity issues and the variable of interest, mathematical-instructional minutes.

Table 12

*Independent/Dependent Variables Included in SPSS v24 Analysis*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Variable Type</th>
<th>SPSS Label</th>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 6 math minutes</td>
<td>Independent</td>
<td>gr6_minutes_per_week</td>
<td>Scale</td>
<td>Grade 6 mathematical minutes per week</td>
</tr>
<tr>
<td>Grade 7 math minutes</td>
<td>Independent</td>
<td>gr7_minutes_per_week</td>
<td>Scale</td>
<td>Grade 7 mathematical minutes per week</td>
</tr>
<tr>
<td>Grade 8 math minutes</td>
<td>Independent</td>
<td>gr8_minutes_per_week</td>
<td>Scale</td>
<td>Grade 8 mathematical minutes per week</td>
</tr>
<tr>
<td>School enrollment</td>
<td>Independent</td>
<td>total_enroll</td>
<td>Scale</td>
<td>Total school enrollment</td>
</tr>
<tr>
<td>Student suspension rate</td>
<td>Independent</td>
<td>percent_suspension</td>
<td>Scale</td>
<td>Percentage of students suspended</td>
</tr>
<tr>
<td>Chronic absenteeism</td>
<td>Independent</td>
<td>percent_chronic_absent</td>
<td>Scale</td>
<td>Percentage of students chronically absent</td>
</tr>
<tr>
<td>Limited English proficiency</td>
<td>Independent</td>
<td>percent_lep</td>
<td>Scale</td>
<td>Percentage of limited English proficient students</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------------</td>
<td>-------------</td>
<td>-------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Students with a disability</td>
<td>Independent</td>
<td>percent_swd</td>
<td>Scale</td>
<td>Percentage of students with a disability</td>
</tr>
<tr>
<td>Economically disadvantaged students</td>
<td>Independent</td>
<td>percent_ed</td>
<td>Scale</td>
<td>Percentage of economically disadvantaged students</td>
</tr>
<tr>
<td>Grade 8 students enrolled in Algebra</td>
<td>Independent</td>
<td>percent_gd8_algebra</td>
<td>Scale</td>
<td>Percentage of Grade 8 students enrolled in Algebra</td>
</tr>
<tr>
<td>Total Proficient/Advanced Proficient Grade 6</td>
<td>Dependent</td>
<td>tpap_gd6</td>
<td>Scale</td>
<td>Total percentage of Proficient/Advanced Proficient scores</td>
</tr>
<tr>
<td>Total Proficient/Advanced Proficient Grade 7</td>
<td>Dependent</td>
<td>tpap_gd7</td>
<td>Scale</td>
<td>Total percentage of Proficient/Advanced Proficient scores</td>
</tr>
<tr>
<td>Total Proficient/Advanced Proficient Grade 8</td>
<td>Dependent</td>
<td>tpap_gd8</td>
<td>Scale</td>
<td>Total percentage of Proficient/Advanced Proficient scores</td>
</tr>
</tbody>
</table>

**Procedure**

Variables ascertained from the 2013-2014 New Jersey School Performance Report and Google Instructional Minutes survey were merged into an Excel file, sorted, reconciled, and aligned for each participating school and each delineated variable. After all data were sorted, reconciled, aligned, filtered, formatted, and proofed, it was imported into IBM Statistical
Package for the Social Sciences (SPSS) v24. The unit of analysis examined in this research study was individual schools, and data were reported in the aggregate for each school.

The initial step in ascertaining which of the independent variables were statistically significant and could be predictors of the dependent variable, total Proficient/Advanced Proficient (TPAP) Grades 6-8 NJ ASK Math scores was to employ the technique of simultaneous regression. When the researcher has no prior ideas of which independent variables would create the best prediction model and has a reasonably small set of predictors, simultaneous regression is considered one of the best methods to use (Leech et al., 2011).

Additionally, the researcher employed the variables the literature base determined were most significant in influencing academic achievement and would not create multicollinearity issues with the variable of interest, mathematical-instructional minutes. Using the “enter” method, seven of the ten predictor variables were entered at the same time to determine which were statistically significant and which had the most influence on the outcome variable (Grades 6-8 NJ ASK Mathematics TPAP scores).

Based on the results of the simultaneous regression model, statistically significant variables were included in various hierarchical regression models. Additional variables deemed significant predictors of academic achievement by the literature base were also included to provide a complete picture to ascertain which variables were statistically significant ($p < .05$), had the strongest predictive strength, and explained the largest amount of variance on the dependent variable, Grades 6-8 NJ ASK Mathematics TPAP scores.

**Research Question 1: Statistical Analysis and Results**

**Research Question 1:** What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the
Null Hypothesis 1: No statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 6 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

Based on the literature review, the researcher chose the variables that were most responsible for influencing academic achievement and entered all variables into the preliminary simultaneous regression model.

Table 13

*Preliminary Simultaneous Regression Grade 6 Mathematics: Dependent/Independent Variables*

<table>
<thead>
<tr>
<th>Simultaneous Regression Model</th>
<th>Dependent Variable</th>
<th>Independent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 6 (IV-7)</td>
<td>Total Proficient/Advanced Proficient (TPAP) NJ ASK Math 6</td>
<td>Grade 6 mathematical minutes per week</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total school enrollment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percentage of students suspended</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percentage of students chronically absent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percentage of limited-English proficient students</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percentage of students with a disability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percentage of economically disadvantaged students</td>
</tr>
</tbody>
</table>

In examining the data output of the original simultaneous regression output, the researcher identified a strong correlation \( r = .646 \) between the predictor variables, percentage limited English proficiency and percentage economically disadvantaged, denoting a potential multi-collinearity issue. Multicollinearity occurs when two or more predictors contain much of
the same information, in this case, percentage limited English proficiency and percentage economically disadvantaged. Limited English proficiency students are more prone to live with a low-income, less educated family and more likely to drop out of school than their English-speaking peers (Sheng, Sheng, & Anderson, 2011). As such, and pursuant to Leech, Barrett, and Morgan (2011), one can eliminate one of the highly correlated variables. Since the research consistently concludes that socioeconomic status (SES) is one of the strongest predictors of academic achievement, SES was retained for future models, while limited English proficiency was eliminated from future models, creating the primary model (Table 14) delineated below that guided this study. The simultaneous regression method also allowed the researcher to ascertain the statistical significance of each of the six variables entered and their influence, if any, on the dependent variable, total Proficient/Advanced Proficient NJ ASK Math 6.

Table 14

*Primary Simultaneous Regression for Grade 6 NJ ASK Mathematics*

<table>
<thead>
<tr>
<th>Variables Entered/Removed</th>
<th>Variables Entered/Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables Entered</td>
<td>Variables Removed</td>
<td>Method</td>
</tr>
<tr>
<td>gr6_minutes_per_week, total_enroll, percent_chronic_absent, percent_swd, percent_suspension, percent_ed</td>
<td>Enter</td>
<td></td>
</tr>
<tr>
<td>a. Dependent Variable: tpap_gd6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. All requested variables entered.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Descriptive Statistics for Research Question 1

The student variables analyzed in the simultaneous regression analysis included: percentage of students suspended, percentage of students chronically absent, percentage students with a disability and percentage of economically disadvantaged students. The school variables analyzed in the simultaneous regression analysis included: total school enrollment and Grade 6 mathematical minutes per week. The dependent variable was the total percentage of Proficient and Advanced Proficient Mathematics scores on the 2014 Grade 6 New Jersey Assessment of Skills and Knowledge.

Table 15

*Grade 6 Mathematics*

<table>
<thead>
<tr>
<th>Descriptive Statistics</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>tpap_gd6</td>
<td>82.1932</td>
<td>15.36581</td>
<td>207</td>
</tr>
<tr>
<td>total_enroll</td>
<td>543.7295</td>
<td>288.90346</td>
<td>207</td>
</tr>
<tr>
<td>percent_suspension</td>
<td>4.3609</td>
<td>4.63864</td>
<td>207</td>
</tr>
<tr>
<td>percent_chronic_absent</td>
<td>7.8435</td>
<td>8.16570</td>
<td>207</td>
</tr>
<tr>
<td>percent_ed</td>
<td>32.1386</td>
<td>28.95093</td>
<td>207</td>
</tr>
<tr>
<td>percent_swd</td>
<td>14.9865</td>
<td>4.42154</td>
<td>207</td>
</tr>
<tr>
<td>gr6_minutes_per_week</td>
<td>324.9082</td>
<td>91.11897</td>
<td>207</td>
</tr>
</tbody>
</table>

In analyzing the Model Summary (Table 16), the $R$ Square was .399, indicating that roughly 39.9% of the variance of the dependent variable, total Proficient/Advanced Proficient NJ ASK Math 6 scores could be predicted from the independent variables delineated in the model. Since the Durbin-Watson statistic (1.643) was between 1.0 and 4.0, the assumption has been met that the residuals do not correlate.
Table 16

*Simultaneous Regression Model Summary for Grade 6 NJ ASK Mathematics*

<table>
<thead>
<tr>
<th>Model Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), gr6_minutes_per_week, total_enroll, percent_chronic_absent, percent_swd, percent_suspension, percent_ed
b. Dependent Variable: tpap_gd6

The ANOVA (Table 17) indicates the combination of these variables in the model were statistically significant \(F(6, 200) = 22.141; p < .001\) and significantly predicts total Proficient/Advanced Proficient Math scores on the Grade 6 NJ ASK when all variables were entered in the model.

Table 17

*Simultaneous Regression ANOVA Table for Grade 6 NJ ASK Mathematics*

<table>
<thead>
<tr>
<th>ANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>Residual</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

a. Dependent Variable: tpap_gd6
b. Predictors: (Constant), gr6_minutes_per_week, total_enroll, percent_chronic_absent, percent_swd, percent_suspension, percent_ed

The coefficients table (Table 18) is one of the most significant tables, as it identifies the standardized beta coefficients. These values when squared give the researcher an indication of the effect size and the amount of unique variance specific to that variable, that is not explained by any other variable when predicting the dependent variable; in this case, TPAP Math scores on the Grade 6 NJ ASK. The coefficients table denotes which of the independent variables are
statistically significant and whether there is multicollinearity (variance inflation factor, or VIF) between the independent variables.

The model denotes that of the six independent variables entered, two were statistically significant. Multi-collinearity was not an issue in the model, as none of the variance inflation factor (VIF) statistics exceeded an absolute value of 10 (Field, 2013, p. 325). Percentage of economically disadvantaged students was the strongest predictor ($\beta = -.597, p < .001$), accounting for 35.64% of the variance in total Proficient/Advanced Proficient Math scores on the Grade 6 NJ ASK. The negative beta denotes that as the percentage of economically disadvantaged students increases within a school, the percentage of TPAP Math scores on the Grade 6 NJ ASK decreases. Percentage of students with a disability was also statistically significant ($\beta = -.150, p = .011$), accounting for 2.25% of the variance in TPAP Math scores on the Grade 6 NJ ASK. The negative beta denotes that as the percentage of students with a disability increases within a school, the percentage of TPAP Math scores on the Grade 6 NJ ASK decreases. The variable of interest in this study, mathematical-instructional minutes, was determined not to be statistically significant ($p = .637$) for Grade 6.

Table 18

*Simultaneous Regression Coefficients Table for Grade 6 Mathematics*

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
<th>Correlations</th>
<th>Collinearity Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
<td>Zero-order</td>
<td>Partial</td>
</tr>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>98.046</td>
<td>5.186</td>
<td>18.905</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>total_enroll</td>
<td>.004</td>
<td>.003</td>
<td>.083</td>
<td>1.479</td>
<td>.141</td>
</tr>
</tbody>
</table>
In an attempt to understand how prediction by certain variables improves on prediction by others, the researcher utilized hierarchical regression analysis (Leech et al., 2011). Variables determined statistically significant in the simultaneous regression, as well as variables deemed significant by the literature to influence academic achievement, were included with the variable of interest, mathematical-instructional minutes, and employed in the hierarchical regression analysis. For this particular study, the variable of interest, mathematical-instructional minutes, was entered singularly and served as the first model for the hierarchical regression analysis. The second model added the variables total school enrollment, percentage of students suspended, and percentage of students chronically absent. The third model added percentage of students with a disability and percentage of economically disadvantaged students.

