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The Influence of a Supplemental Mathematics Course to 9th Grade Algebra 1 Students in a Medium Suburban K–12 School District in New Jersey

by

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Submitted in partial fulfillment of the requirements for the degree

Doctor of Education

Department of Educational Leadership, Management and Policy

Seton Hall University

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COLLEGE OF HUMAN DEVELOPMENT CULTURE & MEDIA
DEPARTMENT OF EDUCATION LEADERSHIP MANAGEMENT & POLICY

APPROVAL FOR SUCCESSFUL DEFENSE

Jacob Cavins has successfully defended and made the required modifications to the text of the doctoral dissertation for the Ed.D. during this Fall Semester 2023.

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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.

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Finally, we must remember that as educational leaders, it is our duty to set the conditions for student and teacher success. Students first; teachers always.

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ABSTRACT

Math performance became an increasing concern in the United States after the launch of Sputnik in 1957. This concern began with attempts to prescribe mathematical standards in the United States to improve student mathematics preparation. When the COVID pandemic began in 2020, policies on quarantining and remote learning were implemented, resulting in increased education gaps. The most contemporary NAEP report shows the first decline in math scores in the United States since the inception of the NAEP. Districts are looking for solutions. Districts are exploring intervention options, including Multi-Tiered Support Systems and Response to Intervention initiatives. They hope to reduce learning gaps, improve performance in math, reduce special education referrals, and provide more equitable access to advanced math courses. There is limited research on MTSS/RTI in mathematics at the secondary level. This study explores the implementation of one such intervention in the form of a supplemental math course offered to underperforming 9th-grade Algebra 1 students in the 2018-2019 school year in one New Jersey K-12 medium suburban district. Underperforming students scored below 750 on the 2017-2018 Math 8 PARCC score. There were three subsets of students in the study. The first subset was students who scored 750 or above on the Math 8 PARCC score and did not receive the intervention. The second subset of students scored under 750 and were offered the intervention but declined enrollment. The third subset was students who scored under 750 and enrolled in the intervention. The study examines the effect of the intervention on four dependent variables: Algebra 1 course grade, Algebra 1 New Jersey Student Learning Assessment (NJSLA), Geometry course grade, and the PSAT 10 math score. A multiple linear regression analysis was run for each dependent variable while controlling for predictor variables of intervention status, gender, race, special education status, free and reduced lunch status, the Math 8 course grade, and the Math 8 PARCC score. The study results revealed that the intervention course had no statistical significance influencing the dependent variables. While the intervention was statistically insignificant, the study offers new insight into applying these interventions. This research can help inform district decisions on implementing mathematics interventions and add to the body of research on mathematical interventions at the secondary level.

Keywords: Multi-Tiered Systems of Support (MTSS), Response to Intervention (RTI), secondary mathematics, ability grouping, electives, student achievement

CHAPTER I

INTRODUCTION AND BACKGROUND

The district in this study was a medium suburban district that includes two high schools and approximately 8,000 students in PK–12. There are approximately 2,400 high school students in the district. It has a district factor group GH. The district recently transitioned from a traditional nine-period day to a rotating drop block schedule with a pre-lunch and post-lunch rotation. These structural changes in the high school schedule required the removal of a lower-level math course in a double period of Algebra 1. The district then implemented a supplemental intervention class for Algebra 1 and the regular Algebra 1 course.

The most recent NAEP report shows the first-ever drop in mathematics in the United States. Learning gaps in mathematics were exacerbated by the COVID-19 pandemic (The Nation's Report Card, 2022). Algebra 1 is an essential course for students. "Mastering algebra is a fundamental step toward gaining access to and preparing for the higher-level math courses that high school students must complete to be prepared for college" (Snipes & Finkelstein, 2015, p. 1). A supplemental course response to intervention was created to reduce learning gaps and improve performance in Algebra 1 for underperforming students. MTSS/RTI research is limited at the secondary level, with most of the research at the elementary level focused on literacy (Bouck, 2017).

Purpose of the Study

This study aims to determine if an Algebra 1 supplemental mathematics course, based on middle school NJSLS-M content standards, delivered to underperforming 9th-grade students, as identified by the Math 8 PARCC state test, enrolled in an Algebra 1 mathematics course influences student achievement.

With limited MTSS/RTI research at the secondary level, this study will provide additional data points and potentially assist districts in decision-making when implementing a tiered intervention.

Research Questions

This study includes four research questions. These research questions explore the influence, if any, of a supplemental math course given to underperforming students on four separate outcomes. The first question explored the intervention course's effect on the Algebra 1 course the students took concurrently, as reflected in the Algebra 1 final grade. The second question explores the effect of the intervention course on that year's state standardized testing requirement, the New Jersey Student Learning Assessment. The third question seeks to identify any influence on the final grade of the follow-on-year math course, Geometry. The fourth question aimed to identify whether there would be any influence on that cohort's PSAT 10 math score.

RQ1: How did implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year influence student achievement, as measured by the students' performance on the Algebra 1 final grade?

RQ2: How did implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year influence student achievement, measured by the students' performance on the Algebra 1 PARCC end-of-course assessment?

RQ3: How did implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year influence future student achievement, measured by the students' performance on the Geometry final grade?

RQ4: How did implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year influence their future achievement, as measured by their performance on the 2019–2020 PSAT10 Math Score?

Null Hypothesis

Null Hypothesis 1: Implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year did not influence student achievement, measured by the Algebra 1 course grade.

Null Hypothesis 2: Implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year did not influence student achievement, as measured by the Algebra 1 NJSLA.

Null Hypothesis 3: Implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year did not influence student achievement, measured by the Geometry course grade.

Null Hypothesis 4: Implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018-2019 school year did not influence student achievement, as measured by the PSAT 10 Math Score.

Significance of the Study

Thomas Jefferson (1829) wrote, “Educate and inform the whole mass of the people” (p. 276). Over the years, the United States has passed several acts that attempt to achieve this goal, such as the Elementary and Secondary Education Act and the No Child Left Behind Act (Miyamoto, 2008). Simultaneously, mathematical standards have evolved over the years, partly due to Russia’s launch of Sputnik (Hekimoglu & Sloan, 2005). These mathematical standards include, but are not limited to New Math, the Curriculum and Evaluation Standards for School

Mathematics, and the New Jersey-specific New Jersey Student Learning Standards. Traditionally, mathematics performance has lagged English (New Jersey School Performance Report, 2022). Mathematic performance is also suffering from the response to the COVID-19 pandemic, as evidenced by the most recent NAEP report (The Nation's Report Card, 2022). Compounding the issue are the socioeconomic and demographic factors that contribute to the mathematics achievement gaps (Crawley, 2018).

Schools must reduce performance gaps among students while addressing each student's needs to provide more equitable access to increasingly rigorous versions of mathematics courses. Some of these efforts focus on interventions, such as ability grouping, acceleration, curriculum compacting, and multi-tiered support systems like response to intervention. Interventions must be carefully considered, due to the impact on student academic opportunities, local communities, financial constraints, and teacher preparedness.

With limited research on Response to Intervention in mathematics at the secondary level (Bouck, 2017), this study seeks to add to the literature on multi-tiered support systems in mathematics at the secondary level, specifically, response to intervention. Additionally, this study can be used as another data point for districts to reference when considering what interventions to implement for their students.

Limitations of the Study

This study was restricted to a New Jersey suburban K–12 district, with two high schools located in the northwestern portion of the state. I only looked at the class of 2022 cohort enrolled in a non-advanced Algebra 1 course at both schools and used data available. The study was non-experimental and explanatory. As such, this study may demonstrate relationships among variables but cannot be used to demonstrate causality (Johnson, 2001). The intervention implemented was an Algebra 1 supplemental course offered to students with poor performance on an 8th-grade state assessment. However, the course was not mandatory for those eligible. The intervention course was unavailable to students who scored 750 and above on the Math 8 standardized state assessment, were enrolled in an advanced Algebra 1 course, or were already in a special education pull-out Algebra 1 class. The implementation process—including teacher experience and professional development given to teachers—may also have influenced the results.

Definition of Terms

Algebra 1: A high school course aligned with the New Jersey State Learning Standards for Algebra 1.

Geometry: A high school course aligned with the New Jersey State Learning Standards for Geometry.

Multi-Tiered Support System (MTSS): A framework of supports and interventions to improve student achievement.

New Jersey Tiered System of Supports (NJTSS): New Jersey's guidelines for implementing MTSS/RTI

Response to Intervention (RTI): Typically, a three-tier prevention logic that falls under the umbrella of MTSS.

Math 8 PARCC (Partnership for Assessment of Readiness for College and Careers): A New Jersey state assessment that assessed student achievement in grade 8 Mathematics.
New Jersey Student Learning Assessment: A New Jersey state assessment that assesses student achievement in different math subjects, including Algebra 1.

PSAT10: Preliminary Scholastic Aptitude Test given to students in grade 10.

Gaps in the Literature

Most of the research on MTSS/RTI focused on the elementary level (Bouck, 2017). Little research has been completed on the response to intervention implementation at the secondary level. This study fills research gaps at the secondary school level and focuses on a specific intervention: a supplemental math course based on supporting content standards for Algebra 1. It will also attempt to find out whether a relationship exists between the intervention and performance on various outcomes, including Algebra 1 grade, Geometry grade, Algebra 1 NJSLA, and the PSAT10 Math score. The results of this study add to the literature for interventions at the secondary level that serve students, create opportunities for teacher success, and better use of taxpayer dollars.

CHAPTER II

REVIEW OF LITERATURE

The literature review shows why there is a need to address underperformance in Algebra 1. It traces the history of educational and mathematical standards in the United States from the 1800s to the present day. Current policies require mathematics courses for graduation in New Jersey and nearby states. Additionally, New Jersey and other states have specific math assessment requirements for graduation that always include Algebra 1 content standards. The literature shows achievement gaps for various demographics, including socioeconomics, race, gender, and special education status. The most recent NAEP report confirms a drop in mathematical performance after the United States resulted from in-person schooling due to the COVID-19 pandemic (The Nation's Report Card, 2022). The categories of interventions that seek to reduce learning gaps and provide more individualized instruction are explored, as are the potential opportunity costs of such interventions for students concerning academic choice in the form of electives.

Mathematical Standards

Mathematical Standards began as an outgrowth of the Standards Movement in the 1800s. Miyamoto (2008), concerned with the decline in academic achievement of Japanese students, traced the origins of the creation of standards to the mass production of Joseph Dixon's pencil in 1866, as well as the mass production of the steel pen, which first occurred in New Jersey in 1870. During the 19th Century, students were given oral and written examinations. Horace Mann (1796–1859), the first administrator to emphasize written examinations, made the following argument for the superiority of written examinations (Caldwell & Curtis, 1924, as cited in Miyamoto, 2008):

1. It is impartial;
2. it is just to the pupils;
3. it is more thorough than older forms of examination;
4. it prevents the officious interference of the teacher;
5. it determines, beyond appeal or gainsaying, whether the pupils have been faithfully and completely taught;
6. it takes away all possibility of favoritism;
7. it makes the information obtained available to all; and
8. it enables all to appraise the ease or difficulty of the questions. (p. 30)

In alignment with these changes, Joseph M. Rice (1893) stated, “A school system must be judged not by what particularly energetic teachers are, of their own accord, willing to do, but what each teacher is required to do in order that she may retain her position” (p. 7).

Frank McMurry (1913) also believed in establishing standards. He wanted a focus “(1) on what the children are doing, and (2) on the value of it as judged by its relation to the purposes of instruction” (McMurry, 1913, p. 17). By the 1930s, there were several types of achievement tests, although “90 percent of actual examinations were still essay type, the objective achievement test was growing rapidly” (McConn, 1935, as cited in Miyamoto, 2008, p. 31). Later, Douglas McGregor would introduce Theory X and Theory Y as a lens for viewing how managers, leaders, etc., viewed their subordinates.

The separation of teacher and performance, and the increased adoption of written examinations, indicated that Theory X was the prevailing notion, as it assumes that “subordinates are lazy, have little ambition, prefer to be led, and resist change” (Bolman & Deal, 2013, p. 123). McGregor would argue that Theory X is a self-fulfilling prophecy: "If you treat people as if they're lazy and need to be directed, they conform to your expectations" (Bolman & Deal, 2013, p. 123).

Lyndon B. Johnson passed the Elementary and Secondary Education Act in 1965, creating Title I. The intent was to move the nation toward full educational opportunity (United States Department of Education, n.d.). This law would pave the way for several iterations and reauthorizations, especially once *A Nation at Risk* was published.

A Nation at Risk suggested the United States was falling behind in academic achievement partly due to the "curricular smorgasbord then offered in American schools with extensive student choice, explained a great deal of the low performance" (Smith, 2004, p. 105). The National Commission on Excellence in Education suggested students were allowed to complete high school without the core knowledge to enter the workforce or secondary school (Smith, 2004). Miyamoto stated that *A Nation at Risk* was a precursor to three major publications: *AMERICA 2000: An Education Strategy* by George Bush in 1991, *Goals 2000* by President Clinton in 1994, and *The No Child Left Behind Act* of 2001 by George W. Bush, which reauthorized the *Elementary and Secondary Education Act* (Miyamoto, 2008).

America 2000: An Education Strategy (1991)

On April 18, 1982, President Bush announced this strategy as a "Bold, comprehensive, and long-range plan to move every community in America toward the National Education Goals adopted by the president and the Governors last year" (Alexander, 1991, p. 1). It listed six goals:

1. All children in America will start school ready to learn.
2. The high school graduation rate will increase to at least 90%.
3. American students will leave grades 4, 8, and 12 having demonstrated competency in challenging subject matter, including English, mathematics, science, history, and

geography. Every school in America will ensure that all students learn to use their minds well, so they can be prepared for responsible citizenship, further learning, and productive employment in our modern economy.

4. U.S. students will be first in the world in science and mathematics achievement.
5. Every adult American will be literate and will possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship; and
6. Every school in America will be free of drugs and violence and will offer a disciplined environment conducive to learning. (p. 3)

One important aspect of America 2000 was that "we begin with the assumption that everyone will want to climb aboard" (Alexander, 1991, p. 34). This assumption was in contrast to Theory X, which arguably initiated the standards movement. America 2000 also laid out four strategy tracks. These tracks were thought to limit the federal government's role, but "that role would be played vigorously" (Alexander, 1991, p. 9). The four tracks Alexander published in *America 2000* are presented here:

1. Track I: Better Accountable Schools
   a. "Through a 15-point accountability package, parents, teachers, schools, and communities will be encouraged to measure results, compare results, and insist on change when the results aren't good enough" (p. 15).
2. Track II: For Tomorrow's Students: A New Generation of American Schools
   a. Sought to "unleash America's creative genius to invent and establish a New Generation of Schools" (p. 20).

3. Track III: For the Rest of Us (Yesterday's Students/Today's Work Force): A Nation of Students
    a. Focus on adults, as evidenced by the statement, “We need to learn more to become better parents, neighbors, citizens, and friends. Education is not just about making a living; it is also about making a life” (p. 24).
4. Track IV: Communities Where Learning Can Happen
    a. Even if we successfully completed the first, second, and third parts of the *AMERICA 2000* education strategy, we would not have done the job. Even with accountability embedded in every aspect of education, achieving the goals requires a renaissance of sound American values like strong families, parental responsibility, neighborly commitment, the community-wide caring of churches, civic organizations, business, labor, and the media. (p. 26)

In contrast to relying on Theory X for the construction of standards, *America 2000* acknowledges that “Parents are the keys to their children’s education” and that parents could “read a story to their children, check to see that tonight's homework is done, thank their child's teacher, talk with their children's teachers and principals about how things are going in school, and set some examples for their children of virtuous, self-disciplined and generous behavior” (Alexander, 1991, p. 35).

Alexander (1991), suggested that parents play a large part in their children’s education was emphasized later in the strategy by stating,

> American homes must be places of learning. Parents should play an active role in their children's early learning, particularly by reading to them on a daily basis. Parents should

have access to the support and training required to fulfill this role, especially in poor, undereducated families. (p. 42)

Goals 2000: Educate America Act

In March 1994, President Clinton, along with Congress, passed *Goals 2000*, which enacted the six goals from *America 2000* and added two more which are the fourth and eighth goals listed below. According to Heise (1994), this legislation was needed to reverse a rising tide of mediocrity in American education by setting eight standards:

1. All children will start school ready to learn;
2. the high school graduation rate will be at least 90%;
3. students will master a challenging curriculum at grades 4, 8, and 12;
4. teachers will have access to professional development opportunities;
5. U.S. students will be first in the world in science and math achievement;
6. all adults will be literate;
7. schools will be free of drugs, violence, and firearms; and
8. every school will promote parental involvement in education. (p. 357)

The act continued the work from *America 2000* but acknowledged that teachers would need access to professional development to meet standards and required schools to promote parental involvement. This parental involvement was mentioned in America 2000's Track IV Strategy. Additionally, Goals 2000 established three types of education standards. The first was to establish general content standards that would not constitute curricula. The second was to establish student performance standards to delineate performance levels. The third was to provide Opportunity to Learn Standards (OTLs) that describe resources, practices, and conditions at each level that give students the opportunity to learn the standards (Stedman & Riddle, 1995).

No Child Left Behind Act of 2001

President George W. Bush announced *No Child Left Behind* (NCLB) in January 2001. The NCLB Act reauthorized the ESEA and included increased accountability for states and school districts, greater choice of parents and students, more flexibility for States and local education agencies (LEAs) to use federal dollars, and a stronger emphasis on reading (United States Department of Education, n.d.).

For increased accountability, NCLB required states to implement statewide accountability systems and break down assessment reports by different demographics. Choice for parents came in the form of Local Education Agencies (LEAs), giving students in poor-performing schools the opportunity to attend a better school in the district, including charter schools. Greater flexibility of federal dollars gave states the opportunity to funnel the funds into Teacher Quality State Grants, Educational Technology, Innovative Programs, and Safe and Drug-Free Schools. Reading First was included to help every child read by the third grade (United States Department of Education, n.d.).

The Mathematical Standards Movement

In 1989, the National Council of Teachers of Mathematics (NCTM) published "Curriculum and Evaluation Standards for School Mathematics." This was the fourth attempt to produce a set of standards. The first three were New Math, Back to Basics, and Problem Solving. New Math was the first reform movement and predated the launch of Sputnik in 1957 (Hekimoglu & Sloan, 2005). With the launch of Sputnik, the United States now faced a sense of urgency to outperform Russia's space program. Moreover, it was aimed almost exclusively at better preparing those who would study mathematics at university (Howson et al., 1981). Morris Kline would later state in his review of “Curriculum Development in Mathematics” by Howson, Keitel, and Kilpatrick that “new math, fortunately, fell on its face” (Kline, 1984, p. 150).

Back to Basics came next. It sought to emphasize mastery of computation. It differed from New Math in that “teachers had been perceived as generally ill-equipped for the instructional demands of New Math, it was thought that well-designed instructional materials could overcome any shortcomings in teachers' content knowledge” (Hekimoglu & Sloan, 2005, p. 36). According to Erlwanger (1973), there is no such thing as a teacher-proof mathematics curriculum (as cited in Hekimoglu & Sloan, 2005, p. 36).

Problem Solving was the third attempt to produce standards. This was produced by the National Council of Teachers of Mathematics (NCTM) and sought to promote meaningful learning by using modified real-world contexts for problem-solving techniques. The goal was to encourage students to develop logical reasoning skills and to take responsibility for their own learning (Hekimoglu & Sloan, 2005). Finally, the NCTM produced "Curriculum and Evaluation Standards for School Mathematics.” The document listed five goals for students: to learn to value mathematics, to learn to reason mathematically, to learn to communicate mathematically, to become confident of their mathematical abilities, and to become mathematical problem solvers (Suydam, 1990).