Table 19

**Hierarchical Regression for Grade 6 Mathematics**

<table>
<thead>
<tr>
<th>Variables Entered/Removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

a. Dependent Variable: tpap_gd6
The Model Summary (Table 20) denotes that when Grade 6 mathematical-instructional minutes was entered alone, it significantly predicted total Proficient/Advanced Proficient Math scores on the Grade 6 NJ ASK, $F(1, 205) = 20.85, p < .001, R^2 = .092$. Model 2 added the variables of total school enrollment, percentage of students suspended, and percentage of students chronically absent. Model 2 also significantly predicted TPAP Math scores on the Grade 6 NJ ASK, $F(3, 202) = 7.98, p < .001, R^2 = .188$. Model 3 added the variables of percentage of students with a disability and percentage of economically disadvantaged students. Model 3 also significantly predicted TPAP Math scores on the Grade 6 NJ ASK, $F(2, 200) = 35.06, p < .001, R^2 = .399$. The Durbin-Watson statistic (1.643) was between 1.0 and 4.0; therefore, the assumption has been met that the residuals in the models do not correlate.

Model 1 displayed an $R$ square change of .092, denoting that 9.2% of the variance in TPAP Math scores on the Grade 6 NJ ASK can be predicted by the variable of interest, mathematical-instructional minutes. Model 2 demonstrated an $R$ square change of .096, indicating that an additional 9.6% of the variance in TPAP Math scores on the Grade 6 NJ ASK can be predicted by including the variables of total school enrollment, percentage of students suspended, and percentage of students chronically absent. Model 3 exhibited an $R$ square change of .211, indicating that an additional 21.1% of the variance in TPAP Math scores on the Grade 6
NJ ASK can be predicted by including the variables of percentage of students with a disability and percentage of economically disadvantaged students.

In analyzing the Model Summary, the best predictive model was Model 3, which contained all six independent variables. The $R^2$ for Model 3 was .399, denoting that 39.9% of the variance in total Proficient/Advanced Proficient Math scores on the Grade 6 NJ ASK can be predicted by including the variables of mathematical-instructional minutes (variable of interest), total school enrollment, percentage of students suspended, percentage of students chronically absent, percentage of students with a disability, and percentage of economically disadvantaged students.

Table 20

Hierarchical Regression Model Summary for Grade 6 Mathematics

<table>
<thead>
<tr>
<th>Model</th>
<th>$R$</th>
<th>$R^2$</th>
<th>Adjusted $R^2$</th>
<th>Std. Error of the Estimate</th>
<th>$R^2$ Change</th>
<th>$F$ Change</th>
<th>df1</th>
<th>df2</th>
<th>Sig. $F$ Change</th>
<th>Durbin-Watson</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.304*</td>
<td>.092</td>
<td>.088</td>
<td>14.67520</td>
<td>.092</td>
<td>20.845</td>
<td>1</td>
<td>205</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>.434*</td>
<td>.188</td>
<td>.172</td>
<td>13.97878</td>
<td>.096</td>
<td>7.978</td>
<td>3</td>
<td>202</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>.632*</td>
<td>.399</td>
<td>.381</td>
<td>12.08840</td>
<td>.211</td>
<td>35.058</td>
<td>2</td>
<td>200</td>
<td>.000</td>
<td>1.643</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), gr6_minutes_per_week
b. Predictors: (Constant), gr6_minutes_per_week, total_enroll, percent_chronic_absent, percent_suspension
c. Predictors: (Constant), gr6_minutes_per_week, total_enroll, percent_chronic_absent, percent_suspension, percent_swd, percent_ed
d. Dependent Variable: tpap_gd6

The ANOVA (Table 21) below indicates that all models utilized in the hierarchical regression analysis were statistically significant.
Table 21

Hierarchical Regression ANOVA Table for Grade 6 Mathematics

<table>
<thead>
<tr>
<th>Model</th>
<th>Regression Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4489.155</td>
<td>1</td>
<td>4489.155</td>
<td>20.845</td>
<td>.000&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Residual 44149.116</td>
<td>205</td>
<td>215.362</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total 48638.271</td>
<td>206</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>9166.208</td>
<td>4</td>
<td>2291.552</td>
<td>11.727</td>
<td>.000&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Residual 39472.063</td>
<td>202</td>
<td>195.406</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total 48638.271</td>
<td>206</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>19412.364</td>
<td>6</td>
<td>3235.394</td>
<td>22.141</td>
<td>.000&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Residual 29225.907</td>
<td>200</td>
<td>146.130</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total 48638.271</td>
<td>206</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:

a. Dependent Variable: tpap_gd6
b. Predictors: (Constant), gr6_minutes_per_week
c. Predictors: (Constant), gr6_minutes_per_week, total_enroll, percent_chronic_absent, percent_suspension
d. Predictors: (Constant), gr6_minutes_per_week, total_enroll, percent_chronic_absent, percent_suspension, percent_swd, percent_ed

If the researcher wants to make comparisons among predictors to determine how much each variable is contributing to the prediction of the dependent variable, it is vital to look at the standardized coefficients and beta weights (Table 22). Squaring the standardized beta coefficients allowed the researcher to determine the amount of variance of each of the statistically significant predictors. Scrutinizing each of the beta coefficients and statistical significance of each of the predictor variables enabled the researcher to get a better understanding of how the variables are measured and weighted to best predict the outcome variable (Leech et al., 2011).

As previously mentioned, when entered singularly in Model 1, the variable of interest, mathematical-instructional minutes was statistically significant, (β = -.304; p < .001), denoting that 9.2% of the variance in this model could be predicted by the variable of interest,
mathematical-instructional minutes. The negative beta denotes that as mathematical-instructional minutes increase, the percentage of total Proficient/Advanced Proficient Math scores on the Grade 6 NJ ASK decreases.

In Model 2, mathematical-instructional minutes was again statistically significant, (β = - .221; p < .001), denoting that 4.88% of the variance in this model could be predicted by the variable of interest, mathematical-instructional minutes. The negative beta denotes that as mathematical-instructional minutes increase, the percentage of TPAP Math scores on the Grade 6 NJ ASK decreases. Percentage of students suspended was also statistically significant (β = - .231; p < .001), denoting that 5.34% of the variance in this model can be predicted by the student suspension rate. The negative beta denotes that as the percentage of students suspended from school increases, the percentage of TPAP Math scores on the Grade 6 NJ ASK decreases. Percentage of students chronically absent was also statistically significant, (β = - .152; p < .05) denoting that 2.31% of the variance in this model can be predicted by the percentage of students chronically absent. The negative beta denotes that as the percentage of students chronically absent from school increases, the percentage of TPAP Math scores on the Grade 6 NJ ASK decreases.

Model 3 indicated that the additional variables of percentage of students with a disability and percentage of economically disadvantaged students were both statistically significant and significantly improved the prediction model. Percentage of students with a disability was statistically significant (β = - .150; p < .05), denoting that 2.25% of the variance in this model could be predicted by the percentage of students with a disability. The negative beta denotes that as the percentage of students with a disability increases, the percentage of TPAP Math scores on the Grade 6 NJ ASK decreases. The percentage of economically disadvantaged students was the
The strongest predictor in any of the models (β = -0.597; p < .001), denoting that 35.64% of the variance in this model could be predicted by the percentage of economically disadvantaged students. The negative beta denotes that as the percentage of economically disadvantaged students increases, the percentage of total Proficient/Advanced Proficient Math scores on the Grade 6 NJ ASK decreases. The variable of interest in this study, mathematical-instructional minutes was not statistically significant in Model 3.

Table 22

Hierarchical Regression Coefficients Table for Grade 6 Mathematics

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>Correlations</th>
<th>Collinearity Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td>t</td>
</tr>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>98.839</td>
<td>3.786</td>
<td>26.107</td>
</tr>
<tr>
<td></td>
<td>gr6_minutes_per_week</td>
<td>-.051</td>
<td>.011</td>
<td>-304</td>
</tr>
<tr>
<td>2</td>
<td>(Constant)</td>
<td>98.762</td>
<td>4.063</td>
<td>24.307</td>
</tr>
<tr>
<td></td>
<td>gr6_minutes_per_week</td>
<td>-.037</td>
<td>.011</td>
<td>-.221</td>
</tr>
<tr>
<td></td>
<td>total_enroll</td>
<td>.002</td>
<td>.003</td>
<td>.039</td>
</tr>
<tr>
<td></td>
<td>percent_suspension</td>
<td>-.766</td>
<td>.228</td>
<td>-.231</td>
</tr>
<tr>
<td></td>
<td>percent_chronic_absent</td>
<td>-.286</td>
<td>.129</td>
<td>-.152</td>
</tr>
<tr>
<td>3</td>
<td>(Constant)</td>
<td>98.046</td>
<td>5.186</td>
<td>18.905</td>
</tr>
<tr>
<td></td>
<td>gr6_minutes_per_week</td>
<td>.005</td>
<td>.011</td>
<td>.032</td>
</tr>
</tbody>
</table>
null_hypothesis_1

Predicated on the simultaneous and hierarchical regression analyses performed, we fail to reject the null hypothesis. There was no statistically significant relationship between mathematical-instructional minutes and the 2014 Grade 6 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

research_question_2: statistical_analysis_and_results

Research Question 2: What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grade 7 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?

Null Hypothesis 2: No statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 7 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

The researcher entered the variables that were most responsible for influencing academic achievement in the simultaneous regression model (Table 23) delineated below. The researcher
also utilized the simultaneous regression method to ascertain statistical significance of each of the six variables entered and their influence, if any, on the dependent variable, total Proficient/Advanced Proficient NJ ASK Math 7.

Table 23

*Simultaneous Regression for Grade 7 NJ ASK Mathematics*

<table>
<thead>
<tr>
<th>Variables Entered/Removed*</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>gd7_minutes_per_week, total_enroll, percent_swd, percent_chronic_absent, percent_suspension, percent_ed</td>
<td>Enter</td>
<td></td>
</tr>
</tbody>
</table>

a. Dependent Variable: tpap_gd7
b. All requested variables entered.

**Descriptive Statistics for Research Question 2**

The student variables analyzed in the simultaneous regression analysis included percentage of students suspended, percentage of students chronically absent, percentage students with a disability, and percentage of economically disadvantaged students. The school variables analyzed in the simultaneous regression analysis included total school enrollment and Grade 7 mathematical minutes per week. The dependent variable was the percentage of Proficient and Advanced Proficient Mathematics scores on the 2014 Grade 7 New Jersey Assessment of Skills and Knowledge.
Table 24

*Grade 7 Mathematics*

<table>
<thead>
<tr>
<th>Descriptive Statistics</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>tpap_gd7</td>
<td>71.1386</td>
<td>17.25030</td>
<td>202</td>
</tr>
<tr>
<td>total_enroll</td>
<td>579.6139</td>
<td>284.59572</td>
<td>202</td>
</tr>
<tr>
<td>percent_suspension</td>
<td>4.9960</td>
<td>4.80321</td>
<td>202</td>
</tr>
<tr>
<td>percent_chronic_absent</td>
<td>7.8822</td>
<td>8.42198</td>
<td>202</td>
</tr>
<tr>
<td>percent_ed</td>
<td>30.6713</td>
<td>28.13944</td>
<td>202</td>
</tr>
<tr>
<td>percent_swd</td>
<td>15.2030</td>
<td>4.45611</td>
<td>202</td>
</tr>
<tr>
<td>gd7_minutes_per_week</td>
<td>315.4158</td>
<td>97.09551</td>
<td>202</td>
</tr>
</tbody>
</table>

In examining the Model Summary (Table 25), the $R^2$ was .675, indicating that approximately 67.50% of the variance of the dependent variable, total Proficient/Advanced Proficient NJ ASK Math 7 scores could be predicted from the independent variables delineated in the model. Since the Durbin-Watson statistic (1.543) was between 1.0 and 4.0, the assumption has been met that the residuals do not correlate.

Table 25

*Simultaneous Regression Model Summary for Grade 7 NJ ASK Mathematics*

<table>
<thead>
<tr>
<th>Model Summaryb</th>
<th>Model</th>
<th>$R$</th>
<th>$R$ Square</th>
<th>Adjusted $R$ Square</th>
<th>Std. Error of the Estimate</th>
<th>Durbin-Watson</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>.822a</td>
<td>.675</td>
<td>.665</td>
<td>9.97783</td>
<td>1.543</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), gd7_minutes_per_week, total_enroll, percent_swd, percent_chronic_absent, percent_suspension, percent_ed
b. Dependent Variable: tpap_gd7

The ANOVA (Table 26) indicates the combination of these variables in the model were statistically significant $F (6, 195) = 67.630; p < .001$ and significantly predicts TPAP Math scores on the Grade 7 NJ ASK when all variables were entered in the model.
Table 26

**Simultaneous Regression ANOVA Table for Grade 7 NJ ASK Mathematics**

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>40398.503</td>
<td>6</td>
<td>6733.084</td>
<td>67.630</td>
<td>.000*</td>
</tr>
<tr>
<td>Residual</td>
<td>19413.616</td>
<td>195</td>
<td>99.557</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>59812.119</td>
<td>201</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Dependent Variable: tpap_gd7
b. Predictors: (Constant), gd7_minutes_per_week, total_enroll, percent_swd, percent_chronic_absent, percent_suspension, percent_ed

The coefficients table (Table 27) identifies the standardized beta coefficients. These values, when squared, give the researcher an indication of the effect size and the amount of unique variance specific to that variable that is not explained by any other variable when predicting the dependent variable; in this case, total Proficient/Advanced Proficient Math scores on the Grade 7 NJ ASK. The coefficients table denotes which of the independent variables are statistically significant and whether there is multicollinearity (VIF) between the independent variables.

The model denotes that of the six independent variables entered, two were statistically significant. Multicollinearity was not an issue in the model, as none of the variance inflation factor (VIF) statistics exceeded an absolute value of 10 (Field, 2013, p. 325). Percentage of economically disadvantaged students was the strongest predictor \( (\beta = -.805, p < .001) \), accounting for 64.80% of the variance in TPAP Math scores on the Grade 7 NJ ASK. The negative beta denotes that as the percentage of economically disadvantaged students increases within a school, the percentage of TPAP Math scores on the Grade 7 NJ ASK decreases.

Percentage of students with a disability was also statistically significant \( (\beta = -.103, p < .05) \), accounting for 1.06% of the variance in TPAP Math scores on the Grade 7 NJ ASK. The
negative beta denotes that as the percentage of students with a disability increases within a school, the percentage of TPAP Math scores on the Grade 7 NJ ASK decreases. The variable of interest in this study, mathematical-instructional minutes, was determined not to be statistically significant ($p = .213$) for Grade 7.

Table 27

*Simultaneous Regression Coefficients Table for Grade 7 Mathematics*

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>Correlations</th>
<th>Collinearity Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td>t</td>
</tr>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>88.681</td>
<td>4.217</td>
<td>21.027</td>
</tr>
<tr>
<td></td>
<td>total_enroll</td>
<td>.004</td>
<td>.003</td>
<td>.073</td>
</tr>
<tr>
<td></td>
<td>percent_suspension</td>
<td>-.219</td>
<td>.178</td>
<td>-.061</td>
</tr>
<tr>
<td></td>
<td>percent_chronic_absent</td>
<td>-.170</td>
<td>.094</td>
<td>-.083</td>
</tr>
<tr>
<td></td>
<td>percent_ed</td>
<td>-.494</td>
<td>.034</td>
<td><strong>-0.805</strong></td>
</tr>
<tr>
<td></td>
<td>percent_swd</td>
<td>-.400</td>
<td>.171</td>
<td><strong>-1.03</strong></td>
</tr>
<tr>
<td></td>
<td>gr7_minutes_per_week</td>
<td>.011</td>
<td>.009</td>
<td>.064</td>
</tr>
</tbody>
</table>

a. Dependent Variable: tpap_gd7

In an attempt to understand how prediction by certain variables improves on prediction by others, the researcher utilized hierarchical regression analysis (Leech et al., 2011). Variables determined statistically significant in the simultaneous regression, as well as variables deemed significant by the literature to influence academic achievement, were included with the variable
of interest, mathematical-instructional minutes, and employed in the hierarchical regression analysis. For this particular study, the variable of interest, mathematical-instructional minutes, was entered singularly and served as the first model for the hierarchical regression analysis. The second model added the variables total school enrollment, percentage of students suspended, and percentage of students chronically absent. The third model added percentage of students with a disability and percentage of economically disadvantaged students.

Table 28

Hierarchical Regression for Grade 7 Mathematics

<table>
<thead>
<tr>
<th>Variables Entered/Removed</th>
<th>Model</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>gr7_minutes_per_week&lt;sup&gt;b&lt;/sup&gt;</td>
<td>. Enter</td>
<td>Enter</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>total_enroll, percent_chronic_absent, percent_suspension&lt;sup&gt;b&lt;/sup&gt;</td>
<td>. Enter</td>
<td>Enter</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>percent_swd, percent_ed&lt;sup&gt;b&lt;/sup&gt;</td>
<td>. Enter</td>
<td>Enter</td>
</tr>
</tbody>
</table>

a. Dependent Variable: tpap_gd7
b. All requested variables entered.

The Model Summary (Table 29) denotes that when Grade 7 mathematical-instructional minutes was entered alone, it significantly predicted total Proficient/Advanced Proficient Math scores on the Grade 7 NJ ASK, \( F(1, 200) = 46.19, p < .001, R^2 = .188. \) Model 2 added the variables total school enrollment, percentage of students suspended, and percentage of students chronically absent. Model 2 also significantly predicted TPAP Math scores on the Grade 7 NJ ASK, \( F(3, 197) = 13.50, p < .001, R^2 = .326. \) Model 3 added the variables percentage of students with a disability and percentage of economically disadvantaged students. Model 3 also
significantly predicted TPAP Math scores on the Grade 7 NJ ASK, $F (2, 195) = 104.92, p < .001, R^2 = .675$. The Durbin-Watson statistic (1.543) was between 1.0 and 4.0; therefore, the assumption has been met that the residuals in the models do not correlate.

Model 1 displayed an $R$ square change of .188, denoting that 18.8% of the variance in total Proficient/Advanced Proficient Math scores on the Grade 7 NJ ASK can be predicted by the variable of interest, mathematical-instructional minutes. Model 2 demonstrated an $R$ square change of .139, indicating that an additional 13.9% of the variance in TPAP Math scores on the Grade 7 NJ ASK can be predicted by including the variables total school enrollment, percentage of students suspended, and percentage of students chronically absent. Model 3 exhibited an $R$ square change of .349, indicating that an additional 34.9%, more than double the variance in TPAP Math scores on the Grade 7 NJ ASK can be predicted by including the variables percentage of students with a disability and percentage of economically disadvantaged students.

In analyzing the Model Summary, the best predictive model was Model 3, which contained all six independent variables. The $R$ square for Model 3 was .675, denoting that 67.5% of the variance in TPAP Math scores on the Grade 7 NJ ASK can be predicted by including the variables mathematical-instructional minutes (variable of interest), total school enrollment, percentage of students suspended, percentage of students chronically absent, percentage of students with a disability, and percentage of economically disadvantaged students.
Table 29

**Hierarchical Regression Model Summary for Grade 7 Mathematics**

<table>
<thead>
<tr>
<th>Model</th>
<th>$R$</th>
<th>$R$ Square</th>
<th>Adjusted $R$ Square</th>
<th>Std. Error of the Estimate</th>
<th>$R$ Square Change</th>
<th>$F$ Change</th>
<th>$df1$</th>
<th>$df2$</th>
<th>Sig. $F$ Change</th>
<th>Durbin-Watson</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.433$^a$</td>
<td>.188</td>
<td>.184</td>
<td>15.58691</td>
<td>.188</td>
<td>46.189</td>
<td>1</td>
<td>200</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>.571$^b$</td>
<td>.326</td>
<td>.312</td>
<td>14.30356</td>
<td>.139</td>
<td>13.500</td>
<td>3</td>
<td>197</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>.822$^c$</td>
<td>.675</td>
<td>.665</td>
<td>9.97783</td>
<td>.349</td>
<td>104.920</td>
<td>2</td>
<td>195</td>
<td>.000</td>
<td>1.543</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), gr7_minutes_per_week

b. Predictors: (Constant), gr7_minutes_per_week, total_enroll, percent_chronic_absent, percent_suspension

c. Predictors: (Constant), gr7_minutes_per_week, total_enroll, percent_chronic_absent, percent_suspension, percent_swd, percent_ed

d. Dependent Variable: tpap_gd7

The ANOVA (Table 30) below indicates that all models utilized in the hierarchical regression analysis were statistically significant.

Table 30

**Hierarchical Regression ANOVA Table for Grade 7 Mathematics**

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>$df$</th>
<th>Mean Square</th>
<th>$F$</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression</td>
<td>11221.775</td>
<td>1</td>
<td>11221.775</td>
<td>46.189</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>48590.344</td>
<td>200</td>
<td>242.952</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>59812.119</td>
<td>201</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Regression</td>
<td>19507.533</td>
<td>4</td>
<td>4876.883</td>
<td>23.837</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>40304.586</td>
<td>197</td>
<td>204.592</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>59812.119</td>
<td>201</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Regression</td>
<td>40398.503</td>
<td>6</td>
<td>6733.084</td>
<td>67.630</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>19413.616</td>
<td>195</td>
<td>99.557</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>59812.119</td>
<td>201</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Dependent Variable: tpap_gd7

b. Predictors: (Constant), gr7_minutes_per_week
c. Predictors: (Constant), gr7_minutes_per_week, total_enroll, percent_chronic_absent, percent_suspension

d. Predictors: (Constant), gr7_minutes_per_week, total_enroll, percent_chronic_absent, percent_suspension, percent_swrd, percent_ed

If the researcher wants to make comparisons among predictors to determine how much each variable is contributing to the prediction of the dependent variable, it is vital to look at the standardized coefficients and beta weights (Table 31). Squaring the standardized beta coefficients allowed the researcher to determine the amount of variance of each of the statistically significant predictors. Examining each of the beta coefficients and statistical significance of each of the predictor variables enabled the researcher to get a better understanding of how the variables are measured and weighted to best predict the outcome variable (Leech et al., 2011).

When entered singularly in Model 1, the variable of interest, mathematical-instructional minutes, was statistically significant ($\beta = -0.433; p < .001$), denoting that 18.75% of the variance in this model could be predicted by the variable of interest, mathematical-instructional minutes. The negative beta denotes that as mathematical-instructional minutes increase, the percentage of total Proficient/Advanced Proficient Math scores on the Grade 7 NJ ASK decreases.

In Model 2, mathematical-instructional minutes was again statistically significant, ($\beta = -0.337; p < .001$), denoting that 11.36% of the variance in this model could be predicted by the variable of interest, mathematical-instructional minutes. The negative beta denotes that as mathematical-instructional minutes increase, the percentage of TPAP Math scores on the Grade 7 NJ ASK decreases. Percentage of students suspended was also statistically significant ($\beta = -0.309; p < .001$), denoting that 9.55% of the variance in this model can be predicted by the student suspension rate. The negative beta denotes that as the percentage of students suspended from school increases, the percentage of TPAP Math scores on the Grade 7 NJ ASK decreases.
Percentage of students chronically absent was also statistically significant, ($\beta = -0.133; p < .05$), denoting that 1.77% of the variance in this model can be predicted by the percentage of students chronically absent. The negative beta denotes that as the percentage of students chronically absent from school increases, the percentage of TPAP Math scores on the Grade 7 NJ ASK decreases.

Model 3 indicated that the additional variables percentage of students with a disability and percentage of economically disadvantaged students were both statistically significant and significantly improved the prediction model. Percentage of students with a disability was statistically significant ($\beta = -0.103; p < .05$), denoting that 1.06% of the variance in this model could be predicted by the percentage of students with a disability. The negative beta denotes that as the percentage of students with a disability increases, the percentage of total Proficient/Advanced Proficient Math scores on the Grade 7 NJ ASK decreases. The percentage of economically disadvantaged students was the strongest predictor in any of the models ($\beta = -0.805; p < .001$), denoting that 64.80% of the variance in this model could be predicted by the percentage of economically disadvantaged students. The negative beta denotes that as the percentage of economically disadvantaged students increases, the percentage of TPAP Math scores on the Grade 7 NJ ASK decreases. The variable of interest in this study, mathematical-instructional minutes, was again not statistically significant in Model 3.
### Table 31

**Hierarchical Regression Coefficients Table for Grade 7 Mathematics**

<table>
<thead>
<tr>
<th>Model</th>
<th>Coefficients</th>
<th>Correlations</th>
<th>Collinearity Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unstandardized Coefficients</td>
<td>Standardized Coefficients</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
</tr>
<tr>
<td>1 (Constant)</td>
<td>95.411</td>
<td>3.736</td>
<td>25.538</td>
</tr>
<tr>
<td>gr7_minutes_per_week</td>
<td>-.077</td>
<td>.011</td>
<td>- .433</td>
</tr>
<tr>
<td>2 (Constant)</td>
<td>96.444</td>
<td>4.138</td>
<td>23.308</td>
</tr>
<tr>
<td>gr7_minutes_per_week</td>
<td>-.060</td>
<td>.011</td>
<td>- .337</td>
</tr>
<tr>
<td>total_enroll</td>
<td>.002</td>
<td>.004</td>
<td>.036</td>
</tr>
<tr>
<td>percent_suspension</td>
<td>-1.109</td>
<td>.234</td>
<td>- .309</td>
</tr>
<tr>
<td>percent_chronic_absent</td>
<td>-.272</td>
<td>.133</td>
<td>- .133</td>
</tr>
<tr>
<td>3 (Constant)</td>
<td>88.681</td>
<td>4.217</td>
<td>21.027</td>
</tr>
<tr>
<td>gr7_minutes_per_week</td>
<td>.011</td>
<td>.009</td>
<td>.064</td>
</tr>
<tr>
<td>total_enroll</td>
<td>.004</td>
<td>.003</td>
<td>.073</td>
</tr>
<tr>
<td>percent_suspension</td>
<td>-.219</td>
<td>.178</td>
<td>-.061</td>
</tr>
<tr>
<td>percent_chronic_absent</td>
<td>-.170</td>
<td>.094</td>
<td>-.083</td>
</tr>
<tr>
<td>percent_ed</td>
<td>-.494</td>
<td>.034</td>
<td>- .805</td>
</tr>
</tbody>
</table>
Null Hypothesis 2

Based on the simultaneous and hierarchical regression analyses performed, we retain the null hypothesis. There was no statistically significant relationship between mathematical-instructional minutes and the 2014 Grade 7 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

Research Question 3: Statistical Analysis and Results

Research Question 3: What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grade 8 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?