The actual standards were divided into three groups: K–4, 5–8, and 9–12. The first four standards were common among the three groups, and the rest differed based on grade level. They are listed here from the work of Suydam (1990):

- The 13 standards for K–4 are Mathematics as Problem-Solving, as Communication, and as Reasoning, and Mathematical Connections; Estimation; Number Sense and

Numeration; Concepts of Whole Number Operations; Whole Number Computation; Geometry and Spatial Sense; Measurement; Statistics and Probability; Fractions and Decimals; and Patterns and Relationships.

- There are 13 standards for grades 5–8: Mathematics as Problem Solving, as Communication, as Reasoning, and Mathematical Connections; Number and Number Relationships; Number Systems and Number Theory; Computation and Estimation; Patterns and Functions; Algebra; Statistics; Probability; Geometry; and Measurement.
- Fourteen standards pertain to grades 9–12: Mathematics as Problem Solving, as Communication, and as Reasoning, and Mathematical Connections; Algebra; Functions; Geometry from a Synthetic Perspective; Geometry from an Algebraic Perspective; Trigonometry; Statistics; Probability; Discrete Mathematics; Conceptual Underpinnings of Calculus; and Mathematical Structure. (p. 4)

Current Standards for New Jersey

The NCTM would then publish different works and variations on standards. In 2010, the Common Core State Standards (CCSS) were introduced. “The standards were created to ensure that all students graduate from high school with the skills and knowledge necessary to succeed in college, career, and life, regardless of where they live” (National Council of Teachers of Mathematics, n.d., para. 92). Although widely adopted initially, CCSS would soon face many criticisms, eventually prompting NJ Governor Chris Christie to state, “Instead of solving problems in our classrooms, it is creating new ones” (Clark, 2016, para. 9).

In May 2016, the New Jersey State Board of Education adopted the New Jersey Student Learning Standards in mathematics (New Jersey Department of Education, 2016). The intent was to improve upon the CCSS document. The state published its own standards document and supplied a crosswalk of changes from CCSS to NJSLS. For K-12 mathematics, 22 of the CCSS standards were updated. These are the standards that NJDOE schools currently use to create curriculum documents and form assessments.

Graduation Types

The New Jersey Department of Education offers two graduation types based on the New Jersey Administrative Code 6A:8-5.2 High School Diplomas (New Jersey Department of Education, n.d.-a). The first is a traditional diploma, and the second is a high school equivalency test (New Jersey Adult Education, n.d.). A traditional high school diploma requires a person to have earned at least 120 credits in various content areas.

In addition to these credits, a student must complete the NJ State testing requirements for their graduation year. For the class of 2022, the state assessment formerly known as PARCC was renamed the New Jersey Student Learning Assessment (NJSLA). Additionally, the New Jersey Department of Education (NJDOE) reduced the number of assessments for high school to one. This one assessment on Algebra 1 content standards was the primary pathway for students to meet the state testing requirement in mathematics through the class of 2022, the cohort of this study (New Jersey Department of Education, n.d.-b). For the class of 2023 and beyond, students are required to take and pass the New Jersey Graduation Assessment (NJGPA) in their 11th-grade year. This assessment includes content from both Algebra 1 and Geometry (New Jersey Department of Education, n.d.-c).

Should a student take their required assessment and not pass, they would have the opportunity to show content mastery through a second pathway. This pathway allows students to earn qualifying scores on alternate assessments like the SAT, ACT, and Accuplacer. If a student fails to pass one of the tests shown in the second pathway, the student can submit a portfolio appeal.

For the portfolio appeals submission, a student will submit four previously approved mathematics-constructed Constructed Response Tasks or CRTs. The student will complete two CRTs based on a reasoning task and two based on a modeling task. The four CRTs must come from five conceptual categories: Number and Quantity, Algebra, Functions, Geometry, and Statistics and Probability (New Jersey Department of Education, n.d.-d).

An alternate diploma offered by the New Jersey Department of Education is the General Education Development (GED) test, which is the qualifying exam for the equivalency test. The GED can be completed by any 16 and/or 17-year-old who is not enrolled in a public or private high school. Exam takers must achieve a passing score of 145 in the four subjects of Social Studies, Science, Reading, and Math (New Jersey Department of Education, n.d.-e). In this case, there is no special graduation mathematics assessment required outside the GED assessment.

Mathematics Student Achievement

Algebra 1 is an important course for students. "Mastering algebra is a fundamental step toward gaining access to and preparing for the higher-level math courses that high school students must complete in order to be prepared for college" (Snipes & Finkelstein, 2015, p. 1). The New Jersey Department of Education recognizes the importance of Algebra 1, as evidenced by its implementation of a standardized testing graduation requirement that focuses largely on Algebra 1 content standards. Additional states in the Northeast, such as Massachusetts, Connecticut, and New York, have established graduation testing requirements that include Algebra 1 content standards.

New Jersey

Students seeking to graduate from a New Jersey public high school must take and pass a mathematics graduation assessment. For the class of 2020, students needed to pass the New Jersey Student Learning Assessment (NJSLA). A passing score in any one of the following would suffice: Algebra 1, Geometry, and Algebra 2. The requirement was changed from the class of 2021, so students would need to take the NJSLA for Algebra 1. At that time, the minimum score required to pass was 750, with a test range of 650–850.

For the 2023–2025 class, the New Jersey DOE has implemented the New Jersey Graduation Proficiency Assessment. This assessment is taken by all 11th-grade students and focuses on both Algebra 1 and Geometry content standards (New Jersey Department of Education, n.d.-b).

Massachusetts

Students seeking to graduate from a Massachusetts public high school must take and pass the Massachusetts Comprehensive Assessment System (MCAS). Students seeking a high school diploma must demonstrate proficiency by meeting the Competency Determination standard. For mathematics, 10th-grade students take an MCAS and must receive a passing score. While the passing score may change from year to year, the Mass DOE website states that the class of 2021 required a 469 or higher with a range of 440–560. This test is composed of Algebra 1 and Geometry standards (Massachusetts Department of Elementary and Secondary Education, n.d.).

New York

New York has a different graduation assessment system than New Jersey and Massachusetts. Instead of one mathematics graduation assessment, New York public schools have end-of-course tests that students must pass to meet graduation requirements. New York offers three different diploma types: a Regents Diploma, an Advanced Regents Diploma, or a local diploma.

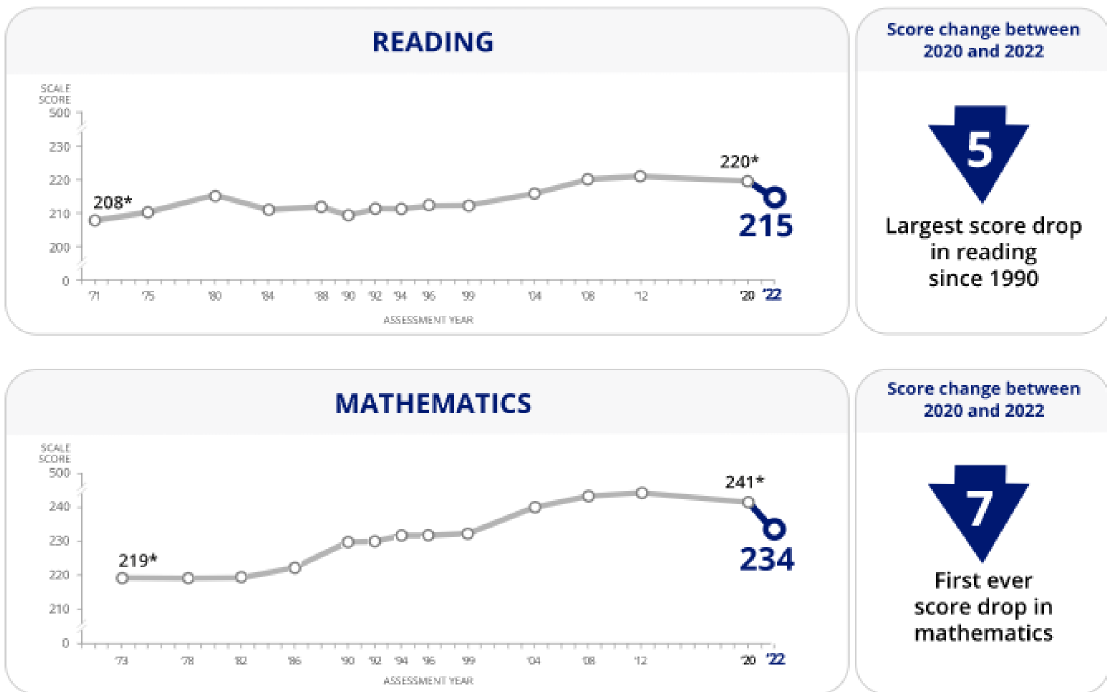
The Regent Diploma requires students to pass five exams in various content areas. For mathematics, an Algebra 1, Geometry, or Algebra 2/Trigonometry exam must be passed with a score of 65 or higher. These exams use a more traditional scale of 0–100. The Advanced Regent Diploma requires students to pass nine exams in various content areas. For mathematics, a student must earn a score of 65 or higher in Algebra 1, Geometry, and Algebra 2/Trigonometry. New York also offers a local diploma. The local diploma is reserved for unique circumstances. The NYC Department of Education website states that “only some students who meet specific criteria can graduate with a local diploma, with lower exam scores” (New York City Public Schools, n.d., para. 1).

Achievement Gap

The most current NAEP information shows that there is an overall reduced level of mathematics achievement. The NAEP published the “NAEP Long-Term Trend Assessment Results: Reading and Mathematics” on their website. This online report focused on reading and mathematics score declines during the COVID-19 pandemic (The Nation’s Report Card, 2022). It is important to note that the students tested were 9 years old. As shown in Figure 1, there were declines in both reading and mathematics. For reading, the score of 220 in 2020 declined by five points to 215 in 2022. The report stated this was the “largest average score decline in reading since 1990” (The Nation’s Report Card, 2022, para. 1). For mathematics, the score of 241 in 2020 declined by 7 points to 234 in 2022. The report states this is the “first-ever score decline in mathematics” (The Nation’s Report Card, 2022, para. 1).

Figure 1

Changes in NAEP Long-Term Trend Reading and Mathematics Average Scores for 9-year-old Students: 2020 and 2022



* Significantly different ($p < .05$) from 2022.

Note. The opening figure from the website. From *Reading and mathematics scores decline during COVID-19 pandemic*, by The Nation's Report Card, 2022 (https://www.nationsreportcard.gov/highlights/ltt/2022/). In the public domain.

While American Indian/Alaska Native, Asian, and two or more races declined, NAEP found no statistically significant changes in these categories for 2022. Figure 2 shows that, there were statistically significant ($p < .05$) score decreases from 2020 to 2022 for Black, Hispanic, and White students. White students had a decline of 5 points. Hispanic students showed a decline of 8 points. Black students showed a decline of 13 points. These results suggest that while all race/ethnicity categories showed a decline, whether significant or not, Black students were most affected. The achievement gap widened when comparing white and Black student performance from 2020 to 2022. In 2020, the gap was 25 points, increasing to 33 points in 2022.

Figure 2

Changes in NAEP Long-Term Trend Reading and Mathematics Average Scores for 9-year-old Students by Race/Ethnicity: 2020 and 2022

Student group	Percentage of students reporting learning remotely in 2020–21 school year	Reading			Mathematics		
		2020 Score	Change	2022 Score	2020 Score	Change	2022 Score
American Indian/ Alaska Native	72%	208	◆ -1	207	232	◆ -2	230
Asian	82%	240	◆ #	241	266	◆ -6	259
Black	72%	205*	↓ 6	199	225*	↓ 13	212
Hispanic	67%	210*	↓ 6	204	232*	↓ 8	223
Two or More Races	72%	224	◆ -8	216	244	◆ -8	236
White	69%	228*	↓ 6	223	250*	↓ 5	244

LEGEND

◆ No significant change in 2022

↓ Score decrease in 2022

\# Rounds to zero.

* Significantly different ($p < .05$) from 2022.

NOTE: Results are not shown for Native Hawaiian/Other Pacific Islander students because reporting standards were not met.

Note. This figure was created by the author with the tools located on the NAEP website. From *Reading and mathematics scores decline during COVID-19 pandemic*, by The Nation's Report Card, 2022 (https://www.nationsreportcard.gov/highlights/ltt/2022/). In the public domain.

In "Report in brief: NAEP 1994 trends in academic progress," White students outperformed Black and Hispanic students for ages 9, 13, and 17 in 1970 and 1994 (Campbell et al., 1996). Byrnes (2003) wrote that "Since its inception, NAEP resorts have usually shown that White students demonstrate substantially higher levels of proficiency than either Black or Hispanic students" (p. 316). Byrnes (2003) analyzed the National Assessments of Educational Progress (NAEP), looking at ethnic differences in grade 12 math achievement. The results indicated that ethnicity "accounted for less than 5% of the variance in math performance once indices of socioeconomic status, exposure to learning opportunities, and motivation were controlled" (p. 316).

When looking at gender in the same report, Figure 3 shows both males and females experienced a similar decrease in scores from 2020 to 2022. For males, the decline was 7 points. For females, the decline was 8 points. When comparing male and female student performance from 2020 to 2022, the achievement gap remained relatively unchanged, especially compared to gaps based on race. In 2020, the male and female gap was 4 points. For 2022, the male and female gap increased to 5 points.

Figure 3

Changes in NAEP Long-Term Trend Reading and Mathematics Average Scores for 9-year-Old Students, by Gender: 2020 and 2022

Student group	Percentage of students reporting learning remotely in 2020–21 school year	Reading			Mathematics		
		2020 Score	Change	2022 Score	2020 Score	Change	2022 Score
Male	69%	217*	↓ 5	212	243*	↓ 7	236
Female	70%	222*	↓ 5	217	239*	↓ 8	231

LEGEND

↓ Score decrease in 2022

* Significantly different (p < .05) from 2022.

Note. This figure was created by the author with the tools located on the NAEP website. From *Reading and mathematics scores decline during COVID-19 pandemic*, by The Nation's Report Card, 2022 (https://www.nationsreportcard.gov/highlights/ltt/2022/). In the public domain.

The achievement gap between males and females has been well studied, albeit with different opinions. Doolittle (1989) conducted a study where high school seniors took a modified ACT Assessment Mathematics Usage test. Of the three background conditions, one was gender. He found that "females performed less well than males on geometry and reasoning items" (Doolittle, 1989, p. 161). However, he did state that "females performed as well as males on algorithmic, operations-oriented items" (Doolittle, 1989, p. 161). Based on his previous research, he concludes that there seem to be differences between male and female students regarding mathematics achievement (Doolittle, 1989).

Scafidi and Bui (2010) used the National Education Longitudinal Study (NELS) data for Grades 8, 10, and 12 to examine gender similarities in mathematics achievement. They stated, “The results showed that gender did not have an overall effect on student’s test scores” (Scafidi & Bui, 2010, p. 254). Cheema and Galluzzo (2013) published an analysis of the gender gap in math achievement using the 2003 US data for the International Student Assessment (PISA). They used variables such as gender, race, socioeconomic status, math anxiety, and math self-efficacy. Their results confirmed racial and socioeconomic gaps but suggested the gender gap disappears once controlling for other predictors of math achievement (Cheema & Galluzzo, 2013).

“Mastering algebra is a fundamental step toward gaining access to and preparing for the higher-level math courses that high school students must complete to be prepared for college” (Snipes & Finkelstein, 2015, p. 1). Snipes and Finkelstein further emphasized this point by stating that students who must repeat Algebra due to failing the course are not guaranteed to succeed. Further, they state that “Failing to master algebra can thwart students’ chances of accessing and succeeding in the higher-level math courses associated with college readiness” (Snipes & Finkelstein, 2015, p. 6).

Secondary Electives

The New Jersey state minimum graduation requirement is 120 credits (New Jersey Department of Education, n.d.-f). The New Jersey Administrative Code prescribes how the 120 credits are spread across content areas. Districts can require more than 120 credits. For example, the district in the study currently requires 135 credits. Subchapter 5 of N.J.A.C.6A:8

"Implementation of Graduation Requirements," discusses in detail the components of the 120 credits (New Jersey Department of Education, n.d.-f).

Students must take at least 20 credits aligned to grade 9 through 12 standards for English Language Arts. For mathematics, students must take at least 15 credits. The NJ DOE states that these credits must include Algebra 1 or the content equivalent, Geometry or the content equivalent, and then a third year of math that builds on the skills learned in Algebra 1 and Geometry. Typically, this third year of mathematics is Algebra 2. Students often take a fourth year of math, with Precalculus being the default for the fourth year. For science, students must take 15 credits. These must include a laboratory biology or life science class, a laboratory/inquiry-based course, such as chemistry, environmental science, or physics, and a third laboratory/inquiry-based course. For Social Studies, students must take at least 15 credits, with 5 in world history, and all credits must integrate civics, economics, geography, and global content.

Students must also take credits in subjects other than what may be considered the core courses. Students must take at least 2.5 credits in a financial literacy class. Students must take 3.75 credits in health and physical education each year. In looking at the district involved with the study, this amounts to 3 marking periods of physical education and one marking period of health class each year. Students must take five credits in visual and performing arts. Students must take at least five credits in a world language. Students must take at least five credits in 21st-century life and careers or career technical education.

Typically, students will have few places in their schedule for electives at the beginning of high school, with elective opportunities increasing as they progress through high school. Implementing tier 2 and tier 3 interventions will impact a student's ability to take electives. "Not all schools have addressed what this means for credit or graduation requirements—a concern that especially exists in high school" (Shinn et al., 2016, as cited in Bouck & Cosby, 2017, p. 242).

The district involved in this study requires more credits than does NJDOE. Currently, 135 high school credits are needed to meet the district requirement. When implementing a separate math course, in addition to the Algebra 1 course, a student must relinquish an elective, which can prevent that student from reaching higher levels in content areas.

For example, this district offers students the ability to take 4 years of computer science, which culminates in an advanced computer programming class. Students who are unable to take the intro course as a freshman due to an additional math course would not then be able to reach this highest level (Wayne Public Schools, n.d.).

- Foundations to Computer Programming
- Honors Computer Programming
- AP Computer Science A
- Advanced Computer Programming

The district offers a four-course pathway for Computer Aided Design. As with computer science, a student who trades an elective as a freshman for an additional math class would never reach Computer-Aided Design 4.

The focus district is a GH District Factor Group. Similar school districts were selected in district factor groups GH and I to show that multiple districts have course pathways that can be impacted by removing an elective.

Cherry Hill district, District Factor Group GH, has two traditional high schools, Cherry Hill East and Cherry Hill West. Using computer science as an example, this district has a four-course sequence (Cherry Hill Public Schools, n.d.).

- Introduction to Computer Programming
- AP Computer Science Principles (AP CSP)
- AP Computer Science A
- Advanced Topics in Computer Science

The Paramus school district, District Factor Group GH, has one high school. Their computer science course sequence is shown here (Paramus Schools, n.d.).

- Intro to Computer Programming and Intro to Computer Hardware/Software
- Computer Programming Honors
- Topics in Computers and Technology
- AP Computer Science Principles
- AP Computer Science A

The Edison school district, District Factor Group GH, has two high schools and a 130-credit graduation requirement. They have a unique course sequence for STEM (Edison High School, n.d.).

- Intro to Engineering
- Engineering Graphics Honors
- Electrical Engineering and Design
- Senior Design & Capstone Experience

The inability of students to select desired electives can have consequences. Lewis et al. (2020) referenced Jennifer Yamin-Ali's book, *Data-driven Decision-making in Schools: Lessons from Trinidad*, where "more than half of students were unhappy with their subject selections and that students felt they needed more options in their offerings" (Lewis et al., 2020, p.75).

Susanne Hidi (1990) argued that "interest is central to determining how we select and persist in processing certain types of information in preference to others" (p. 549). In her article, she makes cases where individual and text-based interests can affect learning. "Allowing students to select their favored options is known to be beneficial for their studies" (Lewis et al., 2020, p. 76). Therefore, removing a student's choice of elective and prescribing an additional math class could inhibit student interest and performance. Further, removing an elective choice early in high school can inhibit advanced studies in non-core content areas, as shown in the school district's programs of study.

Secondary Academic Interventions

Academic interventions can come in many forms. Four general types are discussed for this study: Acceleration, Ability Grouping, Curriculum Compacting, and Response to Intervention. The common factor in these intervention types is the attempt to address specific student needs.

Acceleration

The first type of intervention is acceleration. Acceleration allows students to move faster than their peers or take courses at an earlier age (Pressey, 1949). Steenbergen-Hu et al. (2016) described five primary acceleration modes in the literature: modes are pacing, salience, peers, access, and timing. Pacing refers to the rate at which material is taught. An example would be for a group of students to complete a yearlong Algebra 1 course in one semester instead of two. Salience refers to the degree to which others, especially peers, observe the acceleration intervention. It is more prevalent in elementary and middle schools, which can require students to leave one classroom (Steenbergen-Hu et al., 2016). Salience becomes less relevant in high school, as most students travel to different classrooms throughout the day. Peer acceleration focuses on students separated from their same-age peers. An example of peer acceleration would be 9th- and 10th-grade students taking Geometry together in the same classroom.

Access refers to the availability of acceleration options to include online courses. Financial barriers and district policies can most affect this acceleration mode. As such, this mode can be more strongly associated with the issues surrounding ability grouping for underprivileged students and school funding issues. Examples of increased access would be the ability for a student to transition to a different ability group, giving parents and students the ability to waive out of a particular ability level, taking courses over the summer, or accessing online classes. Lastly, timing in acceleration simply refers to the age when acceleration options are made available to students.

Ability Grouping

The second academic intervention discussed is ability grouping. Ability grouping is a highly debated topic in the literature. Oakes (1985) pointed out that ability grouping can mean different things to different people at various times. Steenbergen-Hu et al. (2016) conducted "two second-order meta-analyses that attempted to synthesize 100 years of research on the effect of ability grouping and acceleration on K–12 students' academic achievement" (p. 849). For this study, Steenbergen-Hu et al. (2016) described ability grouping as instructional practice with three key features:

> (a) it involves placing students into different classrooms or small groups based on their initial achievement skill levels, readiness, or abilities;
>
> (b) the primary purpose of such placement is to create a more homogeneous learning environment, so that teachers can provide instruction better matched to students' needs,

and so that students can benefit from interactions with their comparable academic peers; and

(c) such placements are not permanent school administrative arrangements that lead to restrictions on students' graduation, destination, or career paths. (pp. 850-851)

According to Stennebergen-Hu et al. (2016), ability grouping can also be divided into subcategories. The first is between-class grouping. This grouping assigns students of the same grade into high, average, or low classes based on prior achievement or ability levels. An example includes the distinction between 9th-grade Algebra 1 and 9th-grade Algebra 1 Honors classes. The second is within-class grouping. In this small group instruction grouping, students in the same class are placed into subgroups based on ability for that content. For example, data can be used to group students of the same class based on their understanding of a particular mathematical content standard. The third is cross-grade subject grouping. This grouping technique will group students of different grades into the same class. For example, one Geometry class with 9th- and 10th-grade students. The last grouping is a unique grouping for the gifted. This grouping is most associated with special education pull-out or gifted and talented classes.

Steenbergen-Hu et al. (2016) deliberately distanced their definition of ability grouping from traditional tracking. Ability grouping provides more flexibility than tracking (Tiesto, 2003), suggesting that ability grouping lends itself to a growth mindset, while tracking relies more on a fixed mindset. Regardless of the definition, the literature has conflicting views on ability grouping. The argument seems to focus on between-class grouping, as this method separates students of the same grade into different classrooms based on perceived ability in mathematics.

Research against ability grouping has often cited a lack of growth mindset, inequitable opportunities, negative affect on self-esteem, lack of quality instruction for lower performing students, achievement gaps, and limited educational opportunities (Alam & Mohanty, 2023; Steenbergen-Hu et al., 2016). Hall (2014) argued that "students' self-efficacy or competence beliefs will vary depending on which course they are placed in" (p. 21). Additionally, "students in lower-ability classes have smaller class sizes and less educated and less experienced teachers" (Betts & Shkolnik, 2000, p. 25).

Compounding the issue is teacher quality in lower-ability groups and high-poverty schools. "High-poverty schools tend to have less experienced and less qualified teachers, leading to instructional instability" (Alam & Mohanty, 2023, p. 581). Oakes (1985) argued that tracking unfairly limited educational opportunities for disadvantaged students, exacerbating existing educational and social inequalities.

Research favoring ability grouping often centers around the argument for "addressing the educational needs of students whose prior achievement, skills, or abilities vary greatly" (Tieso, 2003, as cited in Steenbergen-Hu et al., 2016, p. 852). "If students are to realize true gains in achievement, not subject to the educational winds of politics, then school personnel must be aggressive in their use of appropriate and flexible ability grouping combined with curricular adjustment" (Tieso, 2003, p. 35).

Another argument for ability grouping is academic boredom. Boredom is defined as "an aversive state of wanting, but being unable, to engage in satisfying activity" (Eastwood et al., 2012, p. 483). Feuchter and Precke (2022) conducted a 3.5-year study on boredom in mathematics. Boredom can come from under challenge, where high-ability students are placed in heterogeneous grouping and do not feel challenged. Over-challenge results when the task difficulty surpasses individual capabilities (Fuechter & Precke, 2022). It occurs most often in regular classes where underperforming students have difficulty. They found that there was a larger average of boredom due to overchallenge.

Steenberg-Hu et al. (2016) acknowledged that, regardless of position on ability grouping, "ability grouping policies and practices affect students' experiences in school, including the courses they take, the curricula they receive, the peers with whom they learn, and the teacher who provide instruction" (p. 852). Of the four types of ability grouping, the Steenberg-Hu et al. (2016) second-order meta-analysis shows support for within-class grouping, cross-grade subject grouping, and special grouping for the gifted. Francis et al. (2016) listed several factors that may explain poor outcomes for students in the low-ability grouping. These include misallocation to groups, lack of fluidity in groups, quality of teaching for diverse groups, teacher expectations of pupils, differences in application of curriculum to different groups, and impact on learner identity. Tan and Dimmock (2020) stated that if ability grouping is to occur, it should be "based on a more comprehensive set of objective performance criteria" (p. 485). Both sides of the argument provide important considerations for districts to consider with ability grouping, especially when utilizing between-class grouping.

Curriculum Compacting

Curriculum compacting is "an instructional technique that is specifically designed to make appropriate curricular adjustments for students in any curricular area and at any grade level" (Reis & Renzulli, n.d., para. 3). Robertson and Pfeiffer (2016) stated that gifted students spend most of their schooling without any modifications or accommodations, and that underachievement may stem from low intrinsic motivations, as these students earn good grades for low effort in the classroom. Reis et al. (2021) stated that compacting provides time for high-potential and advanced students to experience challenging work at a young age. Several organizations are dedicated to researching gifted and talented students, including the Renzulli Center for Creativity, Gifted Education, and Talent Development out of the University of Connecticut, the Duke University of Talent and Identification Program, and the John Hopkins Center for Talented Youth. The Renzulli Center breaks curriculum compacting into three main phases, which can be further broken down into eight steps (Renzulli Center for Creativity, Gifted Education, and Talent Development, n.d.):

Three basic phases

1. Define Goals and Outcomes
2. Identify Candidates for Compacting
3. Provide Acceleration and Enrichment Options

Eight Basic Steps

1. Selecting the learning objectives for a given subject
2. Finding or creating appropriate methods for pretesting these objectives
3. Identifying students who should take the pretests
4. Pretesting students—before beginning instruction—on one or more of the objectives
5. Streamlining practice, drill, or instructional time for students who have learned the objectives
6. Providing instructional options for students who have not yet attained all the pretested objectives but generally learn faster than their classmates
7. Organizing and recommending enrichment or acceleration options for eligible students

8. Keeping records of the process and instructional options available to students whose curriculum has been compacted. (para 1)

The last academic intervention discussed here is Response to Interventions (RTI). RTI is "a systematic approach to providing early intervention for struggling students and identifying students needing targeted, intensive, and/or special education services" (Bouck et al., 2019, p. 19). Its origins can be traced to data-based instructional decision-making that evolved in the 1970s. Ysseldyke and Salvia (1974) wrote about diagnostic-prescriptive techniques for students with learning difficulties. "Diagnostic-prescriptive teaching is an attempt to identify the most effective instructional strategies for children who differ on variables believed to be related to academic learning (Ysseldyke & Salvia, 1974, p. 181). This technique sought to identify children with learning difficulties, discover their strengths and weaknesses, and then apply an intervention. Deno and Mirkin (1977) established a Data-Based Program Modification program that "is a systematic method of individualized educational plans for children with any kind of learning or behavioral problem" (p. 4). The NJDOE states that these works "shifted the focus from unmalleable student abilities and presumed ability deficits to instruction guided by the assessment of student's skill strengths and weaknesses" and "were instrumental in bringing attention to a need to gather immediate data on the effectiveness of instructional approaches to gauge their appropriateness for individual students" (New Jersey Department of Education, 2019, p. 4).

In the 1980s and 1990s, states like Iowa, Minnesota, and Pennsylvania implemented problem-solving approaches to address skill needs (New Jersey Department of Education, 2019). Ikeda et al. (2007) wrote about two forms of RTI, which were RTI-problem solving and RTI-standard treatment protocol. For RTI-problem solving, "student problems are defined in observable and measurable terms, and the gap between what is expected and what is observed" (Ikeda et al., 2007, p. 255). Examples are student grades, local benchmarks, and state testing, such as the New Jersey Graduation Proficiency Assessment. This problem-solving model aims to identify an intervention specific to the student (Fuchs et al., 2003).

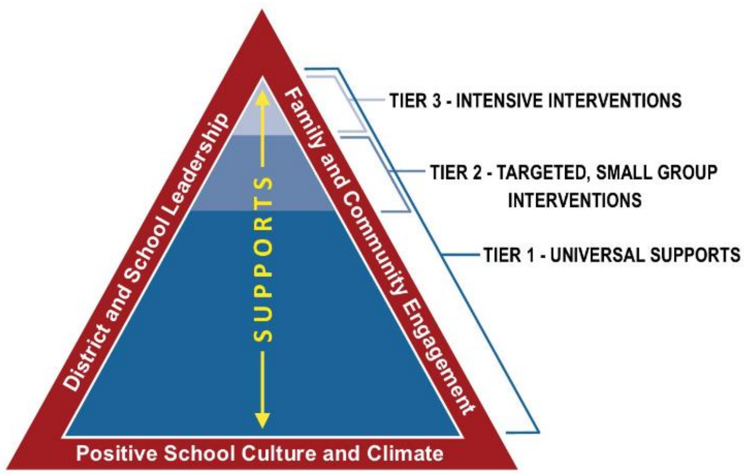
The RTI-standard treatment protocol "requires use of the same empirically validated treatment for all children with similar problems in a given domain" (Fuchs et al., 2003, p. 166). The RTI-standard treatment protocol seeks to apply the same intervention to all identified students, regardless of their individual needs. Fuchs et al. (2003) suggested the standard treatment protocol may offer advantages: "Everyone knows what to implement, and it is easier to train practitioners to conduct one intervention" (p. 166). For this study, the supplemental Algebra 1 intervention aligns itself more with the standard treatment protocol approach, in that a specific curriculum was provided to the teachers. Teachers still had the discretion to differentiate instruction for individual needs within the curricular framework, especially with special education students.

While Bouck et al. (2019) and national organizations such as the RTI Action Network (RTI Action Network, n.d.) suggested that no universal response to intervention model exists, it is widely accepted that RTI uses a 3 or 4 tier system (Mellard et al., 2010), with New Jersey utilizing a 3 tier system. Before RTI, students with learning disabilities were identified through an IQ achievement model (Vaughn & Fuchs, 2003). The RTI Action Network, A Program of the National Center for Learning Disabilities, outlines four components that "must be implemented with fidelity and in a rigorous manner" (RTI Action Network, n.d., para. 1). These components are high-quality, scientifically based classroom instruction, ongoing student assessment, tiered instruction, and parent involvement. RTI is then subdivided into three main tiers. The New

Jersey Department of Education has recognized the need for MTSS/RTI and has created the New Jersey Tiered System of Supports (NJTSS) as shown in Figure 4. Their website provides information on implementation with a foundation in district and school leadership, positive culture and climate, and family and community engagement (New Jersey Department of Education, 2019).

Figure 4

NJTSS Information Graphic from NJTSS Implementation Guidelines



Note. Graphical representation of the NJTSS framework of interventions. From *New Jersey Tiered System of Supports*, by New Jersey Department of Education, 2019 (https://www.nj.gov/education/njtss/). In the public domain.

Tier 1

Tier 1 consists of actions taken in the student's primary math course. As mentioned previously, this tier requires quality instruction by a qualified teacher to ensure that underperformance is not due to instruction. Teachers use formative and summative assessments, including state standardized assessments, to identify struggling students. Students then receive supplemental instruction in their math course. Students showing progress will no longer need in-class supplemental instruction. Students who still show deficiencies would then be moved to Tier 2 (RTI Action Network, n.d.).

Tier 2

Students entering Tier 2 are provided targeted instruction to meet their specific needs. They continue to attend and perform in their regular math courses. Tier 2 brings additional instruction outside the math course. It typically consists of small group instruction and should have a finite time, such as a marking period, a semester, or even an entire grade level (RTI Action Network, n.d.). The time allocated for Tier 2 interventions during the school day typically comes from electives or other core courses, such as Social Studies (Bouck & Cosby, 2017; Lynch, 2019). Students who do not respond to Tier 2 interventions are then moved to Tier 3.

Tier 3

If students do not respond to Tier 1 and 2, they are moved to Tier 3. Tier 3 often includes intensive interventions and services for those students who fail to respond to Tier 2 interventions (Berkeley et al., 2009). The RTI Action Network website describes the Tier 3 interventions as "individualized, intensive interventions that target the students' skill deficits" (RTI Action Network, n.d., para 7). They can be accomplished in a one-on-one or a small group setting. If students fail to respond to Tier 3 interventions, they can be "referred for a comprehensive evaluation and considered for eligibility for special education services under the Individuals with Disabilities Education Improvement Act of 2004 (IDEA 2004)" (RTI Action Network, n.d., para. 7).

Tier 2 Models for Intervention at the Secondary Level

Although most research on RTI focuses on the elementary level (Bouck, 2017), some researchers have organized various approaches to Tier 2. These are additional mathematics instruction, such as math labs, an alternative mathematics course to replace the general education mathematics course, small group pull-out mathematics support, and technological tools such as IXL (Bouck & Cosby, 2017). Bouck and Cosby created a table of these types of Tier 2 intervention in their 2017 article "Tier 2 Response to Intervention in Secondary Mathematics Education." Of the Tier 2 options listed, this study utilized an additional mathematics class, as represented in the reproduction from Bouck's and Cosby's article (see Table 1).

Table 1

Mathematics RTI Tier 2 Options for Secondary Schools

Tier 2 Options	Description and Information
Additional mathematics class	● Students take an additional math class or receive more math instruction (e.g., double period, block course, or additional period) ● Students do not miss Tier 1 instruction ● Students receive intervention consistently ● Group size can be larger
Small group pull-out math support	● Students receive small group help based on ability and/or challenges in mathematics ● Students receive intervention for a variable number of weeks and times per week ● Students may need to miss part of another class to receive intervention
Alternative Math Class	● Students take a class that differs from Tier 1 mathematics instruction ● Students are likely to be grouped based on their struggles in mathematics ● Students would not be receiving Tier 1 mathematics instruction ● Can potentially result in tracking
Technology	● Students can use online or app-based tools as an intervention ● The technology can serve as a progress monitoring, as well as provide feedback and additional practice in areas students struggle

Note. Reprinted from "Tier 2 response to intervention in secondary mathematics Education," by E.C. Bouck and M.D. Cosby, 2017, *Preventing School Failure: Alternative Education for Children and Youth*, *61*(3), p. 242. Copyright 2017 by Taylor & Francis Group, LLC. Reprinted with permission.

Chapter III

METHODOLOGY

Introduction

This non-experimental explanatory study examined the influence of an additional Algebra 1 supplemental course on student outcomes. The study measured the influence of a tier 3 math intervention course in support of Algebra 1 standards on four dependent variables: Algebra 1 grade, Geometry grade, Algebra 1 NJSLA, and PSAT10. The study examined the influence of this supplemental mathematics course while controlling for previous performance and demographic information to include the Math 8 final grade, Math 8 PARCC score, gender, special education status, race, and free/reduced lunch status. The study adds existing literature to help in curricular decision-making, and to the body of literature on MTSS/RTI at the secondary level. The results may help educational leaders select appropriate mathematical interventions for students.

Specific Design

The district had previously identified the need to provide additional math support to Algebra 1 underperforming students through a double block of Algebra 1. In the 2019–2020 school year, the district transitioned from a traditional 9-period schedule, where classes met every day, to a rotating drop schedule. The rotating drop schedule has four courses before lunch that rotate, so only three meet in 1 day. The high schools then have one unit lunch and another four courses that rotate, so only three meet in 1 day. These structural changes required the removal of the double period of Algebra 1. Recognizing the need to support students, the district implemented a supplemental math course, in addition to the underperforming students' Algebra 1 class for 2018–2019 before switching to a rotating schedule.

The design of this study is a correlational, non-experimental explanatory design with quantitative methods to see if a relation exists between an Algebra 1 intervention course and student outcomes on four dependent variables: Algebra 1 NJSLA, Algebra 1 course grade, Geometry course grade, and the PSAT10 math score. The independent variables used were gender, special education status, race, free or reduced lunch status, enrollment in the intervention, and prior performance, as demonstrated by the students' Math 8 course grade and Math 8 PARCC score. A linear regression model attempted to determine the statistical significance of the intervention course on student outcomes of 4 dependent variables while controlling for the independent variables listed above.

Recruitment and Selection of Subjects

All data for this study were from 261 students enrolled in the Algebra 1 course across two high schools in the suburban K-12 district. These students were enrolled in a regular-level high school Algebra 1 course as 9th graders. General education students were included. Special education students who only required support in the general education classroom were included. Students in the advanced Algebra 1 Enriched course were omitted. Special Education students who required a pull-out Algebra 1 class were omitted.

Eligibility to enroll in the intervention course was limited to students who met the above criteria and who scored below "meeting expectations" on the Math 8 PARCC state assessment. This limitation created three subsets within the sample population. The first was the Algebra 1 course students who were not offered the intervention. The second was the Algebra 1 course students offered the intervention but declined. The third group was students in the Algebra 1 course who were offered the intervention and enrolled in it.

Instruments and Data Collection

All data used was secondary data available to the district. The district granted permission to use this information as long as no students were contacted and no identifying information was available to the public. The data came from the class of 2022 student cohort. Demographics and course grades were taken from the student management system. PARCC, NJSLA, and PSAT10 scores were taken from a third-party data storage platform used by the district. No interaction with students or faculty occurred. Data were gathered in Excel spreadsheets. These spreadsheets were edited for easy import into Stata. The data were cleaned and matched via a "Do" file in Stata SE version 17. The Stata files were then merged into a final Stata file to run descriptive statistics and regression statistical analyses.