Null Hypothesis 3: No statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 8 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

The researcher entered the variables that were most responsible for influencing academic achievement in the simultaneous regression model (Table 32) delineated below. The researcher also utilized the simultaneous regression method to ascertain statistical significance of each of the seven variables entered and their influence, if any, on the dependent variable, total Proficient/Advanced Proficient NJ ASK Math 8.
Table 32

Simultaneous Regression for Grade 8 NJ ASK Mathematics

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>gd8_minutes_per_week, total_enroll, percent_swd, percent_chronic_absent, percent_gd8_algebra, percent_suspension, percent_ed</td>
<td>.</td>
<td>Enter</td>
</tr>
</tbody>
</table>

a. Dependent Variable: tpap_gd8
b. All requested variables entered.

Descriptive Statistics for Research Question 3

The student variables analyzed in the simultaneous regression analysis included percentage of students suspended, percentage of students chronically absent, percentage of students with a disability, and percentage of economically disadvantaged students. The school variables analyzed in the simultaneous regression analysis included total school enrollment, percentage of Grade 8 students taking algebra, and Grade 8 mathematical minutes per week. The dependent variable was the percentage of Proficient and Advanced Proficient Mathematics scores on the 2014 Grade 8 New Jersey Assessment of Skills and Knowledge.
Table 33

Grade 8 Mathematics

<table>
<thead>
<tr>
<th>Descriptive Statistics</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>tpap_gd8</td>
<td>76.1386</td>
<td>16.89890</td>
<td>202</td>
</tr>
<tr>
<td>total_enroll</td>
<td>574.0990</td>
<td>284.54546</td>
<td>202</td>
</tr>
<tr>
<td>percent_suspension</td>
<td>5.1193</td>
<td>5.08395</td>
<td>202</td>
</tr>
<tr>
<td>percent_chronic_absent</td>
<td>7.9030</td>
<td>8.43488</td>
<td>202</td>
</tr>
<tr>
<td>percent_gd8_algebra</td>
<td>40.9748</td>
<td>29.24553</td>
<td>202</td>
</tr>
<tr>
<td>percent_ed</td>
<td>29.9262</td>
<td>27.40285</td>
<td>202</td>
</tr>
<tr>
<td>percent_swd</td>
<td>15.2629</td>
<td>4.47033</td>
<td>202</td>
</tr>
<tr>
<td>gd8_minutes_per_week</td>
<td>314.0297</td>
<td>94.19282</td>
<td>202</td>
</tr>
</tbody>
</table>

In examining the Model Summary (Table 34), the $R^2$ Square was .620, indicating that approximately 62.00% of the variance of the dependent variable, TPAP NJ ASK Math 8 scores, could be predicted from the independent variables delineated in the model. Since the Durbin-Watson statistic (1.978) was between 1.0 and 4.0, the assumption has been met that the residuals do not correlate.

Table 34

Simultaneous Regression Model Summary for Grade 8 NJ ASK Mathematics

<table>
<thead>
<tr>
<th>Model</th>
<th>$R$</th>
<th>$R^2$</th>
<th>Adjusted $R^2$</th>
<th>Std. Error of the Estimate</th>
<th>Durbin-Watson</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.787a</td>
<td>.620</td>
<td>.606</td>
<td>10.60572</td>
<td>1.978</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), gd8_minutes_per_week, total_enroll, percent_swd, percent_chronic_absent, percent_gd8_algebra, percent_suspension, percent_ed
b. Dependent Variable: tpap_gd8

The ANOVA (Table 35) indicates the combination of these variables in the model was statistically significant, $F (7, 194) = 45.187; p < .001$, and significantly predicts total
Proficient/Advanced Proficient Math scores on the Grade 8 NJ ASK when all variables were entered in the model.

Table 35

*Simultaneous Regression ANOVA Table for Grade 8 NJ ASK Mathematics*

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression</td>
<td>35578.757</td>
<td>7</td>
<td>5082.680</td>
<td>45.187</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>21821.362</td>
<td>194</td>
<td>112.481</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>57400.119</td>
<td>201</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Dependent Variable: tpap_gd8
b. Predictors: (Constant), gd8_minutes_per_week, total_enroll, percent_swd, percent_chronic_absent, percent_gd8_algebra, percent_suspension, percent_ed

The coefficients table (Table 36) identifies the standardized beta coefficients. These values when squared give the researcher an indication of the effect size and the amount of unique variance specific to that variable that is not explained by any other variable when predicting the dependent variable; in this case, TPAP Math scores on the Grade 8 NJ ASK. The coefficients table denotes which of the independent variables are statistically significant and whether there is multicollinearity (VIF) between the independent variables.

The model denotes that of the seven independent variables entered, three were statistically significant. Multicollinearity was not an issue in the model, as none of the variance inflation factor (VIF) statistics exceeded an absolute value of 10 (Field, 2013, p. 325). Percentage of economically disadvantaged students was the strongest predictor ($\beta = -.755, p < .001$), accounting for 57.00% of the variance in total Proficient/Advanced Proficient Math scores on the Grade 8 NJ ASK. The negative beta denotes that as the percentage of economically disadvantaged students increases within a school, the percentage of TPAP Math scores on the Grade 8 NJ ASK decreases.
Percentage of students taking Grade 8 algebra was also statistically significant (β = .106, $p = < .05$), accounting for 1.12% of the variance in TPAP Math scores on the Grade 8 NJ ASK. The positive beta suggests that as the percentage of students taking Grade 8 algebra increases within a school, the percentage of TPAP Math scores on the Grade 8 NJ ASK also increases.

The variable of interest in this study, mathematical-instructional minutes, was also determined to be statistically significant (β = .108, $p = < .05$) for Grade 8, accounting for 1.17% of the variance in TPAP Math scores on the Grade 8 NJ ASK. The positive beta suggests that as the percentage of students taking Grade 8 algebra increases within a school, the percentage of TPAP Math scores on the Grade 8 NJ ASK also increases.

Table 36

*Simultaneous Regression Coefficients Table for Grade 8 Mathematics*

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>Sig.</th>
<th>Zero-order</th>
<th>Partial</th>
<th>Part</th>
<th>Tolerance</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>88.354</td>
<td>4.878</td>
<td></td>
<td>18.112</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total_enroll</td>
<td>.000</td>
<td>.003</td>
<td>.004</td>
<td>.093</td>
<td>.926</td>
<td>-.024</td>
<td>.007</td>
<td>.004</td>
<td>.956</td>
<td>1.046</td>
</tr>
<tr>
<td>percent_suspension</td>
<td>-.107</td>
<td>.181</td>
<td>-.032</td>
<td>-.591</td>
<td>.555</td>
<td>-.427</td>
<td>-.042</td>
<td>-.026</td>
<td>.661</td>
<td>1.512</td>
</tr>
<tr>
<td>percent_chronic_absent</td>
<td>-.157</td>
<td>.099</td>
<td>-.078</td>
<td>-1.581</td>
<td>.115</td>
<td>-.316</td>
<td>-.113</td>
<td>-.070</td>
<td>.797</td>
<td>1.255</td>
</tr>
<tr>
<td>percent_gd8_algebra</td>
<td>.061</td>
<td>.029</td>
<td>.106</td>
<td>2.100</td>
<td>.037</td>
<td>.424</td>
<td>.149</td>
<td>.093</td>
<td>.763</td>
<td>1.310</td>
</tr>
<tr>
<td>percent_ed</td>
<td>-.466</td>
<td>.039</td>
<td>-.755</td>
<td>-11.965</td>
<td>.000</td>
<td>-.758</td>
<td>-.652</td>
<td>-.530</td>
<td>.492</td>
<td>2.033</td>
</tr>
<tr>
<td>percent_swd</td>
<td>-.343</td>
<td>.184</td>
<td>-.091</td>
<td>-1.865</td>
<td>.064</td>
<td>-.036</td>
<td>-.133</td>
<td>-.083</td>
<td>.829</td>
<td>1.207</td>
</tr>
<tr>
<td>gd8_minutes_per_week</td>
<td>.019</td>
<td>.010</td>
<td>.108</td>
<td>1.981</td>
<td>.049</td>
<td>-.365</td>
<td>.141</td>
<td>.088</td>
<td>.660</td>
<td>1.515</td>
</tr>
</tbody>
</table>

a. Dependent Variable: tpap_gd8
The researcher again utilized hierarchical regression analysis to understand how prediction by certain variables improves on prediction by others. Variables determined statistically significant in the simultaneous regression, as well as variables deemed significant by the literature to influence academic achievement, were included with the variable of interest, mathematical-instructional minutes, and employed in the hierarchical regression analysis. For this particular study, the variable of interest, mathematical-instructional minutes, was entered singularly and served as the first model for the hierarchical regression analysis. The second model added the variables total school enrollment, percentage of students suspended, percentage of students chronically absent, and percentage of students taking Grade 8 algebra. The third model added percentage of students with a disability and percentage of economically disadvantaged students.

Table 37

*Hierarchical Regression for Grade 8 Mathematics*

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>gd8_minutes_per_week&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.</td>
<td>Enter</td>
</tr>
<tr>
<td>2</td>
<td>total_enroll, percent_chronic_absent, percent_gd8_algebra, percent_suspension&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.</td>
<td>Enter</td>
</tr>
<tr>
<td>3</td>
<td>percent_swd, percent_ed&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.</td>
<td>Enter</td>
</tr>
</tbody>
</table>

a. Dependent Variable: tpap_gd8
b. All requested variables entered.
The Model Summary (Table 38) denotes that when Grade 8 mathematical-instructional minutes was entered alone, it significantly predicted total Proficient/Advanced Proficient Math scores on the Grade 8 NJ ASK, $F (1, 200) = 30.77, p < .001, R^2 = .133$. Model 2 added the variables total school enrollment, percentage of students suspended, percentage of students chronically absent, and percentage of students taking Grade 8 algebra. Model 2 also significantly predicted TPAP Math scores on the Grade 8 NJ ASK, $F (4, 196) = 14.94, p < .001, R^2 = .336$. Model 3 added the variables percentage of students with a disability and percentage of economically disadvantaged students. Model 3 also significantly predicted TPAP Math scores on the Grade 8 NJ ASK, $F (2, 194) = 72.47, p < .001, R^2 = .620$. The Durbin-Watson statistic (1.978) was between 1.0 and 4.0; therefore, the assumption has been met that the residuals in the models do not correlate.

Model 1 displayed an $R$ square change of .133, indicating that 13.3% of the variance in TPAP Math scores on the Grade 8 NJ ASK can be predicted by the variable of interest, mathematical-instructional minutes. Model 2 demonstrated an $R$ square change of .202, indicating that an additional 20.2% of the variance in TPAP Math scores on the Grade 8 NJ ASK can be predicted by including the variables total school enrollment, percentage of students suspended, percentage of students chronically absent, and percentage of students taking Grade 8 algebra. Model 3 exhibited an $R$ square change of .284, indicating that an additional 28.4% of the variance in total Proficient/Advanced Proficient Math scores on the Grade 8 NJ ASK can be predicted by including the variables percentage of students with a disability and percentage of economically disadvantaged students.