Data Analysis

I used a multiple linear regression analysis for the four dependent variables. A bivariate linear regression was inappropriate due to several predictor variables used in the regression. Instead, a multiple linear regression was more appropriate. The regression analysis shows if a relationship exists between the predictor variables and the dependent variables. For this study, the predictor variables were gender, student classification, race, free and reduced lunch status, math 8 course grade, math 8 PARCC math score, and enrollment in the intervention course. The dependent variables were the student's Algebra 1 course grade, Algebra 1 NJSLA score, Geometry course grade, and the PSAT 10 math score. The general form of the multiple linear regression equation is:

$$\hat{Y}=b_1X_1+b_2X_2+...+b_kX_k+a$$

In this equation, $\hat{Y}$ is the predicted value of the dependent variable. The dependent variable values for the four different models are the Algebra 1 final course grade, Geometry final course grade, Algebra 1 NJSLA, and the PSAT 10 math score. The *b* values are “the regression coefficients for the respective predictor variables," and *a* is the “regression constant” (Hinkle et al., 2003, pp.461–462). This analysis will determine how much variance in the dependent variables can be explained by the predictor or independent variables in the model. The analysis also showed the direction and magnitude of the regression coefficients of each independent variable and how they relate to the dependent variable.

Additionally, R^2 and Adjusted R^2 shall be examined. The R^2 is “the proportion of the dependent variable’s variance (sd_Y^2) shared with the optimally weighted independent variables (Cohen et al., 2013, p. 70). These values suggest how much variance in the dependent variable can be explained by the independent variables in the model. The Adjusted R^2 is similar to $R^{2,}$ with one major difference. The R^2 value will not decrease as additional independent variables are introduced to the model, which can give the false impression that an independent variable helps determine variability. The Adjusted R^2 corrects for this impression by considering the number of independent variables used for predicting the dependent variable. The advantage of Adjusted R^2 in statistical analysis is that it allows the researcher to determine if the newly introduced independent variable is helpful and allows the comparison of models with different independent variables.

Stata software was used to run the linear regressions. Beta coefficients were examined to determine the strength and direction of the relationship between the independent and dependent variables. P values were examined to determine if an independent variable was statistically significant. R^2 and Adjusted R^2 were reviewed to determine how the models explained the variance of each dependent variable.

Research Questions

RQ1: How did the implementation of the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year influence student achievement, measured by the student's performance on the Algebra 1 final grade?

RQ2: How did the implementation of the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year influence student achievement, measured by the students' performance on the Algebra 1 PARCC end-of-course assessment?

RQ3: How did implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year influence future student achievement, measured by the students' performance on the Geometry final grade?

RQ4: How did implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year influence future student achievement, measured by the students' performance on the 2019–2020 PSAT10 Math Score?

Null Hypothesis

Null Hypothesis 1: Implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year will not influence student achievement, measured by the Algebra 1 course grade.

Null Hypothesis 2: Implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year did not influence student achievement, as measured by the Algebra 1 NJSLA.

Null Hypothesis 3: Implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year did not influence student achievement, measured by the Geometry course grade.

Null Hypothesis 4: Implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year did not influence student achievement, as measured by the PSAT 10 Math Score.

Data Validity and Reliability

Validity refers to whether the assessment measures what the investigator intends to measure (Cohen et al., 2013, p. 55). Reliability is "the correlation between the variable as measured and another equivalent measure of the same variable" (Cohen et al., 2013, p.55). Federal law requires any assessment that the New Jersey Department of Education administers to be valid and reliable (New Jersey Department of Education, 2018). Regarding validity, the NJDOE state assessments are tied to its adopted curriculum standards. For example, the Algebra 1 NJSLA administered by the state uses the content standards found in the New Jersey Student Learning Standards. Therefore, the assessment measures its intended measure of Algebra 1 content standards. For validity and reliability, the state assessments "are reviewed by the U.S. Department of Education through a peer review process conducted by an external group of educators and nationally recognized experts in the field of assessment" (New Jersey Department of Education, 2018, p. 7).

Assessing the reliability and validity of subjective assessments like class grades is more complicated. Class grades can vary depending on school, course, and teacher (Bowers, 2011). This study only focuses on two high schools in the same district. In theory, students and teachers operate under the same curriculum documents, with relatively similar grading structures and the same administrative oversight. Reliability on math assessments will not be as accurate as personality tests. For example, students taking a math assessment should theoretically have some increase in their knowledge if they repeatedly take the same assessment. Contrast this with a personality test, which assesses a person's relatively fixed personality.

The linear regression models in this study were valid since all data were taken from the district's student management system, assuming the data was valid. The *p*-values associated with the *F*-value for each linear regression model were 0.0000, indicating that the models were reliable predictors of the dependent variables. While this study may be valid and reliable regarding the sample population, it would need to be replicated with additional data sets to make broader claims of validity and reliability.

Protection of Subjects

Once the data files were obtained, the students' names remained. Student local identifications were used to merge files in Stata. After all file mergers were complete, local IDs were removed. English Language Learners were omitted from this study, since only two students were in the sample population, and neither was enrolled in the intervention course.

Dependent Variables

As shown in Table 2, there are four dependent variables in this analysis: the Algebra 1 course grade, the Algebra 1 NJSLA score, the Geometry grade, and the PSAT 10 math score. These four dependent variables can be divided into two categories: standardized test scores and teacher-assigned grades. Algebra 1 and Geometry course grades are teacher-assigned, and the Algebra 1 NJSLA and PSAT 10 math scores are standardized test scores. Bowers (2011) conducted a secondary analysis for the Education and Longitudinal Study of 2002. The study used multidimensional scaling to compare the two types. Bowers reported that "grades and test scores have correlated around 0.5 to 0.6, and thus standardized test scores explain about 25–35% of grades" (p. 143). The study showed that teacher grades can assess student engagement, participation, and behavior (Bowers, 2011). Due to the historical differences between teacher-assigned grades and standardized test scores, two teacher-assigned grades and two standardized test scores were selected as dependent variables.

Table 2

Dependent Variables Used in the Study

Variable	Label	Description
Algebra 1 course grade	Alg1classgrade	Algebra 1 class grade for each student in the regular Algebra 1 course with available data.
Algebra 1 NJSLA score	Gr9MathAlgINJSLA2018_2019	Algebra 1 NJSA score for each student in the regular Algebra 1 course with available data.
Geometry course grade	Geometrygrade	Geometry class grade for each student in the sample with available data.
PSAT 10 Math Score	PSATMathScale OR PSAT Math Percentile	PSAT 10 Math score for each student in the sample with available data.

Note. Dependent variables of data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

Independent Variables

There were seven independent variables for this study as shown in Table 3: gender, special education status, race, free or reduced lunch status, enrollment in the intervention course, Math 8 class grade, and Math 8 standardized PARCC math score. The independent variable of English Language Learners was removed from this study since there were only 2 of 261 observations. Race and enrollment in the intervention class had multiple independent variables. Black, Hispanic, Asian, and White were selected for race. Enrollment in the intervention class was subdivided into three categories. The first category is students who were not offered the intervention class. The second category is students who were offered the course and did not enroll. The third category is students who were offered and enrolled in the course.

Table 3

Independent Variables Used in the Study

Variable	Label	Description
Student Gender	STUDENT_GENDER	Male coded 1; Female coded 0
Special Education Status	STUDENT_CLASSIFICATION	Students classified as special education coded 1; Non-classified students coded 0
Race: Hispanic	STUDENT_HISPANIC	Students labeled in the school management system as Hispanic coded 1; all others coded 0
Race: Black	STUDENT_AFRICAN_AMERICAN	Students labeled in the school management system as Black coded 1; all others coded 0
Race: Asian	STUDENT_ASIAN	Students labeled in the school management system as Asian coded 1; all others coded 0
Race: White	STUDENT_WHITE	Students labeled in the school management system as White coded 1; all others coded 0.
Free or Reduced Lunch Status	LunchStatus	Students who qualify for the free or reduced lunch program coded 1; all others coded 0
Enrolled in intervention course	EnrolledinKAT	Students who were offered and enrolled in

		the intervention course coded 1; all others coded 0
Offered intervention course but not enrolled	offerednotenrolledKAT	Students who were offered and not enrolled in the intervention course coded 1; all others coded 0
Not offered intervention course	notofferedKAT	Students who were not offered the intervention course coded 1; all others coded 0
Math 8 course grade	Math8grade2017_2018	Math 8 class grade for each student with available data
Grade 8 Math PARCC score	Gr8MathPARCC201718	Math 8 PARCC score for each student with available data

Note. Independent variables of data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

CHAPTER IV

ANALYSIS OF THE DATA

Introduction

This study examined the influence of a tier 3 Algebra 1 intervention course on four dependent variables: Algebra 1 course grade, Algebra 1 NJSLA, Geometry course grade, and the PSAT 10. This study sought to report several independent variables' statistical analysis and descriptive results. These variables were Math 8 course grade, Math 8 PARCC score, gender, special education status, race, and free/reduced lunch status. This data was entered into STATA version 17. This study researched the strength and relationship of the tier 3 Algebra 1 course on four student outcomes while controlling for demographic factors.

Research Questions

RQ1: How did implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year influence student achievement, measured by the students' Algebra 1 final grade?

RQ2: How did implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year influence student achievement, measured by the students' performance on the Algebra 1 PARCC end-of-course assessment?

RQ3: How did implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year influence future student achievement, measured by the students' performance on the Geometry final grade?

RQ4: How did implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year influence future student achievement, measured by the students' performance on the 2019–2020 PSAT10 Math Score?

Null Hypothesis

Null Hypothesis 1: Implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year did not influence student achievement, measured by the Algebra 1 course grade.

Null Hypothesis 2: Implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year will not influence student achievement, as measured by the Algebra 1 NJSLA.

Null Hypothesis 3: Implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year will not influence student achievement, measured by the Geometry course grade.

Null Hypothesis 4: Implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year will not influence student achievement, as measured by the PSAT 10 Math Score.

Dependent Variables

There are four dependent variables in this analysis as shown in Table 4. These are Algebra 1 course grade, Algebra 1 NJSLA score, GEOMETRY grade, and the PSAT 10 Math score. These four dependent variables can be divided into two categories: standardized test scores and teacher-assigned grades. Algebra 1 and Geometry course grades are teacher-assigned, and the Algebra 1 NJSLA score and PSAT 10 Math score are standardized test scores.

Table 4

Descriptive Statistics for the Four Dependent Variables

Variable	Obs	Mean	Std. dev	Min	Max
Algebra 1 Grade	261	77.67582	10.19202	50	96.21
Algebra 1 NJSLA	257	744.2101	23.5802	662	810
Geometry Grade	238	81.27445	9.782608	50.91	99.69
Grade 10 PSAT	243	440.2469	52.5068	280	580

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

Algebra 1 Class Grade

The Algebra 1 class grade was the final average of four marking periods and one final exam of teacher-made assessments. Each marking period was worth 20% of the grade, and the final exam was worth 10%. Several teachers were assigned to teach Algebra 1, and some variability existed in the number of assignments and their point values in the grade books. Students could be awarded a final grade from 0% to 100%. All students in this study were subject to a 50-floor grade, meaning no student could be awarded a final course grade of less than 50. This study had 261 observations with a mean score of 77.67, a standard deviation of 10.19 with a minimum of 50 and a maximum of 96.21.

Algebra 1 NJSLA Score

The Algebra 1 NJSLA scores are from the New Jersey Student Learning Assessment-Math standardized test administered to all students enrolled in Algebra 1. The NJ DOE separates the scores into Not Meeting (below 700), Partially Meeting (700–724.9), Approaching (725–749.9), Meeting (750–800.9), and Exceeding (801 and above). For this study, only 9th-grade Algebra 1 student scores that were not in an advanced Algebra 1 class, nor a pull-out Algebra 1 course, were used. Two-hundred and fifty-seven observations had a mean score of 744.21, with a standard deviation of 23.58 at a minimum of 662 and a maximum of 810.

Geometry Grade

The Geometry class grade was the final average of four marking periods and one final exam of teacher-made assessments. Each marking period was worth 20% of the grade, and the final exam was worth 10%. Several teachers were assigned to teach Algebra 1, and some variability existed in the number of assignments and point values of the grade books. Students could be awarded a final grade from 0% to 100%. All students in this study were subject to a 50-floor grade, meaning no student could be awarded a final course grade of less than 50. This study had 261 observations with a mean score of 77.67, a standard deviation of 10.19 with a minimum of 50, and a maximum of 96.21.

PSAT10 Math Score

The PSAT 10 Math Score is the math score from the PSAT 10. The College Board designed this test to test college readiness. It contains problems from “heart of algebra,” “problem solving and data analysis,” “passport to advanced math,” and “additional topics in math” (SAT Suite, n.d., para 1). The College Board states that the heart of algebra “focuses on the mastery of linear equations and systems” (SAT Suite, n.d., para 1). It states that problem solving and data analysis “is about analyzing problems drawing information from data” (SAT Suite, n.d., para 1). It states that Passport to Advanced Math “features questions that ask you to manipulate complex equations” (SAT Suite, n.d., para 1). Lastly, it states that Additional Topics in Math “can include geometry and trigonometry most relevant to college and career readiness” (SAT Suite, n.d., para 1). The PSAT 10 Math assessment is scored from 160–760 (SAT Suite, n.d.). This study had 243 observations with a mean score of 440.25, a standard deviation of 52.51, a minimum of 280 and a maximum of 580.

Independent Variables

Enrollment in the Intervention Course

This independent variable had three categories: students who were not offered the course, students who were offered the course but chose not to enroll, and students who were offered and enrolled. This data was created by matching the Math 8 PARCC scores with enrollment in the intervention course as shown in Table 5. Algebra 1 students who scored 750 or above on the Math 8 PARCC were not offered the course. Of the original 261 students in the sample, 145 fell into this category. Algebra 1 students who scored below 750 were offered the course. Of those students, 62 were offered the course and chose not to enroll. Fifty-eight students were offered the course and enrolled in the course. There were four unique cases in this sample. Three students with no Math PARCC 8 score on file enrolled in the course and 1 student was not offered the course but requested to take it anyway. These students were allowed to take the course and did not have a meaningful impact on the results. The number of student observations of the dependent variables had variations due to normal fluctuations in student populations over the 2 years the dependent variable scores were created. To run the regression, a variable for students enrolled in the intervention course (coded 1 and all others coded 0) and a variable for students offered and not enrolled in the course (coded 1 and all others coded 0) were used. Not using the variable for students not offered the course in the regression was done to avoid issues with collinearity.

For the dependent variable of Algebra 1 final grade, 145 students were not offered the intervention course, 62 students were offered the intervention course but chose not to enroll, and

58 students were offered the course and did enroll. For the dependent variable of Algebra 1 NJSLA, there were 141 students not offered the intervention course, 62 students who offered the course and did not enroll, and 58 students who were offered the course and did enroll. For the dependent variable of Geometry final grade, 131 students were offered the intervention course, 58 students were offered the course but did not enroll, and 53 students were offered the course and did enroll. For the dependent variable PSAT 10 math score, 139 students were not offered the intervention course, 57 students were offered the intervention course but did not enroll, and 51 students were offered the course and did enroll.

Table 5

Number of Students in Each Intervention Category

	Algebra 1 final grade (*N*=261)	Algebra 1 NJSLA (*N*=257)	Geometry final grade (*N*=238)	PSAT 10 math score (*N*=243)
Not offered	145	141	131	139
Offered Not Enrolled	62	62	58	57
Offered Enrolled	58	58	53	51
Totals	265	261	242	247

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

Student Gender

This independent variable had two categories: male and female. Males were coded 1, and females were coded 0. These values indicate the number of male students in the sample and the number of female students. This data came from the student management system. Tables 6-10 below provide the breakdown of males and females for each dependent variable for their enrollment category in the intervention course.

Table 6

Male and Female Totals by Dependent Variable

	Algebra 1 final grade (*N*=261)	Algebra 1 NJSLA (*N*=257)	Geometry final grade (*N*=238)	PSAT 10 math score (*N*=243)
Male	131	128	121	121
Female	134	133	121	126
Totals	265	261	242	247

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

There were 131 male and 134 female observations for the dependent variable Algebra 1 final grade. There were 128 male and 133 female observations for the dependent variable Algebra 1 NJSLA. There were 121 male and 121 female observations for the dependent variable Geometry. There were 121 male and 126 female observations for the dependent variable PSAT 10 math score.

Table 7

Male and Female Totals for Algebra 1 Final Grade and Intervention Status

	Algebra 1 final grade (*n*=261)		
	Male	Female	Totals
Not offered	71	74	145
Offered Not Enrolled	33	29	62
Offered Enrolled	27	31	58
Totals	131	134	265

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

For the dependent variable Algebra 1 final grade, gender allocations were examined for intervention status. There were 71 male and 74 female students who were not offered the intervention course; 33 male and 29 female students were offered the intervention course but chose not to enroll; and 27 male and 31 female students were offered the intervention course and enrolled.

Table 8

Male and Female Totals for Algebra 1 NJSLA with Respect to Intervention Status

	Algebra 1 NJSLA (*N*=257)		
	Male	Female	Totals
Not offered	68	73	141
Offered Not Enrolled	33	29	62
Offered Enrolled	27	31	58
Totals	128	133	261

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

For the dependent variable Algebra 1 NJSLA score, gender allocations were examined with respect to the intervention status. There were 68 male and 73 female students who were not offered the intervention course. Thirty-three male and 29 female students were offered the intervention course but chose not to enroll; 27 male and 31 female students were offered the intervention course and enrolled.

Table 9

Male and Female Totals for Geometry Final Grade with Respect to Intervention Status

	Geometry (*N*=238)		
	Male	Female	Totals
Not offered	64	67	131
Offered Not Enrolled	32	26	58
Offered Enrolled	25	28	53
Totals	121	121	242

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

For the dependent variable—Geometry final grade—gender allocations were examined with respect to the intervention status. There were 64 male and 67 female students who were not offered the intervention course. Thirty-two male and 26 female students were offered the intervention course but chose not to enroll; 25 male and 28 female students were offered the intervention course and enrolled.

Table 10

Male and Female Totals for the PSAT 10 Math Score with Respect to Intervention Status

	PSAT 10 Math score (*N*=243)		
	Male	Female	Totals
Not offered	68	71	139
Offered Not Enrolled	30	27	57
Offered Enrolled	23	28	51
Totals	121	126	247

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

For the dependent variable PSAT 10 Math score, gender allocations were examined with respect to the intervention status. There were 68 male and 71 female students who were not offered the intervention course. Thirty male and 27 female students were offered the intervention course but chose not to enroll; 23 male and 28 female students were offered the intervention course and enrolled.

Using Tables 6-10 for males and females listed above, the percentage of each as it pertains to the three categories of intervention status can be examined. Since the numbers are fairly consistent across the four dependent variables, the Algebra 1 course grade dependent variable was used. Of the 131 male students in the sample, 45.8% were offered the intervention, 25.19% chose not to enroll in the intervention, and 20.6% chose to enroll. Of the 134 female students in the sample, 48.33% were offered the intervention, 21.64% chose not to enroll, and 23.13% chose to enroll. Based on these data, there was not much difference between males and females.

Race

There are four independent variables used for race. These were Black, Hispanic, Asian, and White. The data was obtained through the district's student management system. For each variable, 1 was used if it held for the student, and 0 was used if it did not hold for the student. For the regressions, white was omitted to avoid collinearity.

Table 11 depicts the number of students by race for each dependent variable. There were 5 Black, 34 Hispanic, 23 Asian, and 203 White students for the dependent variable Algebra 1 final grade. There were 5 Black, 33 Hispanic, 23 Asian, and 200 White students for the dependent variable Algebra 1 NJSLA. There were 4 Black, 30 Hispanic, 21 Asian, and 187

White students for the dependent variable Geometry. There were 4 Black, 31 Hispanic, 22 Asian, and 190 White students for the dependent variable PSAT 10 math score.

Table 11

Number of Students by Race for Each Dependent Variable

	Algebra 1 final grade (*N*=261)	Algebra 1 NJSLA (*N*=257)	Geometry final grade (*N*=238)	PSAT 10 math score (*N*=243)
Black	5	5	4	4
Hispanic	34	33	30	31
Asian	23	23	21	22
White	203	200	187	190
Totals	265	261	242	247

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

Table 12 depicts the number of Black students per dependent variable in terms of their intervention status. For the dependent variable Algebra 1 final grade, two Black students were not offered the intervention, 0 Black students were offered the intervention but did not enroll, and 3 Black students were offered the intervention course and enrolled. For the dependent variable Algebra 1 NJSLA score, two Black students were not offered the intervention, 0 Black students offered the intervention but did not enroll, and 3 Black students were offered the intervention course and enrolled. For the dependent variable, Geometry, two Black students were not offered the intervention; 0 Black students did not enroll; and two Black students offered the intervention course enrolled. For the dependent variable PSAT 10 Math score, two Black students were not offered the intervention, 0 Black students were offered the intervention but did not enroll, and two Black students were offered the intervention course and enrolled.

Table 12

Number of Black Students for Each Dependent Variable with Respect to Intervention Status

Number of Black Students for each dependent variable with respect to intervention status

	Algebra 1 final grade (*N*=261)	Algebra 1 NJSLA (*N*=257)	Geometry final grade (*N*=238)	PSAT 10 math score (*N*=243)
Not offered	2	2	2	2
Offered Not Enrolled	0	0	0	0
Offered Enrolled	3	3	2	2
Totals	5	5	4	4

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

Table 13 depicts the number of Hispanic students per dependent variable in terms of their intervention status. For the dependent variable Algebra 1 final grade, 15 Hispanic students were not offered the intervention, six Hispanic students were offered the intervention but did not enroll, and 13 Hispanic students were offered the intervention course and enrolled. For the dependent variable Algebra 1 NJSLA score, 14 Hispanic students were not offered the intervention, six Hispanic students were offered the intervention but did not enroll, and 13 Hispanic students were offered the intervention course and enrolled. For the dependent variable, Geometry, 13 Hispanic students were not offered the intervention, six Hispanic students were offered the intervention but did not enroll, and 11 Hispanic students were offered the intervention course and enrolled. For the dependent variable, PSAT 10 Math score, there were 15 Hispanic students not offered the intervention, five Hispanic students were offered the intervention but did not enroll, and 11 Hispanic students were offered the intervention course and enrolled.

Table 13

Number of Hispanic Students for Each Dependent Variable with Respect to Intervention Status

Number of Hispanic Students for each dependent variable with respect to intervention status

	Algebra 1 final grade (*N*=261)	Algebra 1 NJSLA (*N*=257)	Geometry final grade (*N*=238)	PSAT 10 math score (*N*=243)
Not offered	15	14	13	15
Offered Not Enrolled	6	6	6	5
Offered Enrolled	13	13	11	11
Totals	34	33	30	31

Note. Data from School District A. *Confidential data set 4A43*. Unpublished confidential data set; 2023. Used with permission.

Table 14 depicts the number of Asian students per dependent variable in terms of their intervention status. For the dependent variable Algebra 1 final grade, 14 Asian students were not offered the intervention, four Asian students were offered the intervention but did not enroll, and 5 Asian students were offered the intervention course and enrolled. For the dependent variable Algebra 1 NJSLA score, 14 Asian students were not offered the intervention, four Asian students were offered the intervention and did not enroll, and 5 Asian students were offered the intervention course and enrolled. For the dependent variable, Geometry, 12 Asian students were not offered the intervention; four Asian students offered the intervention did not enroll; and five Asian students offered the intervention course who enrolled. For the dependent variable PSAT 10 Math score, 13 Asian students were not offered the intervention, and four Asian students offered the intervention did not enroll—five Asian students offered the intervention course enrolled.

Table 14

Number of Asian Students for Each Dependent Variable with Respect to Intervention Status

Number of Asian Students for each dependent variable with respect to intervention status

	Algebra 1 final grade (*N*=261)	Algebra 1 NJSLA (*N*=257)	Geometry final grade (*N*=238)	PSAT 10 math score (*N*=243)
Not offered	14	14	12	13
Offered Not Enrolled	4	4	4	4
Offered Enrolled	5	5	5	5
Totals	23	23	21	22

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

Table 15 depicts the number of White students per dependent variable in terms of their intervention status. For the dependent variable, Algebra 1 final grade, there were 114 White students not offered the intervention, 52 White students offered the intervention who did not enroll, and 37 White students offered the intervention course who enrolled. For the dependent variable Algebra 1 NJSLA score, there were 111 White students not offered the intervention, 52 White students offered the intervention but did not enroll, and 37 White students were offered the intervention course and enrolled. For the dependent variable, Geometry, there were 104 White students not offered the intervention, 48 White students offered the intervention but did not enroll, and 35 White students were offered the intervention course and enrolled. For the dependent variable PSAT 10 Math score, 109 White students were not offered the intervention, 48 White students offered the intervention but did not enroll, and 33 White students were offered the intervention course and enrolled.

Table 15

Number of White Students for Each Dependent Variable with Respect to Intervention Status

	Algebra 1 final grade (*N*=261)	Algebra 1 NJSLA (*N*=257)	Geometry final grade (*N*=238)	PSAT 10 math score (*N*=243)
Not offered	114	111	104	109
Offered Not Enrolled	52	52	48	48
Offered Enrolled	37	37	35	33
Totals	203	200	187	190

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

The percentage of students offered the intervention course, both offered but not enrolled and offered and enrolled, can be examined using all the tables for race. Since the numbers are reasonably consistent across the four dependent variables, the dependent variable Algebra 1 course grade is used. Of the five Black students, 60% were offered the intervention. 0% of these students declined the intervention, and 60% chose to enroll in the intervention. Of the 34 Hispanic students, 55.88% were offered the intervention. 17.65% declined enrollment, while 38.23% chose to enroll in the intervention. Of the 23 Asian students, 39% were offered the intervention, 17.39% declined, and 21.74% chose to enroll. Of the 203 white students, 43.84% were offered the intervention. 25.62% declined the intervention, while 18.23% chose to enroll. Black students had the highest percentage offered, although only five were in the sample, and Asian students had the lowest. White was the only category where a larger percentage of students offered the course declined.

Student Classification

This independent variable was used to distinguish how many students were classified as special education. Classified students were coded as a 1, and non-classified or general education students were coded as a 0. For this study, 504 students were considered non-classified.

Table 16 depicts the number of students by special education classification for each dependent variable. There were 39 special education and 226 general education observations for the dependent variable Algebra 1 final grade. There were 39 special education and 222 general education observations for the dependent variable Algebra 1 NJSLA. There were 34 special education and 208 general education observations for the dependent variable Geometry. There were 34 special education and 213 general education observations for the PSAT 10 math score dependent variable.

Table 16

Number of Students by Special Education Classification for Each Dependent Variable

	Algebra 1 final grade (*N*=261)	Algebra 1 NJSLA (*N*=257)	Geometry final grade (*N*=238)	PSAT 10 math score (*N*=243)
Special Ed	39	39	34	34
General Ed	226	222	208	213
Totals	265	261	242	247

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

For the dependent variable, Algebra 1, the final grade special education status was examined with respect to the intervention status (see Table 17). There were 13 special education and 132 general education students who were not offered the intervention course. Twenty special education and 42 general education students were offered the intervention course but chose not to enroll. Six special education and 52 general education students were offered the intervention course and enrolled.

Table 17

Special Education and General Education Students for Algebra 1 Final Grade with Respect to Intervention Status

Algebra 1 final grade (*n*=261)			
	Special Education	General Education	Totals
Not offered	13	132	145
Offered Not Enrolled	20	42	62
Offered Enrolled	6	52	58
Totals	39	226	265

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

For the dependent variable Algebra 1 NJSLA score, special education status was examined with respect to the intervention status (see Table 18). Thirteen special education and 128 general education students were not offered the intervention course. Twenty special education and 42 general education students were offered the intervention course and chose not to enroll. Six special education and 52 general education students were offered the intervention course and enrolled.

Table 18

Special Education and General Education Students for Algebra 1 NJSLA with Respect to Intervention Status

	Algebra 1 NJSLA (*N*=257)		
	Special Education	General Education	Totals
Not offered	13	128	141
Offered Not Enrolled	20	42	62
Offered Enrolled	6	52	58
Totals	39	222	261

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

For the Geometry course grade, dependent variable special education status was examined with respect to the intervention status (see Table 19). There were 11 special education and 120 general education students who were not offered the intervention course. Nineteen special education and 39 general education students were offered the intervention course but chose not to enroll. Four special education and 49 general education students were offered the intervention course and enrolled.

Table 19

Special Education and General Education Students for Geometry Final Grade with Respect to Intervention Status

	Geometry final grade (*N*=238)		
	Special Education	General Education	Totals
Not offered	11	120	131
Offered Not Enrolled	19	39	58
Offered Enrolled	4	49	53
Totals	34	208	242

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

For the dependent variable PSAT 10 Math score, special education status was examined with respect to the intervention status (see Table 20). Thirteen special education and 126 general education students were not offered the intervention course. There were 17 special education and 40 general education students offered the intervention course who chose not to enroll. Four special education and 47 general education students offered the intervention course enrolled.

Table 20

Special Education and General Education Students for PSAT 10 Math Score with Respect to Intervention Status

	PSAT 10 Math Score (*N*=243)		
	Special Education	General Education	Totals
Not offered	13	126	139
Offered Not Enrolled	17	40	57
Offered Enrolled	4	47	51
Totals	34	213	247

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

Using all the tables for special education and general education classification listed above, the percentage of each as it pertains to the three categories of intervention status can be examined. Since the numbers are fairly consistent across the four dependent variables, the dependent variable Algebra 1 course grade was used. Of the 39 special education students in the sample, 67% were offered the intervention. 51.28% chose not to enroll in the intervention, while 15.38% chose to enroll. Of the 226 general education students in the sample, 41.59% were offered the intervention. 18.58% chose not to enroll, while 23% chose to enroll in the intervention. Based on the percentage, numerous special education students decided not to enroll in the intervention course.

Free and Reduced Lunch Status

This independent variable was used to identify the number of students qualifying for the Federal Free or Reduced Price Lunch program (see Table 21). Students who did qualify were coded as 1. Students who did not qualify were coded as 0.

Table 21

Number of Students by Free or Reduced Lunch Status for Each Dependent Variable

	Algebra 1 final grade (*N*=261)	Algebra 1 NJSLA (*N*=257)	Geometry final grade (*N*=238)	PSAT 10 math score (*N*=243)
F/R Lunch	9	9	9	9
Non F/R Lunch	256	252	233	238
Totals	265	261	242	247

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

There were 9 free or reduced lunch and 256 non free or reduced lunch observations for the dependent variable Algebra 1 final grade. There were nine free or reduced lunch students and 252 non free or reduced lunch students for the dependent variable Algebra 1 NJSLA. There were 9 free or reduced lunch students and 233 non free or reduced lunch students for the dependent variable, Geometry. There were nine free or reduced lunch students and 238 non-free or reduced lunch students for the dependent variable PSAT 10 math score.

For the dependent variable Algebra 1 final grade, lunch status for students was examined with respect to the intervention status (see Table 22). Four students who qualified for free/reduced lunch and 141 students who did not qualify were not offered the intervention course. One student qualified for free/reduced lunch, and 61 students who did not qualify for free/reduced lunch were offered the intervention course but chose not to enroll. Four students qualified for free/reduced lunch, and 54 students who did not qualify for free/reduced lunch were offered the intervention course and enrolled.

Table 22

Free or Reduced Lunch Status for Algebra 1 Final Grade with Respect to Intervention Status

	Algebra 1 final grade (*n*=261)		
	Free/Reduced Lunch	Non-Free/Reduced Lunch	Totals
Not offered	4	141	145
Offered Not Enrolled	1	61	62
Offered Enrolled	4	54	58
Totals	9	256	265

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

For the dependent variable Algebra 1 NJSLA score, lunch status for students was examined with respect to the intervention status (see Table 23). Four students qualified for free/reduced lunch, and 137 students not qualified for free/reduced lunch were not offered the intervention course. One student who qualified for free/reduced lunch and 61 students who did were offered the intervention course but chose not to enroll. Four students who qualified for free/reduced lunch and 54 who did not qualify were offered the intervention course.

Table 23

Free or Reduced Lunch Status for Algebra 1 NJSLA with Respect to Intervention Status

	Algebra 1 NJSLA (*N*=257)		
	Free/Reduced Lunch	Non Free/Reduced Lunch	Totals
Not offered	4	137	141
Offered Not Enrolled	1	61	62
Offered Enrolled	4	54	58
Totals	9	252	261

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

For the Geometry final grade dependent variable, student lunch status was examined with respect to the intervention status (see Table 24). Four students who qualified for free/reduced lunch and 127 who did not qualify were not offered the intervention course. One student who qualified for free/reduced lunch and 57 students who did not qualify were offered the intervention course but chose not to enroll. Four students who qualified for free/reduced lunch and 49 who did not qualify were offered the intervention course and enrolled.

Table 24

Free or Reduced Lunch Status for Geometry Final Grade with Respect to Intervention Status

	Geometry final grade (*N*=238)		
	Free/Reduced Lunch	Non-Free/Reduced Lunch	Totals
Not offered	4	127	131
Offered Not Enrolled	1	57	58
Offered Enrolled	4	49	53
Totals	9	233	242

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

For the dependent variable PSAT 10 Math score, lunch status for students was examined with respect to the intervention status (see Table 25). Four students who qualified for free/reduced lunch and 135 who did not qualify were not offered the intervention course. One student qualified for free/reduced lunch, and 56 students who did not qualify for free/reduced lunch were offered the intervention course but chose not to enroll. Four students who qualified for free/reduced lunch and 47 students who did not qualify for free/reduced lunch were offered the intervention course and enrolled.

Table 25

Free or Reduced Lunch Status for PSAT 10 Math Score with Respect to Intervention Status

	PSAT 10 Math score (*N*=243)		
	Free/Reduced Lunch	Non Free/Reduced Lunch	Totals
Not offered	4	135	139
Offered Not Enrolled	1	56	57
Offered Enrolled	4	47	51
Totals	9	233	242

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

Using all the tables for lunch status listed above, the percentage of each of the three categories of intervention status can be examined. Since the numbers are fairly consistent across the four dependent variables, the dependent variable Algebra 1 course grade is used. Of the nine students who qualified for free/reduced lunch, 43.84% were offered the intervention. 11.11% chose not to enroll in the intervention, while 44.44% chose to enroll. Of the sample's 256 students who did not qualify for free/reduced lunch, 44.92% were offered the intervention. 23.8% chose not to enroll, while 21.09% chose to enroll in the intervention. It is difficult to draw conclusions, since only nine qualified students were in the sample, although they were more likely to enroll in the course if offered.

Math 8 Course Grade

This independent variable is a student's final grade in their Math 8 course. The tables below depict the descriptive statistics for this independent variable. Table 26 contains the Math 8 course grade descriptive statistics. Table 27 depicts the Math 8 course grade descriptive statistics separated into the three categories of the intervention course (not offered, offered and not enrolled, and offered and enrolled) for each of the four dependent variables. Individual values were sometimes unavailable for all the study's students, mainly due to students coming into the district after grade 8.

Table 26 shows there were 239 observations for the sample’s Math 8 course grade, with a mean of 79.49 and a standard deviation of 8.26. Again, the sample for this study was students enrolled in a regular level 9th grade Algebra 1 course. Students enrolled in Algebra 1 Enriched, a more advanced 9th-grade Algebra 1 course, were not included in the sample, nor were students who took Algebra 1 in 8th grade.

Table 26

Math 8 Course Grade Descriptive Statistics

Variable	*N*	Mean	Standard Deviation
Math 8 Course Grade	239	79.49372	8.235948

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

A common, expected theme occurs in the Math 8 course grades across all four dependent variables with respect to intervention status (see Table 27). For all the dependent variables, students who were not offered the intervention course had the highest average Math 8 grades (82.62 for Algebra 1 course grade, 82.609 for Algebra 1 NJSLA, 82.577 for Geometry course grade, and 82.958 for PSAT 10 math score). Similarly, the students offered the intervention who chose not to enroll had the second highest averages (79.37 for Algebra 1 course grade, 79.37 for Algebra 1 NJSLA, 79.27 for Geometry course grade, and 79.425 for PSAT 10 math score). Students offered the intervention who enrolled had the lowest Math 8 course grades, on average (72.33 for Algebra 1 course grade, 72.33 for Algebra 1 NJSLA, 73 for Geometry course grade, and 73.17 for PSAT 10 math score).

Table 27

Math 8 Course Grade Descriptive Statistics for Each Dependent Variable with Respect to Intervention Status

	Algebra 1 (*N*=261)			Algebra 1 NJSLA (*n*=257)			Geometry (*N*=238)			PSAT 10 math (*n*=243)		
	Not Offered	Offered Not Enrolled	Enrolled	Not Offered	Offered Not Enrolled	Enrolled	Not Offered	Offered Not Enrolled	Enrolled	Not Offered	Offered Not Enrolled	Enrolled
Mean	82.622	79.37288	72.33	82.609	79.37	72.33	82.577	79.27	73	82.958	79.425	73.17
STDdev	7.12	7.66.9	6.64	7.234	7.669	6.64	7.18	7.799	6.48	6.828	7.42	6.48

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

Math 8 PARCC Score

This independent variable is the score a student in the study received for their Math 8 PARCC state standardized test, if available. The NJ DOE separates the scores into Not Meeting (below 700), Partially Meeting (700–724.9), Approaching (725–749.9), Meeting (750–800.9), and Exceeding (801 and above).

When looking at the mean Math 8 PARCC across all four dependent variables with respect to intervention status, a similar hierarchy appears, just like the Math 8 course grades (see Table 28). For all the dependent variables, students who were not offered the intervention course had the highest average Math 8 PARCC scores (766.23 for Algebra 1 course grade, 766.23 for Algebra 1 NJSLA, 766.19 for Geometry course grade, and 766.60 for PSAT 10 math score). Similarly, the students offered the intervention who chose not to enroll had the second highest averages (734.8 for Algebra 1 course grade, 734.81 for Algebra 1 NJSLA, 735.24 for Geometry course grade, and 736.11 for PSAT 10 math score). Students offered the intervention who enrolled had the lowest average Math 8 PARCC scores (723.34 for Algebra 1 course grade, 723.34 for Algebra 1 NJSLA, 722.98 for Geometry course grade, and 723.38 for PSAT 10 math score).

Table 28

Math 8 PARCC Score Descriptive Statistics for Each Dependent Variable with Respect to Intervention Status

	Algebra 1 (*N*=261)			Algebra 1 NJSLA (*n*=257)			Geometry (*N*=238)			PSAT 10 math (*n*=243)		
	Not Offered	Offered Not Enrolled	Enrolled	Not Offered	Offered Not Enrolled	Enrolled	Not Offered	Offered Not Enrolled	Enrolled	Not Offered	Offered Not Enrolled	Enrolled
Mean	766.232	734.8	723.34	766.232	734.806	723.34	766.219	735.24	722.98	766.596	736.105	723.38
STDdev	12.46	13.52	13.51	12.46	13.52	13.51	12.306	12.915	13.83	12.579	11.974	13.9

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

Regression Results

Dependent Variable: Algebra 1 Final Course Grade

The first model tests the relationship between the independent variables previously mentioned and the dependent variable: Algebra 1 final course grade. Stata version 17 was used to run the analysis (see Table 29).

This first model had 235 observations, which means that of the 261 observations in the data set, 235 had data available for the 10 independent variables. This model had an R^2 of 0.5615, meaning the independent variables can explain approximately 56.15% of the variance in the Algebra 1 final grade. The Adjusted R^2 was 0.5419, which means 54.19% of the variance in the Algebra 1 final grade can be explained by the independent variables. It considers the number of independent variables used in the linear regression model. For this model and the following three models, a coefficient followed by *** means it is $p<.001$, ** for $p<.01$, and * for $p<.05$. Each of the coefficients provides insight into how much the dependent variable changes, with a 1 unit change in the independent variable. Only three predictor variables were statistically significant: student classification status, Math 8 final grade, and Math 8 PARCC score.