In analyzing the Model Summary, the best predictive model was Model 3, which contained all seven independent variables. The $R$ square for Model 3 was .620, denoting that
62.0% of the variance in TPAP Math scores on the Grade 8 NJ ASK can be predicted by including the variables mathematical-instructional minutes (variable of interest), total school enrollment, percentage of students suspended, percentage of students chronically absent, percentage of students taking Grade 8 algebra, percentage of students with a disability, and percentage of economically disadvantaged students.

Table 38

Hierarchical Regression Model Summary for Grade 8 Mathematics

<table>
<thead>
<tr>
<th>Model</th>
<th>$R$</th>
<th>$R^2$</th>
<th>Adjusted $R^2$</th>
<th>Std. Error of Estimate</th>
<th>$R^2$ Change</th>
<th>$F$ Change</th>
<th>$df1$</th>
<th>$df2$</th>
<th>Sig. $F$ Change</th>
<th>Durbin-Watson</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.365&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.133</td>
<td>.129</td>
<td>15.77129</td>
<td>.133</td>
<td>30.769</td>
<td>1</td>
<td>200</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>.579&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.336</td>
<td>.319</td>
<td>13.94686</td>
<td>.202</td>
<td>14.937</td>
<td>4</td>
<td>196</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>.787&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.620</td>
<td>.606</td>
<td>10.60572</td>
<td>.284</td>
<td>72.472</td>
<td>2</td>
<td>194</td>
<td>.000</td>
<td>1.978</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), gd8_minutes_per_week
b. Predictors: (Constant), gd8_minutes_per_week, total_enroll, percent_chronic_absent, percent_gd8_algebra, percent_suspension
c. Predictors: (Constant), gd8_minutes_per_week, total_enroll, percent_chronic_absent, percent_gd8_algebra, percent_suspension, percent_swd, percent_ed
d. Dependent Variable: tpap_gd8

The ANOVA (Table 39) below indicates that all models utilized in the hierarchical regression analysis were statistically significant.

Table 39

Hierarchical Regression ANOVA Table for Grade 8 Mathematics

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>$df$</th>
<th>Mean Square</th>
<th>$F$</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>7653.384</td>
<td>1</td>
<td>7653.384</td>
<td>30.769</td>
<td>.000&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Residual</td>
<td>49746.734</td>
<td>200</td>
<td>248.734</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>57400.119</td>
<td>201</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
If the researcher wants to make comparisons among predictors to determine how much each variable is contributing to the prediction of the dependent variable, it is vital to look at the standardized coefficients and beta weights (Table 40). Squaring the standardized beta coefficients allowed the researcher to determine the amount of variance of each of the statistically significant predictors. Examining each of the beta coefficients and statistical significance of each of the predictor variables enabled the researcher to get a better understanding of how the variables are measured and weighted to best predict the outcome variable (Leech et al., 2011).

When entered singularly in Model 1, the variable of interest, mathematical-instructional minutes, was statistically significant (β = -.365; p < .001), denoting that 13.32% of the variance in this model could be predicted by the variable of interest, mathematical-instructional minutes. The negative beta denotes that as mathematical-instructional minutes increase, the percentage of total Proficient/Advanced Proficient Math scores on the Grade 8 NJ ASK decreases.

In Model 2, mathematical-instructional minutes was again statistically significant (β = -.227; p < .001), denoting that 5.15% of the variance in this model could be predicted by the
variable of interest, mathematical-instructional minutes. The negative beta denotes that as mathematical-instructional minutes increase, the percentage of TPAP Math scores on the Grade 8 NJ ASK decreases. Percentage of students suspended was also statistically significant ($\beta = -0.246; p < .001$), denoting that 6.05% of the variance in this model can be predicted by the student suspension rate. The negative beta denotes that as the percentage of students suspended from school increases, the percentage of TPAP Math scores on the Grade 8 NJ ASK decreases.

Percentage of students taking Grade 8 algebra was also statistically significant ($\beta = .269; p < .001$), denoting that 7.24% of the variance in this model can be predicted by the percentage of students taking Grade 8 algebra. The positive beta suggests that as the percentage of students taking Grade 8 algebra increases, the percentage of TPAP Math scores on the Grade 8 NJ ASK also increases.

Model 3 introduced the variables of percentage of students with a disability and percentage of economically disadvantaged students. Percentage of students with a disability was not statistically significant in this model. Percentage of economically disadvantaged students was, yet again, the strongest predictor in any of the models ($\beta = -0.755; p < .001$), denoting that 57.00% of the variance in this model could be predicted by the percentage of economically disadvantaged students. The negative beta denotes that as the percentage of economically disadvantaged students increases, the percentage of total Proficient/Advanced Proficient Math scores on the Grade 8 NJ ASK decreases. Percentage of students taking Grade 8 algebra was also statistically significant ($\beta = .106; p < .05$), denoting that 1.12% of the variance in this model can be predicted by the percentage of students taking Grade 8 algebra. The positive beta suggests that as the percentage of students taking Grade 8 algebra increases, the percentage of TPAP Math scores on the Grade 8 NJ ASK also increases. The variable of interest in this study,
mathematical-instructional minutes, was also statistically significant: however, for this model, the standardized beta coefficient is positive (β = .108; \(p < .05\)), indicating that 1.17% of the variance in this model could be predicted by the variable of interest, mathematical-instructional minutes. The positive beta suggests that as mathematical-instructional minutes increase, the percentage of TPAP Math scores on the Grade 8 NJ ASK also increases.

Table 40

*Hierarchical Regression Coefficients Table for Grade 8 Mathematics*

| Model  | Coefficients\(^a\) |  |  |  |
|--------|---------------------|-----------------|-----------------|-----------------|-----------------|
|        | Unstandardized Coefficients | Standardized Coefficients | Correlations | Collinearity Statistics |
|        | B        | Std. Error | Beta | t   | Sig.  | Zero-order | Partial | Part | Tolerance | VIF |
| 1      | (Constant) | 96.711 | 3.871 | 24.982 | .000 |  |
|        | gd8_minutes_per_week | -.066 | .012 | -365 | .000 | -.365 | -.365 | -.365 | 1.000 | 1.000 |
| 2      | (Constant) | 90.339 | 4.650 | 19.426 | .000 |  |
|        | gd8_minutes_per_week | -.041 | .011 | -227 | .000 | -.365 | -.256 | -.216 | .906 | 1.104 |
|        | total_enroll | -.003 | .003 | -.058 | -.989 | .324 | -.024 | -.070 | -.058 | .982 | 1.018 |
|        | percent_suspension | -.816 | .220 | -246 | -3.702 | .000 | -.427 | -.256 | -.216 | .770 | 1.298 |
|        | percent_chronic_absent | -.206 | .130 | -103 | -1.585 | .115 | -.316 | -.112 | -.092 | .804 | 1.244 |
|        | percent_gd_8_algebra | .156 | .037 | 269 | 4.253 | .000 | .424 | .291 | .248 | .847 | 1.181 |
| 3      | (Constant) | 88.354 | 4.878 | 18.112 | .000 |  |
Null Hypothesis 3

Based on the simultaneous and hierarchical regression analyses performed, we reject the null hypothesis. There was a statistically significant relationship between mathematical-instructional minutes ($p < .05$) and the 2014 Grade 8 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

Summary

The researcher retained the null hypothesis between mathematical-instructional minutes and the 2014 Grade 6 New Jersey Assessment of Skills and Knowledge Mathematics scores. There was no statistically significant relationship between mathematical-instructional minutes and the 2014 Grade 6 NJ ASK Mathematics scores of public schools when controlling for student and school variables. The variable of interest, mathematical-instructional minutes, was

<table>
<thead>
<tr>
<th>gd8_minutes_per_week</th>
<th>.019</th>
<th>.010</th>
<th>.108</th>
<th>1.981</th>
<th>.049</th>
<th>-.365</th>
<th>.141</th>
<th>.088</th>
<th>.660</th>
<th>1.515</th>
</tr>
</thead>
<tbody>
<tr>
<td>total_enroll</td>
<td>.000</td>
<td>.003</td>
<td>.004</td>
<td>.093</td>
<td>.926</td>
<td>-.024</td>
<td>.007</td>
<td>.004</td>
<td>.956</td>
<td>1.046</td>
</tr>
<tr>
<td>percent_suspension</td>
<td>-.107</td>
<td>.181</td>
<td>-.032</td>
<td>-.591</td>
<td>.555</td>
<td>-.427</td>
<td>-.042</td>
<td>-.026</td>
<td>.661</td>
<td>1.512</td>
</tr>
<tr>
<td>percent_chronic_absent</td>
<td>-.157</td>
<td>.099</td>
<td>-.078</td>
<td>-1.581</td>
<td>.115</td>
<td>-.316</td>
<td>-.113</td>
<td>-.070</td>
<td>.797</td>
<td>1.255</td>
</tr>
<tr>
<td>percent_gd8_algebra</td>
<td>.061</td>
<td>.029</td>
<td>.106</td>
<td>2.100</td>
<td>.037</td>
<td>.424</td>
<td>.149</td>
<td>.093</td>
<td>.763</td>
<td>1.310</td>
</tr>
<tr>
<td>percent_ed</td>
<td>-.466</td>
<td>.039</td>
<td>-.755</td>
<td>-11.965</td>
<td>.000</td>
<td>-.758</td>
<td>-.652</td>
<td>-.530</td>
<td>.492</td>
<td>2.033</td>
</tr>
<tr>
<td>percent_swd</td>
<td>-.343</td>
<td>.184</td>
<td>-.091</td>
<td>-1.865</td>
<td>.064</td>
<td>-.036</td>
<td>-.133</td>
<td>-.083</td>
<td>.829</td>
<td>1.207</td>
</tr>
</tbody>
</table>

a. Dependent Variable: tpap_gd8
not a significant predictor of student achievement on the 2014, Grade 6, NJ ASK Mathematics scores.

The researcher ascertained that the strongest, statistically significant \((p < .001)\) predictor of student achievement on the 2014, Grade 6, New Jersey Assessment of Skills and Knowledge Mathematics scores was the percentage of economically disadvantaged students, accounting for 35.64% of the variance in total proficient/advanced proficient math scores on the Grade 6, NJ ASK. The other statistically significant \((p < .05)\) predictor of student achievement on the 2014 Grade 6 NJ ASK Mathematics scores was the percentage of students with a disability, accounting for 2.25% of the variance in TPAP Math scores on the Grade 6 NJ ASK.

The researcher also retained the null hypothesis between mathematical-instructional minutes and the 2014 Grade 7 New Jersey Assessment of Skills and Knowledge Mathematics scores. There was no statistically significant relationship between mathematical-instructional minutes and the 2014 Grade 7 NJ ASK Mathematics scores of public schools when controlling for student and school variables. The variable of interest, mathematical-instructional minutes, was not a significant predictor of student achievement on the 2014 Grade 7 NJ ASK Mathematics scores.

The researcher ascertained that the strongest, statistically significant \((p < .001)\) predictor of student achievement on the 2014 Grade 7 New Jersey Assessment of Skills and Knowledge Mathematics scores was the percentage of economically disadvantaged students, accounting for 64.80% of the variance in total Proficient/Advanced Proficient Math scores on the Grade 7 NJ ASK. The other statistically significant \((p < .05)\) predictor of student achievement on the 2014 Grade 7 NJ ASK Mathematics scores was the percentage of students with a disability, accounting for 1.06% of the variance in TPAP Math scores on the Grade 7 NJ ASK.
The researcher did, however, reject the null hypothesis between mathematical-instructional minutes and the 2014, Grade 8, New Jersey Assessment of Skills and Knowledge Mathematics scores. There was a statistically significant relationship between mathematical-instructional minutes and the 2014 Grade 8 NJ ASK Mathematics scores of public schools when controlling for student and school variables. The variable of interest, mathematical-instructional minutes, was a statistically significant ($p < .05$) predictor of student achievement on the 2014 Grade 8 NJ ASK Mathematics scores, accounting for 1.17% of the variance in total Proficient/Advanced Proficient Math scores on the Grade 8 NJ ASK.

The researcher determined that the strongest, statistically significant ($p < .001$) predictor of student achievement on the 2014, Grade 8, New Jersey Assessment of Skills and Knowledge Mathematics scores was again, the percentage of economically disadvantaged students, accounting for 57.00% of the variance in TPAP Math scores on the Grade 8 NJ ASK. The other statistically significant ($p < .05$) predictor of student achievement on the 2014 Grade 8 NJ ASK Mathematics scores was the percentage of students taking Grade 8 algebra, accounting for 1.12% of the variance in TPAP Math scores on the Grade 8 NJ ASK.