Table 29

Stata Output for Linear Regression using Dependent Variable: Algebra 1 Final Grade

Source	SS	df	MS		
				Number of obs	**235**
Model	**13671.5027**	**10**	**1367.15027**	F(10, 224)	**28.68**
Residual	**10678.253**	**224**	**47.6707722**	Prob>F	**0.0000**
Total	**24349.7557**	**234**	**104.058785**	R squared	**0.5615**
				Adj R squared	**0.5419**
				Root MSE	**6.9044**

Alg1classgrade	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
STUDENT_GENDER	**-0.2255068**	**0.9315439**	**-0.24**	**0.809**	**-2.061217**	**1.610204**
STUDENT_CLASSIFICATION	**-3.918906**	**1.386759**	**-2.83**	**0.005**	**-6.651667**	**-1.186144**
STUDENT_HISPANIC	**0.1777932**	**1.432231**	**0.12**	**0.901**	**-2.644578**	**3.000164**
STUDENT_AFRICAN_AMERICAN	**3.238279**	**3.567484**	**0.91**	**0.365**	**-3.791844**	**10.2684**
STUDENT_ASIAN	**-0.3083424**	**1.760029**	**-0.18**	**0.861**	**-3.776675**	**3.15999**
LunchStatus	**3.052175**	**2.5212**	**1.21**	**0.227**	**-1.916129**	**8.020479**
EnrolledinKAT	**2.212899**	**1.928469**	**1.15**	**0.252**	**-1.587363**	**6.01316**
offerednotenrolledKAT	**1.07465**	**1.58115**	**0.68**	**0.497**	**-2.041181**	**4.190482**
Math8grade2017_2018	**0.8202486**	**0.068191**	**12.03**	**0.000**	**0.6858706**	**0.9546265**
Gr8MathPARCC201718	**0.0833592**	**0.0384425**	**2.17**	**0.031**	**0.0076038**	**0.1591145**
_cons	**-50.09863**	**28.00762**	**-1.79**	**0.075**	**-105.2908**	**5.093498**

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

Statistically Significant Variables for the Algebra 1 Final Grade Regression

Student Classification

The first statistically significant independent variable was the student's classification status (*b* = -3.918906**). On average, a classified student had an Algebra 1 final grade that was 3.9% lower than a non-classified student.

Math 8 Course Grade

The second statistically significant independent variable was the Math 8 course grade (*b* = 0.820***). On average, for every 1 percentage point a student earned on their Math 8 final grade, they would have earned .82 of a percentage point on their Algebra 1 final grade.

Math 8 PARCC Score

The third statistically significant independent variable was the Grade 8 Math PARCC score (*b* = 0.083*). On average, for every 1 point increase in the Grade 8 Math PARCC score, an expected increase of .08 points on the Algebra 1 final grade. While this is a relatively slight increase, seeing the effects when looking at the standard deviation may be beneficial. The standard deviation for this independent variable was 22.89, so for every 1-point standard deviation increase in the Math 8 PARCC score, the Algebra 1 grade increased by 1.8312 percentage points (22.89 x 0.08).

Non-Statistically Significant Variables for the Algebra 1 Final Grade Regression

The remaining independent variables were not statistically significant. They are student gender, race, free/reduced lunch status, and intervention status. While not statistically significant, the linear regression results held for this sample.

Student Gender

Student gender was not statistically significant (b = -0.225). This coefficient was negative and can be interpreted as males scored an average 0.22 points lower than females on the Algebra 1 final grade.

Race

None of the race categories proved statistically significant for this regression. On average, Hispanic students (b = 0.1278) scored 0.1278 points lower than White students. On average, Black students (b = 3.238) scored 3.238 points higher than White students. Asian students (b = -0.308), on average, scored 0.308 points lower than White students.

Free or Reduced Lunch Status

On average, students with free or reduced lunch status (b = 3.052) scored 3.052 points higher than students who did not qualify for free or reduced lunch.

Intervention Status

There were three categories for the intervention status: students not offered the intervention, students offered who chose not to enroll, and students offered the intervention who enrolled. On average, students who enrolled in the intervention (*b* = 2.213) scored 2.213 points higher than those not offered the intervention. On average, students who were offered the course and chose not to enroll (*b* = 1.075) scored 1.075 points higher than those not offered the course. While the enrolled students scored higher than those eligible who did not enroll, this difference was negated by these beta coefficients' confidence intervals.

Dependent Variable: Algebra 1 NJSLA Score

The second model tested the relationship between the independent variables previously mentioned and the dependent variable: the Algebra 1 NJSLA score. Stata version 17 was used to run the analysis (see Table 30).

This second model had 235 observations, which means that of the 261 observations in the data set, 235 of them had data available for the 10 independent variables. This model had an R^2 of 0.3976, meaning that the independent variables can explain approximately 39.76% of the Algebra 1 NJSLA score variance. The adjusted R^2 is 0.3707, meaning 37.07% of the Algebra 1 NJSLA score variance can be explained by the independent variables and considers the number of independent variables used in the linear regression model. Similar to the first model, only three predictor variables were statistically significant: student classification status, Math 8 final grade, and Math 8 PARCC score.

Table 30

Stata Output for Linear Regression using Dependent Variable: Algebra NJSLA Score

Source	SS	df	MS		
Model	**50734.3512**	**10**	**5073.43512**	Number of obs	**235**
Residual	**76858.3892**	**224**	**343.117809**	F(10, 224)	**14.79**
Total	**127592.74**	**234**	**545.268121**	Prob>F	**0.0000**
				R squared	**0.3976**
				Adj R squared	**0.3707**
				Root MSE	**18.523**

Gr9MathAlgINJSLA201~2019	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
STUDENT_GENDER	**2.932229**	**2.499188**	**1.17**	**0.242**	**-1.992698**	**7.857156**
STUDENT_CLASSIFICATION	**-13.85794**	**3.720458**	**-3.72**	**0.000**	**-21.18951**	**-6.526361**
STUDENT_HISPANIC	**-1.54538**	**3.842455**	**-0.4**	**0.688**	**-9.117363**	**6.026603**
STUDENT_AFRICAN_AMERICAN	**-10.32603**	**9.571006**	**-1.08**	**0.282**	**-29.18676**	**8.534699**
STUDENT_ASIAN	**0.8710702**	**4.721885**	**0.18**	**0.854**	**-8.433928**	**10.17607**
LunchStatus	**-8.654338**	**6.763987**	**-1.28**	**0.202**	**-21.98353**	**4.67485**
EnrolledinKAT	**7.339833**	**5.173782**	**1.42**	**0.157**	**-2.855678**	**17.53534**
offerednotenrolledKAT	**5.266772**	**4.241979**	**1.24**	**0.216**	**-3.09252**	**13.62606**
Math8grade2017_2018	**0.524355**	**0.1829459**	**2.87**	**0.005**	**0.1638399**	**0.8848701**
Gr8MathPARCC201718	**0.5542512**	**0.1031354**	**5.37**	**0.000**	**0.3510115**	**0.757491**
_cons	**286.0717**	**75.14011**	**3.81**	**0.000**	**137.9998**	**434.1436**

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

Statistically Significant Variables for the Algebra 1 NJSLA Score Regression

Student Classification

The first statistically significant independent variable was the student's classification status (*b* = -13.857***). On average, a classified student had an Algebra 1 NJSLA score 13.857 points lower than a non-classified student.

Math 8 Course Grade

The second statistically significant independent variable was the Math 8 course grade (*b* = 0.524**). On average, for every 1 percentage point a student earned on their Math 8 final grade, they would have earned .524 points on their Algebra 1 NJSLA score.

Math 8 PARCC Score

The third statistically significant independent variable was the Grade 8 Math PARCC score (*b* = 0.554***). On average, for every 1 point increase on the Grade 8 Math PARCC score, an expected increase of .554 points on the Algebra 1 NJSLA score. The standard deviation for this independent variable was 22.89, so for every standard deviation increase in the Math 8 PARCC score, the Algebra 1 grade increased by 12.68 points (22.89 x 0.554).

Non-Statistically Significant Variables for the Algebra 1 NJSLA Score Regression

The remaining independent variables—student gender, race, free/reduced lunch status, and intervention status—were not statistically significant. They are. While not statistically significant, the linear regression results hold for this sample and are worth examining.

Student Gender

Student gender was not statistically significant (b = 2.932). This coefficient was positive and can be interpreted as males scored 2.932 points higher than females on the Algebra 1 NJSLA score.

Race

None of the race categories proved statistically significant for this regression. On average, Hispanic students (b = -1.545) scored 1.545 points lower than White students. On average, Black students (b = -10.326) scored 10.326 points lower than White students. Asian students (b = 0.871), on average, scored 0.871 points lower than White students.

Free or Reduced Lunch Status

On average, students with free or reduced lunch status (b =-8.654) scored 8.654 points lower than students who did not qualify for free or reduced lunch.

Intervention Status

There were three categories for the intervention status: students not offered the intervention, students who were offered the intervention yet chose not to enroll, and students offered the intervention and enrolled. On average, students who enrolled in the intervention (b =

7.340) scored 7.340 points higher than those not offered the intervention. On average, students who were offered the course and chose not to enroll (*b* = 5.267) scored 5.267 points higher than those not offered the course. It is worth comparing the two groups eligible for the intervention. While the enrolled students scored higher than those eligible yet did not enroll, this difference is negated when referencing these beta coefficients' confidence intervals.

Dependent Variable: Geometry Final Grade

The third model tests the relationship between the previously mentioned independent variables and the dependent variable: Geometry final grade. Stata version 17 was used to run the analysis (see Table 31).

This third model had 215 observations. Of the 261 observations in the data set, 215 had data available for the 10 independent variables. This model had an R^2 of 0.4667, meaning the independent variables can explain approximately 46.67% of the variance in the Geometry final grade. The adjusted R^2 is 0.4406, which means that the independent variables can explain 44.06% of the variance in the Geometry final grade and consider the number of independent variables used in the linear regression model. Only two independent variables for this model were statistically significant: student classification status and Math 8 final grade.

Table 31

Stata Output for Linear Regression using Dependent Variable: Geometry Final Grade

Source	SS	df	MS		Number of obs	215
Model	**9645.9027**	**10**	**964.59027**		F(10, 204)	**17.85**
Residual	**11021.518**	**204**	**54.027049**		Prob>F	**0.0000**
Total	**20667.4207**	**214**	**96.5767322**		R squared	**0.4667**
					Adj R squared	**0.4406**
					Root MSE	**7.3503**

Geometrygrade	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
STUDENT_GENDER	**0.2104338**	**1.035725**	**0.20**	**0.839**	**-1.831665**	**2.252532**
STUDENT_CLASSIFICATION	**-4.111629**	**1.576938**	**-2.61**	**0.010**	**-7.220815**	**-1.002442**
STUDENT_HISPANIC	**-1.408104**	**1.597605**	**-0.88**	**0.379**	**-4.558039**	**1.741832**
STUDENT_AFRICAN_AMERICAN	**2.429834**	**4.337015**	**0.56**	**0.576**	**-6.121288**	**10.98096**
STUDENT_ASIAN	**0.2421007**	**1.986971**	**0.12**	**0.903**	**-3.675532**	**4.159733**
LunchStatus	**-4.426646**	**2.691969**	**-1.64**	**0.102**	**-9.734295**	**0.8810029**
EnrolledinKAT	**1.385959**	**2.171296**	**0.64**	**0.524**	**-2.895101**	**5.667018**
offerednotenrolledKAT	**0.9432309**	**1.759111**	**0.54**	**0.592**	**-2.525139**	**4.411601**
Math8grade2017_2018	**0.7198473**	**0.0747881**	**9.63**	**0.000**	**0.5723905**	**0.8673042**
Gr8MathPARCC201718	**0.0614421**	**0.0433529**	**1.42**	**0.158**	**-0.0240351**	**0.1469193**
_cons	**-21.53708**	**31.6562**	**-0.68**	**0.497**	**-83.95237**	**40.87822**

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

Statistically Significant Variables for the Geometry Final Grade Regression

Student Classification

The first statistically significant independent variable was the student's classification status (*b* = -4.112**). On average, a classified student had a Geometry final grade that was 4.112 points lower than a non-classified student.

Math 8 Course Grade

The second statistically significant independent variable was the Math 8 course grade (*b* = 0.720***). On average, for every 1 percentage point a student earned on their Math 8 final grade, they would have earned .720 points on their Geometry final grade.

Non-Statistically Significant Variables for the Geometry Final Grade Regression

The remaining independent variables—gender, race, free/reduced lunch status, intervention status, and Math 8 PARCC score—were not statistically significant, but the linear regression results hold for this sample and are worth examining.

Student Gender

Student gender was not statistically significant (*b* = 0.210). This coefficient was positive and can be interpreted as males scored 0.210 points higher than females on the Geometry final grade.

Race

None of the race categories proved statistically significant for this regression. On average, Hispanic students (*b* = -1.408) scored 1.408 points lower than White students. On average, Black students (*b* = 2.42) scored 2.42 points higher than White students. Asian students (*b* = 0.242), on average, scored 0.242 points lower than White students.

Free or Reduced Lunch Status

On average, students with free or reduced lunch status (*b* = -4.427) scored 4.427 points lower than students who did not qualify for free or reduced lunch.

Intervention Status

There were three categories for the intervention status: students not offered the intervention, students who were offered yet chose not to enroll, and students offered and enrolled in the intervention. On average, students who enrolled in the intervention (*b* = 1.386) scored 1.386 points higher than those not offered the intervention. On average, students who were offered the course and chose not to enroll (*b* = 0.94e, scored 0.943 points higher than those not offered the course. It is worth comparing the two groups eligible for the intervention. While the enrolled students scored higher than those eligible yet did not enroll, this difference is negated when referencing these beta coefficients' confidence intervals.

Math 8 PARCC Score

The Math PARCC score (*b* = 0.061) for this regression was not statistically significant. On average, for every 1 point increase on the Grade 8 Math PARCC score, an expected increase of 0.061 points on the Geometry final grade. The standard deviation for this independent variable is 22.89, so for every 1 standard deviation increase in the Math 8 PARCC score, the Geometry final grade increased by 1.40 points (22.89 x 0.061).

Dependent Variable: PSAT 10 Math Score

The fourth model tests the relationship between the previously mentioned independent variables and the PSAT 10 Math Score dependent variable. Stata version 17 was used to run the analysis (see Table 32).

This fourth model had 217 observations, which means that of the 261 observations in the data set, 217 of them had data available for the 10 independent variables. This model had an R^2 of 0.3189, meaning the independent variables can explain approximately 31.89% of the variance in the PSAT 10 math score. The adjusted R^2 is 0.2859, which means that the independent variables can explain 28.59% of the variance in the PSAT 10 Math score and consider the number of independent variables used in the linear regression model. For this model, three independent variables were statistically significant: student gender, classification status, and Math 8 PARCC score.

Table 32

Stata Output for Linear Regression using Dependent Variable: PSAT 10 Math Score

Source	SS	df	MS		
Model	**189040.038**	**10**	**18904.0038**	Number of obs	**217**
Residual	**403693.603**	**206**	**1959.67768**	F(10, 206)	**9.65**
Total	**592733.641**	**216**	**2744.13722**	Prob > F	**0.0000**
				R squared	**0.3189**
				Adj R squared	**0.2859**
				Root MSE	**44.268**

PSATMathscale	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
STUDENT_GENDER	**17.24036**	**6.214866**	**2.77**	**0.006**	**4.987462**	**29.49326**
STUDENT_CLASSIFICATION	**-26.27285**	**9.454103**	**-2.78**	**0.006**	**-44.91205**	**-7.633643**
STUDENT_HISPANIC	**2.207613**	**9.610355**	**0.23**	**0.819**	**-16.73965**	**21.15488**
STUDENT_AFRICAN_AMERICAN	**-15.08494**	**26.27851**	**-0.57**	**0.567**	**-66.89425**	**36.72437**
STUDENT_ASIAN	**11.6394**	**11.64239**	**1.00**	**0.319**	**-11.31411**	**34.59291**
LunchStatus	**-6.177721**	**16.22056**	**-0.38**	**0.704**	**-38.15732**	**25.80188**
EnrolledinKAT	**-19.49817**	**13.18227**	**-1.48**	**0.141**	**-45.48763**	**6.491294**
offerednotenrolledKAT	**-8.845549**	**10.44947**	**-0.85**	**0.398**	**-29.44717**	**11.75608**
Math8grade2017_2018	**0.6426245**	**0.4624514**	**1.39**	**0.166**	**-0.26912**	**1.554369**
Gr8MathPARCC201718	**0.6854256**	**0.260025**	**2.64**	**0.009**	**0.1727741**	**1.198077**
_cons	**-123.3399**	**190.6201**	**-0.65**	**0.518**	**-499.1564**	**252.4766**

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

Statistically Significant Variables for the PSAT 10 Math Score

Student Gender

The first statistically significant dependent variable was the student's gender (*b* = 17.24**). On average, a male student scored 17.24 points higher than a female on the math portion of the PSAT 10.

Student Classification

The second statistically significant independent variable was the student's classification status (b = -26.273**). On average, a classified student had a PSAT 10 math score 26.273 points lower than a non-classified student.

Math 8 PARCC Score

The third statistically significant independent variable was the Math PARCC score (b = 0.685**). On average, for every one point increase on the Grade 8 Math PARCC score, an expected increase of 0.685 points on the PSAT 10 math score would occur. The standard deviation for this independent variable was 22.89, so for every 1 standard deviation increase in the Math 8 PARCC score, the PSAT 10 math score increased by 15.68 points (22.89 x 0.685).

Non-Statistically Significant Variables for the PSAT 10 Math Score Regression

The remaining independent variables were not statistically significant. They are race, free/reduced lunch status, intervention status, and Math 8 final grade. While not statistically significant, the linear regression results still hold for this sample and are worth examining.

Race

None of the race categories proved statistically significant for this regression. On average, Hispanic students (b = 2.20) scored 2.20 points higher than White students. On average, Black students (b = -15.08) scored 15.08 points lower than White students. Asian students (b = 11.63), on average, scored 11.63 points higher than White students.

Free or Reduced Lunch Status

On average, students with free or reduced lunch status (b = -6.178) scored 6.178 points lower than students who did not qualify for free or reduced lunch.

Intervention Status

There were three categories for the intervention status: students not offered the intervention, students who were offered yet chose not to enroll, and students offered and enrolled in the intervention. On average, students who enrolled in the intervention (b = -19.500) scored 19.5 points lower than those not offered the intervention. On average, students who were offered the course and chose not to enroll (b = -8.846) scored 8.846 points lower than those not offered the course. It is worth comparing the two groups eligible for the intervention. While the enrolled students scored lower than those eligible yet did not enroll, the difference between these two groups is negated when referencing their respective beta coefficients' confidence intervals.

Math 8 Course Grade

This fourth model's Math 8 course grade (b = 0.642) was not statistically significant. On average, for every 1 percentage point a student earned on their Math 8 final grade, they would have earned 0.642 points on their PSAT 10 math score.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Introduction

The United States has seen several programs like No Child Left Behind that have attempted to address student learning (Miyamoto, 2008). Historically, mathematics performance has been challenging, as evidenced by several attempts to create lasting standards (National Council of Teachers of Mathematics, n.d.). New Jersey's standardized math scores fall below its English scores. The New Jersey Department of Education reported that the ELA proficiency rate for the 2021–2022 school year was 49%, while the math proficiency rate was 36% (New Jersey School Performance Report, 2022). There have been several iterations of mathematical content standards, and still, there has been no consensus on addressing underperforming students and their learning gaps. Underperformance and learning gaps have only been exasperated by the COVID-19 pandemic (The Nation's Report Card, 2022), which creates a daunting task for those in education. The role of educators is to meet students where they are and ensure that their students are best prepared for the future. Tieso (2003) stated that the educational needs of students vary significantly due to prior achievement, skills, or abilities. Socioeconomic and demographic differences contribute to concerns about math performance (Alam & Mohanty, 2023; Steenbergen-Hu et al., 2016). Academic interventions are necessary to address these concerns. Response to Intervention is a major attempt to address learning gaps, but limited research is still available at the secondary level.

Implementation of any intervention is not a guarantee of success. Deliberate, thoughtful interventions are essential to outweigh the cost of losing instructional time in other areas, omitting elective opportunities available to students, preserving positive student identity, and acknowledging demographics and socioeconomics. This study sought to analyze the value of one such intervention and add to the body of intervention research at the secondary level.

Purpose

This study aimed to determine if an Algebra 1 supplemental mathematics course, based on middle school NJSLS-M content standards, delivered to underperforming 9th-grade students, as identified by the Math 8 PARCC state test, enrolled in an Algebra 1 mathematics course influences student achievement. With limited MTSS/RTI research at the secondary level, this study will provide additional data points and potentially assist districts in decision-making when implementing a tiered intervention.

Through linear regression analysis, the intervention course implemented did not significantly impact the four distinct student outcomes of Algebra 1 final course grade, Algebra 1 NJSLA, Geometry final course grade, and the PSAT 10 Math score. No statistically significant relationship exists between the implemented intervention and these outcome-dependent variables.

Organization of the Chapter

This chapter summarizes the research, including the research questions, null hypotheses, and findings for each question. This chapter also discusses recommendations for policy, practice, and future research.

Summary of Findings

Findings for Research Question 1

The summary of findings below answers each of the four research questions concerning the intervention status and highlights the statistically significant independent variables for each question. After all four research questions are addressed individually, an overview is provided to draw conclusions about this sample population.

Research Question 1: How did implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year influence student achievement, measured by the students' performance on the Algebra 1 final grade?

Null Hypothesis 1: Implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year did not influence student achievement, measured by the Algebra 1 course grade.

Based on the interpretation and analysis of data from Chapter IV, the researcher must maintain the Null Hypothesis. The linear regression suggests that implementing the intervention course was not a significant predictor when utilizing the Algebra 1 final course grade as the dependent variable.

To answer Research Question 1, a linear regression was conducted using six independent variables focusing on demographics, two independent variables focusing on intervention status, and two independent variables focusing on prior achievement. The adjusted R^2 was 0.54129, which means the ten independent variables can predict 54.19% of the variance in the dependent variable. The ten independent variables were student gender, student classification, race (separated into Black, Hispanic, Asian, and White, where White was omitted due to concerns over collinearity), free or reduced lunch status, intervention status (offered and enrolled, offered and not enrolled, and not offered where not offered was omitted to avoid issues with collinearity), Math 8 final course grade, and Math 8 PARCC score. The statistically significant variables were student classification ($p < 0.01$), Math 8 course grade ($p < 0.001$), and Math 8 PARCC score ($p < 0.05$).

Student Classification

The first statistically significant independent variable was the student's classification status (b = -3.918906**). On average, a classified student had an Algebra 1 final grade that was 3.9% lower than a non-classified student.

Math 8 Course Grade

The second statistically significant independent variable was the Math 8 course grade (b = 0.820***). On average, for every 1 percentage point a student earned on their Math 8 final grade, they would have earned .82 of a percentage point on their Algebra 1 final grade.

Math 8 PARCC Score

The third statistically significant independent variable was the Grade 8 Math PARCC score (b = 0.083*). On average, for every 1 point increase in the Grade 8 Math PARCC score, an expected increase of .08 points on the Algebra 1 final grade. While this is a relatively minor increase, seeing the effects when looking at the standard deviation may be beneficial. The standard deviation for this independent variable is 22.89, so for every 1 standard deviation increase in the Math 8 PARCC score, the Algebra 1 grade increased by 1.8312 percentage points (22.89 x 0.08). The variable of interest—intervention status—was not statistically significant. Similarly, neither student gender nor free or reduced lunch status was statistically significant.

Findings for Research Question 2

Research Question 2: How did the supplemental Algebra 1 course implemented for identified 9th-grade students in the 2018–2019 school year influence student achievement, measured by the students' performance on the Algebra 1 PARCC end-of-course assessment?

Null Hypothesis 2: Implementing the supplemental Algebra 1 course for identified 9th–grade students in the 2018–2019 school year did not influence student achievement, as measured by the Algebra 1 NJSLA.

Based on the interpretation and analysis of data from Chapter IV, the researcher must maintain the Null Hypothesis. The linear regression suggests that implementing the intervention course was not a significant predictor when utilizing Algebra 1 NJSLA as the dependent variable.

To answer Research Question 2, a linear regression was conducted using six independent variables focusing on demographics, two independent variables focusing on intervention status, and two independent variables focusing on prior achievement. The adjusted R^2 was 0.3707, which means that the 10 independent variables can predict 37.07% of the variance in the dependent variable. The seven independent variables were student gender, student classification, race (separated into Black, Hispanic, Asian, and White, where White was omitted due to concerns over collinearity, free or reduced lunch status, intervention status, offered and enrolled, offered, and not enrolled, were not offered was omitted to avoid issues with collinearity), Math 8 final course grade, and Math 8 PARCC score. The statistically significant variables were student classification ($p < 0.001$), Math 8 course grade ($p < 0.01$), and Math 8 PARCC score ($p < 0.001$).

Student Classification

The first statistically significant independent variable was the student's classification status (b = -13.857***). On average, a classified student had an Algebra 1 NJSLA score that was 13.857 points lower than a non-classified student.

Math 8 Course Grade

The second statistically significant independent variable was the Math 8 course grade ($b = 0.524^{**}$). On average, for every 1 percentage point a student earned on their Math 8 final grade, they would have earned .524 points on their Algebra 1 NJSLA score.

Math 8 PARCC Score

The third statistically significant independent variable was the Grade 8 Math PARCC score ($b = 0.554^{***}$). On average, for every 1 point increase on the Grade 8 Math PARCC score, an expected increase of .554 points on the Algebra 1 NJSLA score. The standard deviation for this independent variable is 22.89, so for every 1 standard deviation increase in the Math 8 PARCC score, the Algebra 1 grade increased by 12.68 points (22.89 x 0.554).

The variable of interest—intervention status—was not statistically significant. Similarly, student gender and free or reduced lunch status were not statistically significant.

Findings for Research Question 3

Research Question 3: How did implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year influence future student achievement, measured by the students' performance on the Geometry final grade?

Null Hypothesis 3: Implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year did not influence student achievement, measured by the Geometry course grade.

Based on the interpretation and analysis of data from Chapter IV, the researcher must maintain the Null Hypothesis. The linear regression suggests that implementing the intervention course was not a significant predictor when utilizing the Geometry final course grade as the dependent variable.

To answer Research Question 3, a linear regression was conducted using six independent variables focusing on demographics, two independent variables focusing on intervention status, and two independent variables focusing on prior achievement. The adjusted R^2 was 0.4406, which means that the 10 independent variables can predict 44.06% of the variance in the dependent variable. The seven independent variables were student gender, student classification, race (separated into Black, Hispanic, Asian, and White, where White was omitted due to concerns over collinearity), free or reduced lunch status, intervention status (offered and enrolled, offered and not enrolled, and not offered where not offered was omitted to avoid issues with collinearity), Math 8 final course grade, and Math 8 PARCC score. The statistically significant variables were student classification ($p < 0.01$) and Math 8 course grade ($p < 0.001$)

Student Classification

The first statistically significant independent variable was the student's classification status (b = -4.112**). On average, a classified student had a Geometry final grade that was 4.112 points lower than a non-classified student.

Math 8 Course Grade

The second statistically significant independent variable was the Math 8 course grade (b = 0.720***). On average, for every 1 percentage point a student earned on their Math 8 final grade, they would have earned .720 points on their Geometry final grade. The variable of interest, intervention status, was not statistically significant. Similarly, student gender, Math 8 PARCC score, and free or reduced lunch status were not statistically significant.

Findings for Research Question 4

Research Question 4: How did implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year influence future student achievement, measured by the students' performance on the 2019–2020 PSAT10 Math Score?

Null Hypothesis 4: Implementing the supplemental Algebra 1 course for identified 9th-grade students in the 2018–2019 school year did not influence student achievement, as measured by the PSAT 10 Math Score.

Based on the interpretation and analysis of data from Chapter IV, the researcher must maintain the Null Hypothesis. The linear regression suggests that implementing the intervention course was not a significant predictor when utilizing the PSAT 10 Math Score as the dependent variable.

To answer Research Question 4, a linear regression was conducted using six independent variables focusing on demographics, two independent variables focusing on intervention status, and two independent variables focusing on prior achievement. The adjusted R^2 was 0.2859, which means that the 10 independent variables can predict 28.59% of the variance in the dependent variable. The seven independent variables were student gender, student classification, race (separated into Black, Hispanic, Asian, and White, where White was omitted due to concerns over collinearity), free or reduced lunch status, intervention status (offered and enrolled, offered and not enrolled, and not offered where not offered was omitted to avoid issues with collinearity), Math 8 final course grade, and Math 8 PARCC score. The statistically significant variables were student gender ($p < 0.01$), student classification ($p < 0.01$), and Math 8 PARCC score ($p < 0.01$).

Student Gender

The first statistically significant dependent variable was the student's gender (*b* = 17.24**). On average, a male student scored 17.24 points higher than a female on the math portion of the PSAT 10.

Student Classification

The second statistically significant independent variable was the student's classification status (*b* = -26.273**). On average, a classified student had a PSAT 10 math score 26.273 points lower than a non-classified student.

Math 8 PARCC Score

The third statistically significant independent variable was the Math PARCC score (*b* = 0.685**). On average, for every 1 point increase in the Grade 8 Math PARCC score, an expected increase of 0.685 points on the PSAT 10 math score would occur. The standard deviation for this independent variable is 22.89, so for every 1 standard deviation increase in the Math 8 PARCC score, the PSAT 10 math score increased by 15.68 points (22.89 x 0.685)

The variable of interest—intervention status—was not statistically significant. Similarly, race, free or reduced lunch status, and Math 8 course grades were also statistically significant.

An Overview of the Findings

Table 33 provides the adjusted R^2 values and a collection of the coefficients for all the independent variables in the study concerning the dependent variables. Coefficients in grey were statistically insignificant, while the coefficients in white were statistically insignificant.

Adjusted R^2

The linear regression model has room for improvement and provides less longitudinal insight as it currently exists. The variance for each model, Adjusted R^2, was higher for the subjective dependent variables of Algebra 1 and Geometry grades and lower for the objective dependent variables of the Algebra 1 NJSLA and the PSAT 10 Math score. There may be benefits in creating separate models when working with either objective or subjective outcomes. One can argue that the Algebra 2 final course grade may be more useful as a dependent variable than the Geometry grade since Algebra 2 content standards are more closely related to Algebra 1.

Table 33

Overview of Statistical Significance of Independent Variables

Independent variable coefficients for the dependent variables				
	Algebra 1 Grade	**Algebra 1 NJSLS**	**Geometry Grade**	**PSAT 10 math score**
Adjusted R2	0.5419	0.3707	0.4406	0.2859
Student Gender	-0.2255068	2.932229	0.2104338	17.24036
Student Classification	-3.918906	-13.85794	-4.111629	-26.273
Race: Hispanic	0.1777932	-1.54538	-1.408104	2.207613
Race: Black	3.238279	-10.32603	2.429834	-15.08494
Race: Asian	-0.3083424	0.8710702	1.986971	11.6394
Free and Reduced Lunch Status	3.052175	-8.654338	-4.426646	-6.177721
Enrollment in Intervention	2.212899	7.339833	1.385959	-19.49817
Offered but not enrolled in intervention	1.07465	5.266772	0.9432309	-8.845549
Math 8 Grade	0.8202486	0.524355	0.7198473	0.6426245
Grade 8 PARCC	0.0833592	0.5542512	0.0614421	0.6854256

Note. Data from School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023. Used with permission.

Student Gender

For this independent gender variable, males typically scored higher in three of the four dependent variables but were only statistically significant in the PSAT 10 math score.

Student Classification

This independent variable was statistically significant across all four dependent variables. In each case, classified students underperformed their non-classified counterparts. This finding aligns with research literature and suggests continuing to assess this population's needs and provide support.

Math 8 Grade and the Math 8 PARCC Score

The Math 8 course grade was statistically significant for all dependent variables except the PSAT 10 Math score. The Math 8 PARCC score was statistically significant for all dependent variables, except the Geometry final course grade. Past performance seems to be a relatively consistent predictor of future performance.

Race

While no independent variables on race were statistically significant, there are interesting observations. On average, Hispanic students outperformed White students in Algebra 1 and the PSAT 10 math scores but underperformed on the Algebra 1 NJSLA and Geometry grades. On average, Black students outperformed their White counterparts in Algebra 1 and Geometry, both of which are subjective grades. They underperformed on the Algebra 1 NJSLA and the PSAT 10 Math scores, which are objective grades. On average, Asian students outperformed their White counterparts in all areas except the Algebra 1 course grade.

Free and Reduced Lunch Status

Economically disadvantaged students, as identified by their lunch status, outperformed their counterparts on the Algebra 1 final grade but underperformed in all other areas. The literature shows that economically disadvantaged students underperform their counterparts.

Intervention Status

The independent variables concerning intervention status were not statistically significant. As such, it is difficult to draw conclusions about the intervention, especially considering the standard of error. While the intervention did not “hurt” student scores, enrollment did inhibit those students from taking a self-selected elective during their freshman year.

Recommendations for Policy and Practice

This study did not provide statistically significant evidence that the supplemental Algebra 1 intervention was effective, but this does not mean districts should avoid implementing mathematics interventions. Instead, districts should take a methodical, research-based approach when implementing interventions. The literature shows that many types of interventions, such as acceleration, ability grouping, response to intervention, and curriculum compacting, are available to districts. These types of interventions can be interwoven to create a system of support that addresses the needs of students and hedges against the issues critics take with certain intervention types, such as between-class grouping.

For example, most districts have honors classes, regular classes, and special education classes. These groupings are essential to providing homogeneity. Districts can leverage responses to intervention and curriculum compacting within these between-class groupings. According to Bouck et al. (2019), both are a “systematic approach to providing early intervention for struggling students and identifying students in need of targeted, intensive, and/or special education services” (p. 19). Early intervention is helpful for all ability levels. Districts should have identification methods for students who need support to correct underperformance and for students who should be allowed to push forward in the curriculum. Teachers can leverage both types of interventions when conducting within-class groupings. However, the more heterogeneous a class is, the more monumental the task for the teacher.

Another important consideration when applying interventions is the mobility opportunities of the student. Students should not be stuck in a particular grouping or track if their performance suggests otherwise. Districts need mechanisms to move students between groups and levels. For example, if a student in a lower ability group consistently achieves high scores, that student should have opportunities to move to a higher ability group. Another example is acceleration. Often, higher-ability math students will take Algebra 1 in 8th grade, Geometry in 9th grade, and Algebra 2 in 10th grade. If students excel in Algebra 1 in 9th grade, they should be allowed to take Geometry and Algebra 2 in 10th grade. Another option would be to allow this student to take Geometry over the summer so they can take Algebra 2 in 10th grade. Either solution puts that student on the same trajectory as the initially identified high-ability group. In cases where the student's placement could go either way, input from the parent/guardian is essential. NJDOE identifies family and community engagement as one of the three foundational elements of its New Jersey Tiered Support Systems. Districts should consider a waiver system for math placement in such cases.

As was mentioned in the literature review, "interest is central to determining how we select and persist in processing certain types of information in preference to others" (Hidi, 1990, p. 549). Regarding a supplemental math course, removing an elective from a student's schedule early in their high school career can limit advanced studies in non-core content areas. Doing so may have a disproportionate effect on historically underperforming groups. Combining several intervention categories into a cohesive system will help best support student success, minimize the loss of instructional time in other courses, minimize the loss of electives, and ideally reduce the need for referrals to special services.

Districts also need to consider other factors, including teacher quality, teacher preparation, and the resources to use in the intervention. Teacher preparation can be viewed with subcategories such as teacher experience, education level, and professional development training. Teacher experience was one key to improving elementary math learning (Harris & Sass 2011). Campbell and Malkus (2011) found that years of experience have a greater impact on student outcomes than education at the elementary level. These authors suggested that teachers with 5 to 9 years of experience have better outcomes than early-career teachers. Harris and Sass (2011) confirmed this conclusion, stating that the largest gains for early teachers tend to occur in the first 5 years. Regardless of teacher experience, teacher expectations of students play a role in outcomes associated with ability grouping (Saleh et al., 2005). The literature suggests that more effective, veteran teachers with high expectations and proper training will improve the chances of an intervention's success.

Districts across the country need to attract the highest caliber teachers possible. The United States' education system is often compared to high-performing countries like Finland, Singapore, and South Korea (Alam & Mohanty, 2023). McKinsey & Company conducted a report in 2007 to understand why the world's top-performing school systems do so much better than others. The report suggested that attracting the right candidates is the main factor. High-performing countries could develop processes for selecting and training teachers, pay reasonable starting compensation, and manage the status of the teaching profession (Barber & Mourshed, 2007). The report states that Singapore and Finland have the most effective selection process, which assesses three items: academic achievement, communication skills, and motivation for teaching. Even if there is a good selection process, an education system must attract high-quality teaching applicants.

Teachers’ starting salaries are much lower in the United States than in other countries. In 2007, the starting salary in South Korea was 141% per capita GDP. Finland and Singapore had 95% per capita GDP, while the United States had 81% per capita GDP (Barber & Mourshed, 2007). For example, a math or engineering student must be financially incentivized to choose teaching instead of the corporate workforce. The last factor, the status of the profession, is paramount. “New teachers in all of the systems studied consistently reported that the profession's status is one of the most important factors in their decision to become a teacher” (Barber & Mourshed, 2007, p. 22). Policymakers must celebrate the profession of teaching. Policymakers and districts need to increase teacher pay. Celebrating the teaching profession and paying higher salaries should increase the demand to enter teaching. Sufficient demand to enter teaching will naturally allow for a more rigorous selection process.

Resource selection is essential but should not be the only solution. The selected primary resources used in the mathematics courses may have sufficient content for the intervention mathematics course. Bernstein (1985) expressed concern over textbook selection, stating that districts typically purchase a book at grade level or one that the least able students can read. This practice sacrifices the needs of the more advanced students and may not demand high enough expectations of the lower-ability students. Additional resources can be used to supplement the low and high-ability students, but resources alone will not address the issue. For example, Tienken and Maher (2008) found that computer-assisted instruction did not significantly improve 8th-grade math scores.

Lastly, it may be prudent for districts to investigate the role of the student in their learning, including motivation, socioeconomics, other demographic factors, student engagement, math readiness, and support in the home. The need for support in the home continually appears in the literature, policies, and intervention models.

Recommendations for Future Research

More research is needed on the outcomes of implementing response to intervention at the secondary level, especially in mathematics. This study suggested that implementing a supplemental math course is not enough to affect student outcomes and that a systematic and research-based intervention implementation approach may provide a better probability of success.

Based on this study, there are a few recommendations for future research. The first would be to conduct a proper experimental design for an intervention mathematics course. Johnson (2001) wrote that non-experimental research could suggest a need for experimental research design. The second would be to incorporate factors such as teacher experience, teacher preparation, and resource type as predictor variables in future models. The third would be to conduct research that incorporates student predictor factors, including demographics, student motivation, math readiness, attendance, engagement, and support in the home. A fourth recommendation for future research would be to investigate why students offered an intervention will choose to enroll or not enroll. Finally, this study examined an intervention in its first year of implementation. An extended longitudinal study may prove helpful.