Additional discussion pertaining to the statistically significant variables as well as the variable of interest, mathematical-instructional minutes, is addressed in Chapter V. Further analysis, summary of the findings, and recommendations for policy and practice are also discussed. Finally, recommendations for future research are included based on the data, literature base, and interpretations found in this study.
CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

Introduction

The concept seems logical and simple: more time in school should result in more learning and higher student achievement. The production function theory, which undergirds this study is based on the premise that an increase in student or school inputs (time) will result in an increase in output (student achievement). However, the relationship between time and learning is anything but straightforward. Public schools have long been criticized for ineffective use of time. Studies examining increasing instructional time have obtained mixed results. The influence of instructional time in middle school mathematics is particularly salient for teachers and administrators, as mathematics continues to be one of the two subjects, the other language arts, to be used as the barometer for high-stakes decision making. With high-stakes decisions making predicated on the subject of mathematics, it seems extremely prudent to determine the influence of instructional minutes on mathematics. Administrators can then schedule classes that deliver the best results.

The existing literature regarding mathematical-instructional minutes at the middle school level is weak and lacks conclusive data. Broader, international studies have found weak or even negative correlations between hours of instruction and student achievement (Baker, Fabrega, Galindo, & Mishook, 2004). It is necessary to further investigate this relationship to determine if this intervention will impact student achievement. Many New Jersey schools have increased subject-specific content time because of increased accountability despite little, if any, evidence to support this structural intervention. The limited research on subject-specific, mathematical-instructional minutes at the middle school level motivated the researcher to ascertain the
influence of mathematical-instructional minutes on the 2014 New Jersey Assessment of Skills and Knowledge 6, 7, and 8 Mathematics scores. Information gleaned from this study will provide middle school administrators with additional tools to make informed decisions regarding student scheduling and allocation of instructional minutes in mathematics and determine whether increasing time in the classroom really contributes to the academic achievement of students.

**Purpose**

The purpose of this study was to examine the influence, if any, of mathematical-instructional minutes on academic achievement as measured by the New Jersey Assessment of Skills and Knowledge 6, 7, and 8 Mathematics scores. In addition, I hoped to explain the amount of variance in student test scores for which mathematical-instructional minutes are responsible while accounting for other factors that influence student achievement, including selected variables listed on the 2013-2014 New Jersey School Performance Report. This research study included both school and student variables. The student variables pertained to absenteeism, suspension, limited-English proficiency, socioeconomic status, and students with a disability. The school variables related to the length of school day, instructional time, school enrollment, algebra enrollment, student-faculty ratio, and the variable of interest, mathematical-instructional time. Previous studies have focused on the influence of total instructional time on academic achievement, but there is a lack of research on the impact of subject-specific (mathematics) instructional time on student achievement. This study will add to the existing research on the influence of instructional time on achievement. The findings of this study will provide board of education members, administrators, and educators with the data to implement policy on a school and district level to create schedules and time configurations that could impact student achievement.
Organization of the Chapter

This chapter summarizes the research findings by addressing each specific research question, null hypothesis, and data analysis pertaining to each research question. In the context of this chapter, the researcher scrutinizes the findings and expands on the results, juxtaposing the results of this study with previous research regarding instructional minutes. It is within this structural frame that the empirical data presented, as well as the analyses garnered, can assist policy makers, legislators, and educational bureaucrats in making informed decisions on how to improve academic achievement. In addition, the researcher utilizes the data from this study in conjunction with the literature base to make recommendations for policy and practice as well as future research.

Research Questions/Answers

This research study was conducted utilizing a non-experimental, explanatory, cross-sectional, correlational, quantitative design to determine the influence of school and student variables, specifically mathematical-instructional time, on student achievement in Grades 6, 7, and 8 as measured by Mathematics scores on the NJ ASK. This study sought to explain the strength and direction of the relationship between mathematical-instructional minutes and student performance in Grades 6, 7, and 8 based on data procured from the 2014 New Jersey School Performance Report, the 2014 Grades 6-8 NJ ASK, and School Survey results. The overarching research question for this study was the following: What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grades 6-8 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?
Utilizing IBM’s Statistical Package for the Social Sciences (SPSS) software, v24, the researcher performed simultaneous regression and hierarchical regression in an attempt to answer the research questions. While it was determined that the variable of interest, mathematical-instructional minutes, did not have a statistically significant relationship with the 2014 Grade 6 and Grade 7 NJ ASK Mathematics scores of public schools when controlling for student and school variables, mathematical-instructional minutes did have a statistically significant relationship with the 2014 Grade 8 NJ ASK Mathematics scores of public schools when controlling for student and school variables.

**Research Question 1:** What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grade 6 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?

**Null Hypothesis 1:** No statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 6 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

**Answer for Research Question 1:** The researcher retained the null hypothesis based on the analysis of the data presented in Chapter IV. Both the simultaneous regression model and the best predictive hierarchical regression model determined that mathematical-instructional minutes was not a significant predictor of achievement, and no statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 6 NJ ASK Mathematics scores of public schools when controlling for student and school variables.

The Grade 6 simultaneous regression model included Grade 6 mathematical minutes per week, total school enrollment, percentage of students suspended, percentage of students
chronically absent, percentage of students with a disability, and percentage of economically disadvantaged students. The $R^2$ of the model was .399, denoting that 39.9% of the variance of the dependent variable, total Proficient /Advanced Proficient (TPAP) NJ ASK Math 6 scores, could be predicted from the variables entered in the model.

Two of the six variables were statistically significant in the simultaneous regression model. The percentage of economically disadvantaged students was the strongest predictor, accounting for 35.64% of the variance in Grade 6 TPAP Math scores. Percentage of students with a disability was the other significant predictor, accounting for 2.25% of the variance in Grade 6 TPAP Math scores. The variable of interest in this study, mathematical-instructional minutes, was not a significant predictor ($p = .637$) of student achievement on the Mathematics section of the 2014 Grade 6 NJ ASK.

The hierarchical regression method was utilized to determine the best predictive model. The best predictive hierarchical model was Model 3, accounting for 39.9% of the variance in TPAP Math scores on the Grade 6 NJ ASK. Model 3 was identical to the Grade 6 simultaneous regression model, yielding matching results among predictors. Based on the best hierarchical regression model, the researcher retained the null hypothesis and concluded that no statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 6 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

**Research Question 2:** What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grade 7 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?
Null Hypothesis 2: No statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 7 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

Answer for Research Question 2: The researcher retained the null hypothesis based on the analysis of the data presented in Chapter IV. Both the simultaneous regression model and the best predictive hierarchical regression model determined that mathematical-instructional minutes was not a significant predictor of achievement and no statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 7 NJ ASK Mathematics scores of public schools when controlling for student and school variables.

The Grade 7 simultaneous regression model included Grade 7 mathematical minutes per week, total school enrollment, percentage of students suspended, percentage of students chronically absent, percentage of students with a disability, and percentage of economically disadvantaged students. The $R^2$ of the model was .675, denoting that 67.5% of the variance of the dependent variable, total Proficient /Advanced Proficient (TPAP) NJ ASK Math 7 scores could be predicted from the variables entered in the model.

Two of the six variables were statistically significant in the simultaneous regression model. The percentage of economically disadvantaged students was the strongest predictor, accounting for 64.80% of the variance in Grade 7 TPAP Math scores. Percentage of students with a disability was also significant, accounting for 1.06% of the variance to the model. The variable of interest in this study, mathematical-instructional minutes, was not a significant predictor ($p = .213$) of student achievement on the Mathematics section of the 2014 Grade 7 NJ ASK.
The hierarchical regression method was employed to determine the best predictive model. The best predictive hierarchical model was Model 3, accounting for 67.50% of the variance in TPAP Math scores on the Grade 7 NJ ASK. Model 3 was identical to the Grade 7 simultaneous regression model, yielding identical results among predictors. Based on the best hierarchical regression model, the researcher retained the null hypothesis and concluded that no statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 7 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

**Research Question 3:** What is the nature of the relationship between mathematical-instructional minutes and the percentage of Proficient and Advanced Proficient scores on the 2014 Grade 8 New Jersey Assessment of Skills and Knowledge Mathematics section when controlling for student and school variables?

**Null Hypothesis 3:** No statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 8 New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when controlling for student and school variables.

**Answer for Research Question 3:** The researcher rejected the null hypothesis based on the analysis of the data presented in Chapter IV. Both the simultaneous regression model and the best predictive hierarchical regression model determined that mathematical-instructional minutes was a significant predictor of achievement and a statistically significant relationship exists between mathematical-instructional minutes and the 2014 Grade 8 NJ ASK Mathematics scores of public schools when controlling for student and school variables.

The Grade 8 simultaneous regression model included Grade 8 mathematical minutes per week, total school enrollment, percentage of students suspended, percentage of students
chronically absent, percentage of Grade 8 students taking algebra, percentage of students with a
disability, and percentage of economically disadvantaged students. The $R^2$ of the model was
.620, denoting that 62.0% of the variance of the dependent variable, total Proficient /Advanced
Proficient (TPAP) NJ ASK Math 8 scores could be predicted from the variables entered in the
model.

Three of the seven variables were statistically significant in the simultaneous regression
model. The percentage of economically disadvantaged students was the strongest predictor,
accounting for 57.00% of the variance in Grade 8 TPAP Math scores. The variable of interest,
mathematical-instructional minutes, had a relatively weak effect, accounting for 1.17% of the
variance in the model. Last, percentage of Grade 8 students taking algebra also had a weak
effect, accounting for 1.12% of the variance in the model.

The hierarchical regression method was utilized to determine the best predictive model.
The best predictive hierarchical model was Model 3, accounting for 62.0% of the variance in
TPAP Math scores on the Grade 8 NJ ASK. Model 3 was identical to the Grade 8 simultaneous
regression model, yielding matching results among predictors. Based on the best hierarchical
regression model, the researcher rejected the null hypothesis and concluded that a statistically
significant relationship exists between mathematical-instructional minutes and the 2014 Grade 8
New Jersey Assessment of Skills and Knowledge Mathematics scores of public schools when
controlling for student and school variables.

Conclusions and Discussion

There was no statistically significant relationship between mathematical-instructional
minutes and the 2014 Grade 6 or Grade 7 NJ ASK Mathematics scores of public schools when
controlling for student and school variables. However, there was a statistically significant
relationship between mathematical-instructional minutes and the 2014 Grade 8 NJ ASK Mathematics scores of public schools when controlling for student and school variables. The variable of interest in this study, mathematical-instructional minutes, accounted for 1.17% of the variance of the total Proficient/Advanced Proficient Mathematics scores on the Grade 8 2014 NJ ASK.

The relationship between time and learning is neither direct nor straightforward (Silva, 2007). Educational reformers have called for public schools to remedy their supposed ineffective use of time. Policy makers often equate increasing the length of time a teacher instructs to improved academic achievement (Ayodele, 2014). The findings of this study substantiate this perspective; however, it is limited in scope (Grade 8), subject (mathematics), and strength (variance = 1.17%).

A number of educational researchers posit that students who spend more time in school learn more (Walberg, 2011; Lavy, 2010). Barro and Lee (2001) add that more time in school improves math and science scores. On the contrary, Levin (1984) cautions that simply adding more time would not result in appreciable student learning. Slavin and Davis (2006) contend there is little relationship between instructional time and students’ achievement.

Baker, Fabrega, Galindo, and Mishook (2004) examined the relationship between mathematical-instructional time and mathematical achievement, utilizing data from the Programme for International Student Assessment (PISA, 2000). Similar to the findings of this research study, Baker et al. (2004) found a weak relationship (variance = 2.2%) between mathematical-instructional time and mathematics achievement. However, contrary to this study, the researchers found both positive and negative associations between instructional time and
student achievement depending on the country. This research study only determined a positive association in Grade 8 mathematics.

Consistent with the literature reviewed for this study (Coleman, 1966; Sirin, 2005; Morgan, Farkas, Hillmeier, & Maczuga, 2009; Tienken, 2012), the percentage of economically disadvantaged students or SES was found to be the strongest predictor of student achievement. Sirin (2005) concluded that SES accounted for up to 60% of the variance in standardized test scores. This research study reached comparable conclusions, determining that SES accounted for 35.64% (Grade 6), 64.80% (Grade 7) and 57.00% (Grade 8) of the variance in TPAP Math scores on the NJ ASK.