Conclusion

This study examined the effectiveness of a supplemental Algebra 1 intervention course given to underperforming 9th-grade students. While the intervention had no statistical significance, the scope of the study offers greater insight into intervention applications and their considerations. Opportunities exist to support both low and high ability students simultaneously. Incorporating acceleration, ability grouping, response to intervention, and curriculum compacting through a growth mindset lens may provide districts with a way to serve all students best. The school, the community, and the student must work synergistically to increase the probability of success.

Finally, districts should continually evaluate their intervention programs, collect and analyze data, refine instructional processes, and adjust as new research becomes available. Doing this will better enable districts to meet the needs of all students, regardless of ability or background.

REFERENCES

Alam, A., & Mohanty, A. (2023). Cultural beliefs and equity in educational institutions: Exploring the social and philosophical notions of ability groupings in teaching and learning of mathematics. *International Journal of Adolescence and Youth*, *28*(1), 576-599. https://doi.org/10.1080/02673843.2023.2270662

Alexander, L. (1991). *America 2000: An education strategy*. United States Department of Education.

Barber, M., & Mourshed, M. (2007). *How the world's best-performing school systems come out on top*. McKinsey & Company. https://www.mckinsey.com/industries/education/our-insights/how-the-worlds-best-performing-school-systems-come-out-on-top

Berkeley, S., Bender, W. N., Gregg Peaster, L., & Saunders, L. (2009). Implementation of response to intervention: A snapshot of progress. *Journal of Learning Disabilities*, *42*(1), 85–95. https://doi.org/10.1177/0022219408326214

Bernstein, H. T. (1985). The new politics of textbook adoption. *The Phi Delta Kappan*, *66*(7), 463–466. https://www.jstor.org/stable/20387395

Betts, J. R., & Shkolnik, J. (2000). Key difficulties in identifying the effects of ability grouping on student achievement. *Economics of Education Review*, *19*(1), 21–26. https://doi.org/10.1016/s0272-7757(99)00022-9

Bolman, L. G., & Deal, T. E. (2013). *Reframing organizations: Artistry, choice, and leadership*. John Wiley & Sons.

Bouck, E. C., & Cosby, M. D. (2017). Tier 2 response to intervention in secondary mathematics education. *Preventing School Failure: Alternative Education for Children and Youth*, *61*(3), 239–247. https://doi.org/10.1080/1045988X.2016.1266595

Bouck, E. C., Park, J., Bouck, M., Alspaugh, J., Spitzley, S., & Buckland, A. (2019). Supporting middle school students in tier 2 math labs: Instructional strategies. *Current Issues in Middle Level Education*, *24*(2), 18-32. https://doi.org/10.20429/cimle.2019.240203

Bowers, A. J. (2011). What's in a grade? The multidimensional nature of what teacher-assigned grades assess in high school. *Educational Research and Evaluation*, *17*(3), 141–159. https://doi.org/10.1080/13803611.2011.597112

Byrnes, J. P. (2003). Factors predictive of mathematics achievement in White, Black, and Hispanic 12th graders. *Journal of Educational Psychology*, *95*(2), 316–326. https://doi.org/10.1037/0022-0663.95.2.316

Caldwell, O. W., & Courtis, S. A. (1924). *Then & now in education, 1845:1923: A message of encouragement from the past to the present*. World Book Company. http://hdl.handle.net/2027/mdp.39015005566347

Campbell, J. R., & Dossey, J. A., & Reese, C. M., & O'Sullivan, C. (1996). *NAEP 1994 trends in academic progress*. National Center for Education Statistics, Office of Educational Research and Improvement, U.S. Department of Education. https://nces.ed.gov/nationsreportcard/pubs/main1994/97095.aspx

Campbell, P. F., & Malkus, N. N. (2011). The impact of elementary mathematics coaches on student achievement. *The Elementary School Journal*, *111*(3), 430-454. https://www.jstor.org/stable/10.1086/657654

Cheema, J. R., & Galluzzo, G. (2013). Analyzing the gender gap in Math achievement: Evidence from a large-scale U.S. sample. *Research in Education*, *90*, 98-112. https://www.proquest.com/scholarly-journals/analyzing-gender-gap-math-achievement-evidence/docview/1498088029/se-2

Cherry Hill Public Schools. (n.d.). *High school course selection booklet/Mathematics*. Retrieved April 14, 2023, from https://www.chclc.org/Page/1144

Clark, A. (2016, May 4). *N.J. revises, renames common core academic standards.* NJ.com. https://www.nj.com/education/2016/05/nj_common_core_standards_christie.html

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2013). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.). Taylor and Francis. https://doi.org/10.4324/9780203774441

Crawley, P. (2018). *The effect of mandating algebra for all students in grade 8 versus grade 9 in a small suburban k-12 school district in new jersey* [Doctoral dissertation, Seton Hall University]. ProQuest LLC. https://www.proquest.com/docview/2985646786/1BF3D92DAFF242CEPQ/3?accountid=13793&sourcetype=Dissertations%20&%20Theses

Deno, S. L., & Mirkin, P. K. (1977). *Data-based program modification: A manual*. University of Minnesota.

Doolittle, A. E. (1989). Gender differences in performance on mathematics achievement items. *Applied Measurement in Education*, *2*(2), 161-177. https://doi.org/10.1207/s15324818ame0202_5

Eastwood, J. D., Frischen, A., Fenske, M. J., & Smilek, D. (2012). The unengaged mind. *Perspectives on Psychological Science*, *7*(5), 482–495. https://doi.org/10.1177/1745691612456044

Edison High School. (n.d.). *Student handbook.* Retrieved April 14, 2023, from https://ehs.edison.k12.nj.us/student-resources/student-handbook

Erlwanger, S. H. (1973). Benny's conception of rules and answers in IPI mathematics. *Journal of Children's Mathematical Behavior*, *1*(2), 7–26.

Feuchter, M. D., & Preckel, F. (2022). Reducing boredom in gifted education—Evaluating the effects of full-time ability grouping. *Journal of Educational Psychology*, *114*(6), 1477–1493. https://doi.org/10.1037/edu0000694

Francis, B., Archer, L., Pepper, D., Taylor, B., Travers, M.-C., & Hodgen, J. (2017). Exploring the relative lack of impact of research on "ability grouping" in England: A discourse analytic account. *Cambridge Journal of Education*, *47*(1), 1-17. https://doi.org/10.1080/0305764X.2015.1093095

Fuchs, D., Mock, D., Morgan, P. L., & Young, C. L. (2003). Responsiveness-to-intervention: Definitions, evidence, and implications for the learning disabilities construct. *Learning Disabilities Research & Practice*, *18*(3), 157–171. https://doi.org/10.1111/1540-5826.00072

Hall, A G. (2014). *Investigating ability grouping and self-efficacy in middle grade mathematics* [Master's thesis, University of Kentucky]. University of Kentucky's Institutional Repository. https://uknowledge.uky.edu/edp_etds/26

Harris, D. N., & Sass, T. R. (2011). Teacher training, teacher quality and student achievement. *The Journal of Public Economics*, *95*(7–8), 798-812. https://www.sciencedirect.com/science/article/pii/S0047272710001696

Heise, M. (1994). Goals 2000: Educate America act: The federalization and legalization of educational policy. *Fordham Law Review*, *63*(2), 345-381. https://ir.lawnet.fordham.edu/cgi/viewcontent.cgi?article=3133&context=flr

Hekimoglu, S., & Sloan, M. H. (2005). A compendium of views on the NCTM standards. *The Mathematics Educator*, *15*(1), 35–43. https://eric.ed.gov/?id=EJ845846

Hidi, S. (1990). Interest and its contribution as a mental resource for learning. *Review of Educational Research*, *60*(4), 549-571. https://www.proquest.com/scholarly-journals/interest-contribution-as-mental-resource-learning/docview/214118921/se-2

Hinkle, D. E., Jurs, S. G., & Wiersma, W. (2003). *Applied statistics for the behavioral sciences* (5th ed.). Cengage Learning.

Howson, G., Keitel, C., & Kilpatrick, J. (1981). *Curriculum development in mathematics*. Cambridge University Press. https://doi.org/10.1017/CBO9780511569722

Ikeda, M. J., Rahn-Blakeslee, A., Niebling, B. C., Gustafson, J. K., Allison, R., & Stumme, J. (2007). The heartland area education agency 11 problem-solving approach: An overview and lessons learned. In S. R. Jimerson, M. K. Burns, & A. M. VanDerHeyden (Eds.), *Handbook of response to intervention: The science and practice of assessment and intervention* (pp. 255–268). Springer. https://doi.org/10.1007/978-0-387-49053-3_19

Jefferson, T. (1829). *Memoir, correspondence, and miscellanies from the papers of T. Jefferson*. F. Carr & Co.

Johnson, B. (2001, March 1). Toward a new classification of nonexperimental quantitative research. *Educational Researcher*, *30*(2), 3-13. https://doi.org/10.3102/0013189x030002003

Lewis, R., Anderson, T., & Carroll, F. (2020). Can school enrollment and performance be improved by maximizing students' sense of choice in elective subjects? *Journal of Learning Analytics*, *7*(1), 75–87. https://dx.doi.org/10.18608/jla.2020.71.6

Lynch, M. (2019, October 15). *Types of classroom interventions.* The Edvocate. https://www.theedadvocate.org/types-of-classroom-interventions/

Massachusetts Department of Elementary and Secondary Education. (n.d.). *Massachusetts comprehensive assessment system: Massachusetts graduation requirements and related guidance*. Retrieved April 14, 2023, from https://www.doe.mass.edu/mcas/graduation.html

McConn, M. (1935). *Examinations old and new: Their uses and abuses*. American Council on Education.

McGregor, D. (1960). *The human side of enterprise*. McGraw-Hill.

McMurry, F. (1913). *Elementary school standards: Instruction, course of study, supervision applied to New York City schools.* World Book Company. http://hdl.handle.net/2027/loc.ark:/13960/t80k34f8b

Mellard, D., McKnight, M., & Jordan, J. (2010). RTI tier structures and instructional intensity. *Learning Disabilities Research & Practice*, *25*(4), 217–225. https://doi.org/10.1111/j.1540-5826.2010.00319.x

Miyamoto, K. (2008). The origins of the standards movement in the United States: Adoption of the written test and its influence on class work. *Educational Studies in Japan, International Yearbook*, *3*(0), 27–40. https://doi.org/10.7571/esjkyoiku.3.27

Morris Kline. (1984). [Review of *Curriculum Development in Mathematics.*, by Geoffrey Howson, Christine Keitel, & Jeremy Kilpatrick]. *The American Mathematical Monthly*, *91*(2), 150–151. https://doi.org/10.2307/2322127

National Council of Teachers of Mathematics. (n.d.). *NCTM 100 Timeline—National council of teachers of mathematics*. https://www.nctm.org/100timeline/

New Jersey Adult Education. (n.d.). *Pathways to a high school diploma*. Retrieved April 15, 2023, from https://www.nj.gov/education/adulted/pathways/

New Jersey Department of Education. (2016, July). *Historical context: Overview of New Jersey's statewide testing program*. https://www.nj.gov/education/assessment/history.shtml

New Jersey Department of Education. (2018, July 12). *New Jersey Department of Education statewide assessment outreach summary of findings, recommendations for next steps*. https://www.nj.gov/education/assessment/outreach.shtml

New Jersey Department of Education. (2019). *New Jersey tiered system of supports*: *Implementation guidelines*. https://www.nj.gov/education/njtss/

New Jersey Department of Education. (2022). *New Jersey school performance report*. https://rc.doe.state.nj.us/2021-2022/state/detail/academic?lang=EN

New Jersey Department of Education. (n.d.-a). *New Jersey administrative code and statute: Current rules title 6A:8, standards and assessment*. https://www.nj.gov/education/code/current/

New Jersey Department of Education. (n.d.-b). *Class of 2022 high school graduation assessment requirements*. Retrieved April 15, 2023, from https://www.nj.gov/education/assessment/requirements/2022.shtml

New Jersey Department of Education. (n.d.-c). *Classes of 2023–2025 high school graduation assessment requirements*. Retrieved April 15, 2023, from https://www.nj.gov/education/assessment/requirements/2023_2025.shtml

New Jersey Department of Education. (n.d.-d). *Informational guide for the mathematics portfolio appeals process*. Retrieved April 15, 2023, from https://www.nj.gov/education/assessment/requirements/MathematicsInformationalGuidePortfolioAppeals.shtml

New Jersey Department of Education. (n.d.-e). *New Jersey adult education: GED*. Retrieved April 15, 2023, https://www.nj.gov/education/adulted/pathways/ged/index.shtml

New Jersey Department of Education. (n.d.-f). *Administrative code and statute: New Jersey state minimum graduation requirements by content area 120 credits (N.J.A.C. 6A:8-5.1)*. https://www.nj.gov/education/code/current/

New York City Public Schools. (n.d.). *Graduation requirements*. Retrieved April 15, 2023, from https://www.schools.nyc.gov/learning/student-journey/graduation-requirements

Oakes, J. (1985). *Keeping track: How schools structure inequality.* Yale University Press.

Palmer, T. A., Burke, P. F., & Aubusson, P. (2017). Why school students choose and reject science: A study of the factors that students consider when selecting subjects. *International Journal of Science Education*, *39*(6), 645– 662. https://doi.org/10.1080/09500693.2017.1299949

Paramus Schools (n.d.). *Program of studies.* Retrieved April 16, 2023, from https://sites.google.com/paramusschools.org/programofstudies2022-23/s-t-e-m/course-list

Pressey, S. L. (1949). *Educational acceleration; appraisals and basic problems.* Ohio State University.

Reis, S. M., & Renzulli, J. S. (n.d.). *Curriculum compacting: a systematic procedure for modifying the curriculum for above average ability students*. Renzulli Center for Creativity, Gifted Education, and Talent Development. Retrieved December 13, 2023, from https://gifted.uconn.edu/schoolwide-enrichment-model/curriculum_compacting/

Reis, S. M., Renzulli, J. S., & Burns, D. E. (2021). *Curriculum compacting: A guide to differentiating curriculum and instruction through enrichment and acceleration*. Routledge. https://doi.org/10.4324/9781003234036

Renzulli Center for Creativity, Gifted Education, and Talent Development. (n.d.). *Compacting*. University of Connecticut. Retrieved December 12, 2023, from https://gifted.uconn.edu/compacting/

Rice, J. M. (1893). *The public-school system of the United States*. The Century Co. http://hdl.handle.net/2027/mdp.39015011928705

Robertson, S., & Pfeiffer, S. (2016). Development of a procedural guide to implement response to intervention (RtI) with high-ability learners. *Roeper Review*, *38*(1), 9–23. https://doi.org/10.1080/02783193.2015.1112863

RTI action network. (n.d.). *What is response to intervention (RTI)?* Retrieved April 17, 2023, from http://www.rtinetwork.org/learn/what/whatisrti

Saleh, M., Lazonder, A. W., & De Jong, T. (2005). Effects of within-class ability grouping on social interaction, achievement, and motivation. *Instructional Science*, *33*(2), 105–119. https://doi.org/10.1007/s11251-004-6405-z

SAT Suite. (n.d.). *The math test: Overview*. Retrieved May 15, 2023, from https://satsuite.collegeboard.org/psat-10/whats-on-the-test/math/overview

Scafidi, T., & Bui, K. (2010). Gender similarities in math performance from middle school through high school. *Journal of Instructional Psychology*, *37*(3), 252–255. https://www.proquest.com/docview/762316057?sourcetype=Scholarly%20Journals

School District A. *Confidential data set 4A43.* Unpublished confidential data set; 2023.

Shinn, M. R., Windram, H. S., & Bollman, K. A. (2016). Implementing response to intervention in secondary schools. In S. R. Jimerson, M. K. Burns, & A. M. VanDerHeyden (Eds.), *Handbook of response to intervention: The science and practice of multi-tiered systems of support* (2nd ed., pp. 563–586). Springer. https://doi.org/10.1007/978-1-4899-7568-3_32

Smith, T. M. (2004). Curricular reform in mathematics and science since a nation at risk. *Peabody Journal of Education*, *79*(1), 105–129. https://doi.org/10.1207/s15327930pje7901_6

Snipes, J., & Finkelstein, N. (2015). *Opening a gateway to college access: Algebra at the right time. Research brief*. Regional Educational Laboratory West. https://eric.ed.gov/?id=ED559739

Stedman, J. B., & Riddle, W. (1995). *Goals 2000: Educate America Act implementation status and issues*. Congressional Research Service, Library of Congress.

Steenbergen-Hu, S., Makel, M. C., & Olszewski-Kubilius, P. (2016). What one hundred years of research says about the effects of ability grouping and acceleration on K-12 Students' academic achievement: findings of two second-order meta-analyses. *Review of Educational Research*, *86(4)*, 849–899. https://www.jstor.org/stable/44668238

Suydam, M. N. (1990). *Curriculum and evaluation standards for mathematics education*. U.S. Department of Education, Office of Educational Research and Improvement, Educational Resources Information Center. https://eric.ed.gov/?id=ED319630

Tan, C. Y., & Dimmock, C. (2022). The relationships among between-class ability grouping, teaching practices, and mathematics achievement: a large-scale empirical analysis. *Educational Studies*, *48*(4), 471-489–489. https://doi.org/10.1080/03055698.2020.1780416

The Nation's Report Card (2022). *NAEP long-term trend assessment results: Reading and mathematics: Reading and mathematics scores decline during COVID-19 pandemic.* Retrieved May 11, 2023, from https://www.nationsreportcard.gov/highlights/ltt/2022/

Tienken, C. H., & Maher, J. A. (2008). The influence of computer-assisted instruction on eighth grade mathematics achievement. *Research in Middle Level Education Online*, *32*(3), 1-13. https://doi.org/10.1080/19404476.2008.11462056

Tieso, C. L. (2003). Ability grouping is not just tracking anymore. *Roeper Review*, *26*(1), 29–36. https://doi.org/10.1080/02783190309554236

United States Department of Education. (n.d.). *Archived: The No Child Left Behind Act of 2001*. https://www2.ed.gov/about/offices/list/oii/nonpublic/nclbinfo.html

United States Department of Education. (2008). *A nation accountable: Twenty-five years after a nation at risk*. United States Department of Education.

Vaughn, S., & Fuchs, L. S. (2003). Redefining learning disabilities as inadequate response to instruction: The promise and potential problems. *Learning Disabilities Research and Practice*, *18*(3), 137–146. https://doi.org/10.1111/1540-5826.00070

Wayne Board of Education. (n.d.). *Wayne township public schools program of studies: 2022-2023*. Retrieved April 16, 2023, from https://www.wayneschools.com/page/curriculum-and-instruction

Westphal, A., Lazarides, R., & Vock, M. (2020). Are some students graded more appropriately than others? Student characteristics as moderators of the relationships between teacher-assigned grades and test scores in mathematics. *British Journal of Educational Psychology*, *91*(3), 865–881. https://doi.org/10.1111/bjep.12397

Ysseldyke, J. E., & Salvia, J. (1974). Diagnostic-prescriptive teaching: Two models. *Exceptional Children*, *41*(3), 181–185. https://doi.org/10.1177/001440297404100305

APPENDIX

IRB Exemption Letter

SETON HALL UNIVERSITY
1856

June 17, 2023

Jacob Cavins
Seton Hall University

Dear Jacob,

The Proposal entitled "The effect of an Algebra 1 supplemental mathematics course, based on NJDOE produced materials, to 9th grade Algebra 1 students in a medium, suburban K-12 School District in NJ." has been reviewed by the Research Ethics Committee of the Seton Hall University Institutional Review Board and based on the information provided we found the same to be exempt from IRB approval.

Thank you for your cooperation.

The IRB Team