The percentage of students with a disability was found to be a significant predictor of student achievement in Grade 6 and Grade 7 TPAP NJ ASK Math scores. However, it was not a significant predictor in Grade 8. The negative correlation between students with a disability and achievement in Grades 6 and 7 is akin to the findings of Abedi (2009) and Gronna, Jenkins, and Chance (1998) that contend that students with a disability have a negative association with student achievement. However, the lack of statistical significance between students with a disability and achievement in Grade 8 is perplexing and absent from the literature reviewed in this study.

Percentage of Grade 8 students taking algebra was also determined to be a significant predictor of Grade 8 TPAP Math scores. The slight positive association found in this study between percentage of Grade 8 students taking algebra, and Grade 8 TPAP NJ ASK math scores, was congruent to the research of Spielhagen (2006), who also implemented multiple regression techniques to conclude that participation in Grade 8 algebra had only a marginal impact on predicting student performance.
The relatively weak effects of mathematical-instructional minutes, percentage of Grade 8 students taking algebra, and percentage of students with a disability on student achievement might also suggest the results of the study could be due to the quality of instructional time, and not the quantity of instructional time. Comparable to the research of Aronson, Zimmerman, and Carlos (1999), the weak positive effects between instructional time and achievement could be dependent upon how that time is used.

Much of the literature regarding instructional time and its influence on student achievement is within the context of allocated, total instructional time and is easier to obtain, quantify, and measure. Cotton (1989) found a strong association between academic learning time (time when learning occurs) and achievement. Similar to this research study, Cotton (1989) concluded there is little or no relationship between allocated time and student achievement.

It is within this realm of debate that the researcher hopes to add additional knowledge to the literature base, focusing on middle school mathematical achievement and how it is impacted by instructional time.

**Variance in the Models**

In examining the results of the simultaneous and hierarchical regression models for Grades 6-8, there was a disproportionate amount of variance explained by the models. Grade 6 regression models explained 39.9% of the variance in total Proficient/Advanced Proficient (TPAP) Math scores on the NJ ASK in student achievement, while Grade 7 and Grade 8 models explained 67.5% and 62.0%, respectively. This increase of 155%-169% between the models is certainly substantial and challenges the researcher to reflect on potential reasons why. While these results were garnered utilizing a cross-sectional approach, it would be compelling to ascertain if the results would be as disparate, using a longitudinal approach, to determine if the
results are unique to that specific cohort of students or indicative of grade level differences (Roberts, 2010).

Inequality in the models led the researcher to re-examine the correlation matrix. Large correlations were evidenced between the predictor variables of mathematical-instructional minutes and percentage of economically disadvantaged students at all grade levels: Grade 6 ($r = .560; p < .001$), Grade 7 ($r = .588; p < .001$), Grade 8 ($r = .571; p < .001$). According to Cohen (as cited in Ravid, 2005), these effect sizes are large and indicate that schools with a higher percentage of economically disadvantaged students provided more mathematical-instructional minutes for their students. Kolbe, Partridge, and O'Reilly (2012) affirm that schools with increased instructional time are more likely to serve low-income and minority students and provide these students with additional opportunities to learn.

The disparity between the regression models of Grade 6 versus Grade 7 and Grade 8 could be attributed to the middle school model being a more specialized, subject-specific curriculum vs. the elementary model of one teacher teaching all subjects. The middle school years sometimes mark a decline in student achievement as students transition from elementary (house model) to a more transitory, independent model (Freshcorn, 2000). Teachers in New Jersey are required to be highly qualified in their departmentalized area in middle school versus their non-departmentalized elementary peers (NJDOE, 2014e).

Descriptive statistics for the Grade 6 sample reveal a TPAP Mathematics score of 82.19, the Grade 7 sample was 71.14, and the Grade 8 sample was 76.14. This higher mean TPAP score in Grade 6 Mathematics could indicate a less rigorous math assessment than in Grades 7 or 8. This speculation was further substantiated when the researcher juxtaposed the sample’s results with the TPAP rate of the 2014 NJ ASK population: Grade 6 (79.3), Grade 7 (66.8), and Grade 8
(71.5), verifying that the Grade 6 NJ ASK had the highest mean TPAP rate (NJDOE, 2014b). As such, it could be the result of a less rigorous assessment. Last, the disparity between the variances in the models for Grade 6 and Grades 7 and 8 could be attributed to the unique developmental characteristics of children approaching adolescence. Children at this age undergo rapid cognitive, emotional, and social changes, maturing at a very uneven pace; and these changes are factors in how children learn (Lawton, 1993).

**Percentage of Economically Disadvantaged Students**

Pursuant to Coleman (1966), Caldas and Bankston (2001), Sirin (2005), Tienken (2012), and numerous other educational researchers, the variable of socioeconomic status (SES), delineated in this study as the percentage of economically disadvantaged students, was the strongest predictor of academic achievement. Percentage of economically disadvantaged students accounted for 35.64% of the variance in Grade 6, 64.80% of the variance in Grade 7, and 57.00% of the variance in Grade 8 on the total Proficient/Advanced Proficient Math scores on the 2014 NJ ASK. The negative association (-β ) suggests that as the percentage of economically disadvantaged students increases, the percentage of TPAP Math scores on the Grade 8 NJ ASK decreases.

Since the Civil Rights Act of 1964, SES has been determined to be the most powerful predictor of school performance. The higher the SES of the family, the greater the student’s achievement becomes (Coleman, 1966). As such, numerous federal programs, beginning with Title One of the Elementary and Secondary Education Act (ESEA), the No Child Left Behind Act (NCLB), and its most recent iteration, the Every Student Succeeds Act (ESSA), have attempted to address this most significant predictor of student achievement by distributing federal funds to schools/districts with a high percentage of low-income families in hope of
increasing student achievement. According to Sirin (2005), poverty accounts for up to 60% of the variance in standardized test scores. This research study verified that claim.

**Percentage of Grade 8 Students taking Algebra**

Grade 8 students taking algebra accounted for 1.12% of the variance of the total Proficient/Advanced Proficient Mathematics scores on the Grade 8 2014 NJ ASK. The New Jersey Department of Education (NJDOE) asserts that an indicator of future academic success and college readiness is algebra enrollment and includes this percentage as one of its college and career readiness metrics on each school’s New Jersey School Performance Report (NJDOE, 2015c). Descriptive statistics reveal that 40.97% of Grade 8 students in New Jersey who took the Grade 8 NJ ASK were enrolled in algebra.

Foley, Mishook, Thompson, Kubiak, Supovitz, and Rhude-Faust (2008) also identify pre-algebra and algebra enrollment as one of these academic success indicators. Foley et al. (2008) contend that success in algebra presents opportunities in advanced math, college preparatory courses, higher college attendance rates, and higher college graduation rates. The positive association ($\beta = .106$) suggests that as the percentage of students taking Grade 8 algebra increases, the percentage of TPAP Math scores on the Grade 8 NJ ASK also increases. However, pursuant to Spielhagen (2006), participation in Grade 8 algebra had only a minimal influence; in this case, 1.12%, on the variance in predicting student performance on standardized mathematics assessments. Gamoran and Mare (1989) add that most of the differences in math achievement come from pre-existing differences among students, not the tracks those students are on.

**Percentage of Students with a Disability**

Percentage of students with a disability was statistically significant in Grades 6 and 7, explaining 2.25% and 1.06%, respectively, of the variance in TPAP Math scores on the 2014 NJ
ASK. The negative association \(- \beta\) suggests that as the percentage of students with a disability increases, the percentage of TPAP Math scores on the Grade 6 and 7 NJ ASK decreases. Interestingly, percentage of students with a disability was not a significant predictor on the Grade 8 NJ ASK, leaving the researcher to speculate why.

One supposition is that the skill areas for Grade 6 and Grade 7 NJ ASK Mathematics are identical, but different for Grade 8. Grade 6 and Grade 7 Mathematics content clusters included ratios/proportional relationships, the number system, expressions/equations, geometry, and statistics/probability. The skill areas for Grade 8 Mathematics included the number system, expressions/equations, functions, geometry, and statistics/probability. Perhaps the omission of ratios/proportional relationships in Grades 6 and 7 and the addition of functions in Grade 8 affected the sample of students with a disability differently and in disproportionate ways.

Another hypothesis could be the use/non-use of assistive technology (ruler, protractor, calculator) in conjunction with when these items are permissible. Calculators are permitted on Day 2 for Grade 6 and Grade 7, while in Grade 8 calculators are permitted on the last three sections of the test (NJDOE, 2014a).

Percentage of students with a disability may also benefit from the inclusion of the highly qualified, departmentalized content specialist teacher required by the New Jersey Department of Education (NJDOE, 2014e). The addition of the content specialist in the classroom may reduce or diminish the impact of the disability, thereby counteracting its statistical significance on TPAP Grade 8 Mathematics.

Last, there could also be a concomitant between age-specific self-advocacy and increased coping skills, thereby diminishing the impact of the disability on academic achievement. As students get older (Grade 8), their willingness to self-advocate may increase and attain a better
grasp on their unique disability than in the younger grades. Students often develop a self-awareness of their learning styles, including their strengths and needs, allowing them to lessen the impact of negative self-attribution (Lackaye & Margalit, 2006).

**Mathematical-Instructional Minutes**

The variable of interest, mathematical-instructional minutes was not statistically significant in Grades 6 or 7. It was statistically significant in Grade 8, explaining 1.17% of the variance in TPAP Math scores on the Grade 8 NJ ASK. The positive association (β) suggests that as mathematical-instructional minutes increases, the percentage of TPAP Math scores on the Grade 8 NJ ASK also increases. Once more, the researcher is left to speculate why a predictor variable—in this case, the variable of interest, mathematical-instructional minutes—is statistically significant in one grade (Grade 8) but not the others (Grades 6 and 7).

The introduction of algebra into the Grade 8 NJ ASK may increase academic rigor where students seem to benefit from additional mathematical-instructional time. Although the researcher’s findings reflect subject-specific mathematical-instructional minutes, accounting for 1.17% of the variance in TPAP for Grade 8 NJ ASK Mathematics scores, Baker et al. (2004) found a similar average variance of 0.8% between total instructional time and math achievement for the eighth grade 1999 TIMSS.

Analyzing the variable from a cognitive perspective and borrowing from Piaget’s (1950), stages of intellectual development (formal operations), around the time of early adolescence, children begin to reason in more abstract ways. Perhaps the cognitive development of the student, in conjunction with additional mathematical-instructional minutes, is only significant in Grade 8 because the cognitive differences (abstract reasoning/logic) are less prevalent in Grades 6 or 7. This potential concomitant of achieved cognitive development and instructional minutes
may benefit the Grade 8 students but not students in Grades 6 or 7. Middle school students have very disparate cognitive and developmental abilities, which are factors in how students learn (Lipsitz, 1984).

Last, analyzing the variable from an operational level, departmentalized Grade 8 mathematics teachers in New Jersey are required to be highly qualified content specialists and may even teach similar high school credit courses (NJDOE, 2014e). These content specialists may provide additional academic rigor that, when combined with increased instructional time and student cognitive ability, results in the reported positive association between mathematical-instructional minutes and Grade 8 NJ ASK TPAP Math scores. These Grade 8 highly qualified teachers may have the content expertise, the pedagogy to engage, and an attentive audience that chose the course (algebra) which, when combined with additional mathematical-instructional minutes, manifests itself into a positive association with academic achievement because the instructional activity is aligned with a students’ readiness to learn (Huit, 2005).

**Recommendations for K-12 Policy and Practice**

There was no statistically significant relationship between mathematical-instructional minutes and the 2014 Grade 6 or Grade 7 NJ ASK Mathematics scores of public schools when controlling for student and school variables. However, there was a statistically significant relationship between mathematical-instructional minutes and the 2014 Grade 8 NJ ASK Mathematics scores of public schools when controlling for student and school variables. The variable of interest in this study, mathematical-instructional minutes, accounted for 1.17% of the variance of the total Proficient/Advanced Proficient Mathematics scores on the Grade 8 2014 NJ ASK.
The findings of this research study may continue to fuel the debate on the influence of instructional time on student achievement. Research often answers the question and raises more. The correlational data used in this study posits that mathematical-instructional minutes had a positive influence on academic achievement. Hossler, Stage, and Gallagher (1988) expressed concern over the abundance of correlational data in measuring the impact of instructional time on student achievement. The researchers posit that due to the complexity of the many factors influencing student achievement, the ability to separate out the influence of one variable, time, is extremely challenging. The researchers also concluded that increasing instructional time has modest positive effects on learning.

This subject-specific research study found a small, positive effect on student achievement in Grade 8 only. Increasing mathematical-instructional time did not influence achievement in Grades 6 or Grade 7. Legislators, policy makers, and educators should not expect large gains, if any, to materialize from increasing mathematical instructional time. Yet the reformers and policy elites continue to tout the virtue of increased instructional time, despite the lack of rigorous research, mixed results, slight student achievement gains, and inhibitive additional costs of teacher salaries (Cuban, 2008). Educational bureaucrats, legislators, and policy makers have been extolling increased learning time as the panacea to what ails the perceived United States’ educational crisis for over 100 years. The Committee of Ten (Mackenzie, 1894) lamented over the amount of time American students spent in school when compared to their European counterparts. President Obama echoed that same sentiment 115 years later when he called upon the nation to rethink the school day to incorporate more time (Obama, 2009).

Borrowing from the production framework theory and the seminal work of Coleman (1966), an increase in student or school inputs (time) should result in an increase in output
(student achievement). This research study refutes that the variable of interest, mathematical-instructional time influences student academic achievement in Grade 6 and Grade 7. It also suggests that the variable of mathematical-instructional time has a small but statistically significant effect on student academic achievement in Grade 8.

Data derived from this study will help school administrators schedule classes based on empirical research, not bureaucratic rhetoric. The building-level question is straightforward: Is the slight, positive effect (variance=1.17%) in TPAP for Grade 8 Mathematics scores worth the resources to procure that return on investment? Designing a new schedule to accommodate more instructional minutes may create confusion, waste resources, and cause unnecessary stress to all stakeholders within the school (Rettig & Canady, 2000). Additional costs of faculty salaries and operational and building expenses may negate the slight benefit derived from increasing mathematical-instructional minutes. If the goal is to improve achievement, the variable of instructional time may be too dependent on its relationship to grade curriculum and instructional quality so that it becomes significant only in connection with more primary resources in the input process and probably should not warrant much attention (Baker et al., 2004).

Although this and numerous other studies (Coleman, 1966; Caldas and Bankston, 2001; Sirin, 2005; Tienken, 2012; Sammarone, 2014) have demonstrated that socioeconomic status has the strongest influence on academic achievement, policy makers continue to ignore the “elephant in the room.” Educational bureaucrats, legislators, and pundits continue to dismiss the empirically validated, statistically significant evidence from countless researchers and simply “can’t see the forest for the trees.” Forty-five years of empirical research documents the nexus between poverty and student achievement (Tienken, 2012). This inability to acknowledge poverty as the strongest inhibiting factor on student achievement compels the policy elites to
seek other solutions (instructional time) that have at best, proven to show modest, if any, influence on student achievement. Administrators need to ask policy makers, bureaucrats, and legislators for empirical evidence of their proposed solutions that address the root causes of underachievement, namely poverty, before they simply comply (Tienken, 2012).

This research study demonstrated that percentage of economically disadvantaged students was the strongest predictor, accounting for 35.64%-64.80% of the variance in Grades 6-8 TPAP Math scores. This research also demonstrated that 29.93%-32.14% of the sample was considered “economically disadvantaged.” The impact of this cannot be overstated. The 2009 *Programme for International Student Assessment* (PISA) revealed that the United States had the highest poverty rate (21.7%), scored 500, and was in the medial range of countries tested. A more accurate assessment of the PISA scores would have analyzed the scores of American schools to other countries with similar poverty rates. When compared to countries with the same poverty rates (< 10%), the U.S. schools ranked first, with a score of 551. When compared to countries with similar poverty rates (10%-24.9%), the U.S. schools ranked first again, with a score of 527 (OECD, 2010).

Federal and state policy makers need to address the systemic condition of poverty that schools cannot overcome alone. The potent variable of poverty is diminished in other PISA testing countries via social policies of pre-kindergarten education and adequate healthcare. Lack of these services immediately puts the child at an educational disadvantage, leading to sight-vocabulary deficits and reading achievement gaps by the time they enter school (Hart & Risley, 1995). Deficiency in adequate child healthcare often manifests into preventable chronic illnesses and inadequate nutrition, leading to increased absenteeism (Tienken, 2013). Policy makers and legislators should address the potent variable of SES through the very same social policies (pre-
k, healthcare) that are benefiting the Nordic/Scandinavian countries that highly subsidize spending on social benefits directly to families (Tienken & Orlich, 2013).

School superintendents and principals are undoubtedly familiar with the strong association between SES and academic achievement. The results of this study would inform and remind administrators of the social inequities that enter the school building every day. School administrators need to make certain the parent and child are aware of all federal, state, county and local resources that may help alleviate some of the negative influence SES has on student achievement. Utilizing these resources in partnership with all community stakeholders and extolling the value of education, literacy, parent involvement and student engagement, administrators may help ease the considerable negative impact SES has on students.

Policy makers need to be cognizant of the percentage of students with a disability, as the influence of this variable was small but statistically significant in Grade 6 and Grade 7. In this study, the variable of percentage of students with a disability was no longer significant in Grade 8. Policy makers need to be very aware of the pitfalls learned from the No Child Left Behind Act (NCLB), as its prescriptive requirements became increasingly unworkable for schools and educators (USDOE, 2015). Under NCLB, sub-groups, such as students with a disability, had the same annual targets as the total school population (USDOE, 2002).

Policy makers and practitioners must realize that the very notion of standardized testing and its premise of homogeneity and reliability seem to conflict with the concept of a disability (Thurlow, Quenemoen, Altman, & Cuthbert, 2008). As demonstrated in this study and pursuant to Abedi (2009), students with a disability score significantly lower than their non-classified general education peers. Policy makers, legislators, and educational bureaucrats need to be very cognizant of this fact of holding schools and students accountable when interpreting the latest
iteration of the 50-year-old Elementary and Secondary Education Act (ESEA), the Every Student Succeeds Act (ESSA).

Results of this research study will inform middle school administrators that the percentage of students with a disability has a slight, negative influence on student achievement in Grades 6 and 7. Including a highly qualified content specialist teacher may help negate some of this influence, as the percentage of students with a disability variable is no longer significant in Grade 8. Scheduling a content specialist with a special education teacher in a collaborative/consultative manner may help meet the academic, social, and emotional needs of the student while also improving student achievement (Smith, 2007).

Last, algebra continues to be one of the fundamental themes in K-12 mathematics. Grade 8 students who studied algebra were more likely to take higher-level mathematic courses and attend college than those who did not study it (Atnada, 1999). The NJDOE suggests that algebra is an indicator of future academic success, and that subsequent college and career readiness is challenging, rigorous course work (NJDOE, 2015c).

Grade 8 students taking algebra accounted for 1.12% of the variance of the total Proficient/Advanced Proficient Mathematics scores on the Grade 8 2014 NJ ASK. Roughly 41% of Grade 8 students in New Jersey who took the Grade 8 NJ ASK were enrolled in algebra. Enrollment in algebra has a small, positive association to academic achievement. Although enrollment in Grade 8 algebra presents opportunities for advanced math in high school and college (Adelman, 2006), this research study yielded similar results to that of Spielhagen (2006), where participation in Grade 8 algebra had a minimal influence in predicting student performance on mathematics assessments.
School administrators should view algebra enrollment in Grade 8 not as a mechanism to increase standardized test scores but perhaps as the beginning of a trajectory to experience more advanced math courses (Evan, Gray, & Olchefske, 2006). Middle school principals must be equitable and not restrict access to algebra. Restricting access to algebra in Grade 8 was determined to impact mathematical course trajectory (Spielhagen, 2006). As Dewey once stated, “What the best and wisest parent wants for his own child, that must the community want for all of its children. Any other ideal for our schools is narrow and unlovely; acted upon, it destroys our democracy” (Dewey, 1900, p. 7).

**Recommendations for Future Research**

This research study examined the influence, if any, of mathematical-instructional minutes on academic achievement as measured by the NJ ASK 6, 7, and 8 Mathematics scores. The results of this study determined that mathematical-instructional minutes did not have a significant influence on the 2014 Grade 6 and Grade 7 NJ ASK Mathematics scores. However, mathematical-instructional minutes did have a significant influence on the 2014 Grade 8 Mathematics scores. The results of this study regarding the variable of time only adds to the already mixed results regarding the association between time and learning.

The influence of percentage of economically disadvantaged (SES) on student achievement is abundantly clear. After 50 years of research, the negative relationship between poverty and student underachievement has never been fully addressed or solved. More needs to be done to level the playing field when students enter the school system. The influence of Grade 8 algebra enrollment was positively associated with mathematics achievement. The results of this study confirm previous research. The percentage of students with a disability was a predictor of achievement in Grades 6 and 7, but not in Grade 8. Like many research endeavors, the questions
posed were answered, but more questions were generated from this study. It is with that lens that the researcher has compiled the topics below for further research.

- Conduct this study using NJ ASK/HSPA data from Grades 3-5 or Grades 11 to ascertain the influence of mathematical-instructional minutes on student achievement.
- Recreate this study utilizing Grades 6-8 PARCC data to ascertain the influence of mathematical-instructional minutes on student achievement.
- Develop a research study that demarcates student enrollment in Grade 8 algebra from the overall aggregate performance of all Grade 8 students so that more defined conclusions on the predictor variables could be made regarding the influence of mathematical-instructional time on student achievement.
- Examine the influence of mathematical-instructional minutes on academic achievement (NJ ASK/PARCC) by district factor group (DFG). Mathematics-instructional time may influence student achievement differently by DFG.
- Develop a longitudinal study to examine the influence of mathematical-instructional minutes based on grade cohorts that tracks the same students through Grades 6-8.
- Create a study that determines the influence of mathematical-engaged learning time, not allocated learning time, and its impact on academic achievement.
- Examine the influence of percentage of students with disabilities on mathematics academic achievement on the NJ ASK Grades 3-5 or HSPA Grade 11.
- Investigate the influence of percentage of students with disabilities on mathematics academic achievement on the PARCC in Grades 3-11.
- Research the influence of Grade 8 algebra enrollment on mathematics academic achievement using statewide 2014 Grade 8 NJ ASK data.
• Examine the influence of Grade 8 algebra enrollment on mathematics academic achievement using statewide PARCC data or from the surrounding PARCC states.

• Create a longitudinal study that includes teacher efficacy via NJDOE teacher evaluation models to determine influence on student achievement.

Conclusion Statement

This study sought to explain the influence of mathematical-instructional minutes on the Grades 6-8 NJ ASK Mathematics scores. There was no statistically significant relationship between mathematical-instructional minutes and the 2014 Grade 6 or Grade 7 NJ ASK Mathematics scores. However, there was a significant, small, positive association between mathematical-instructional minutes and the 2014 Grade 8 NJ ASK Mathematics scores. The relationship between time and student achievement is complex and will undoubtedly continue to be debated.

Policy makers need to disaggregate data and make decisions based on empirical evidence before initiating reform efforts and implementing policy. Programs and policies should be aimed at the factors that influence student achievement the most, especially poverty. This research study found other significant predictors of student achievement, such as students with a disability (Grades 6-7) and Grade 8 algebra enrollment. These also warrant attention. Instructional time was indeed a significant predictor for Grade 8 mathematics. However, if policy makers, legislators, and educational stakeholders are truly trying to improve academic achievement and improve the lives of children, the variables that are most responsible for influencing student achievement should be their first priority.
References


TO:  Eric Kosek
FROM:  Pauline F. Anderson
SUBJECT:  Scheduling
DATE:  October 20, 2014

Thank you for your help in developing this year’s new rotating schedule. Would you please continue researching scheduling alternatives so we can analyze the time allotted for mathematics instruction in grades 6-8 in the surrounding counties? I believe this information would prove valuable with future scheduling decisions as they relate to our students’ mathematics scores.
Appendix B

From: Kosek, Eric <ekosek@vtsd.com>
Date: Wed, Dec 3, 2014 at 6:09 PM
Subject: Request from a fellow NJ Administrator
To: Eric Kosek <ekosek@vtsd.com>

Dear colleagues,

My name is Eric Kosek and I am the Assistant Principal at [School Name].

I am in the process of gathering information about Math instruction for grades 6-8. I would like to know how many minutes a day your students received Math instruction for the 2013-2014 school year. I hope to use this information to inform future scheduling decisions.

The link below will take you to an 8 question survey that will take you less than 2 minutes to complete. Your help is greatly appreciated.

Click Here Now to take the Survey

Sincerely,

Eric W. Kosek
Assistant Principal

[School Name]
Vernon, NJ 07462
Appendix C

Scheduling Survey

Please answer the questions below relating to grades 6, 7, 8 for school year 2013-2014.

* Required

Name: *

Email Address: *

School: *

District: *

How many minutes a day did your students receive Math instruction?

6th Grade: 

7th Grade: 

8th Grade: 

Is there any type of rotation to be aware of to ascertain weekly minutes?