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USING THE NEW YORK STATE ALGEBRA 1 REGENTS RESULTS FOR INTRODUCTORY MATH COURSE PLACEMENT AT A SUBURBAN NEW YORK STATE COMMUNITY COLLEGE

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ABSTRACT

USING THE NEW YORK STATE ALGEBRA 1 REGENTS RESULTS FOR INTRODUCTORY MATH COURSE PLACEMENT AT A SUBURBAN NEW YORK STATE COMMUNITY COLLEGE

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This study evaluated the impact of a change to the math placement policy at a suburban New York Community College on entering students' math grades. Before the policy change, the community college required new students to take the College Board ACCUPLACER exam and used those scores to place students into math courses. Under the new policy, students were no longer required to take a placement test, and students' New York State Algebra 1 Regents exam scores were used to determine the appropriate math course placement. Prior research suggests that high school grade point average and SAT/ACT scores are strong predictors of student success, and better predictors than third-party placement testing systems like the College Board ACCUPLACER. However, there is little information about the validity of the Algebra 1 Regents exam for collegiate math course placement. This quantitative study used: (1) a multiple linear regression to determine if students' New York State Algebra 1 Regents exam scores predicted their math grades at a community college; and (2) an interrupted time series design to determine how the change from the ACCUPLACER to the Regents exam for course placement affected average math course grades among 2,888 entering degree-seeking students who enrolled between fall 2015 and 2019 for all students and by subgroup. The findings from this study illustrated that the New York State Algebra 1 Regents and ACCUPLACER test promoted similar academic success for students enrolled in introductory credit-bearing math courses.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

Introduction

Throughout the United States, many community colleges operate with open admissions policies; the only entrance requirement for an applicant is a traditional high school diploma or an equivalency diploma. This criterion, commonplace since the early 1960s at more than 1,490 two-year public colleges in the country (Chronicle of Higher Education, 2019), poses a challenge to student graduation rates from the outset. Many students arrive on campus without having completed the necessary pre-college work. Moreover, since additional variables such as SAT scores and extra-curricular activities are not measured or required, Academic Affairs, Student Affairs, and Enrollment Services offices have little information to properly chart a successful course of study for each student.

Of particular importance in conversations around student preparation for college-level curricula is the use of developmental courses. Developmental courses, offered by community colleges, are designed to prepare students who need to improve their academic skills prior to taking credit-bearing course work. In recent years, these courses have multiplied across community college campuses. In 2011-2012, forty-one percent of students enrolled at public community college reported enrolling in a developmental course (Skomsvold, 2014). While these courses are valuable for some students, the credits they earn do not count toward college graduation, and taking them will delay students' graduation and incur additional costs (Porter & Polikoff, 2012). Moreover, the courses are costly for schools to administer. In other words, placement into developmental courses is only useful if it is truly needed for success in future course

work and the student could not have succeeded in a credit-bearing course. Community colleges, therefore, need to find ways to identify which courses are optimal for their students.

In particular, community colleges must identify proficiency levels in English, reading, and mathematics for college-level course placement. However, no universal policy defines how community colleges place students into introductory math and English courses. Placement testing, standardized testing, and high school grade point averages can all provide information about a student's knowledge in a given subject area. While many community colleges draw on more than one measure for course placement, 92% percent of community colleges offer some type of placement test in these core areas to determine whether or not students should enroll in credit-bearing courses or non-credit bearing (developmental) course work (Parsad, Lewis, & Greene, 2003). These placement tests, in many ways, compensate for missing college admissions test data (SAT or ACT).

Improper course placement may result in a student enrolling in a course that is overly challenging, leading to not earning a passing grade and having to re-take a class or take a different course to meet their academic requirements. It may also result in students being placed into a course below their current academic level may be enrolling in a class they may not need to take. This results in students paying tuition for courses they do not need, which could delay graduation, and impact a student's financial aid eligibility. Moreover, some students, who enroll in developmental courses, believe there is no incentive to demonstrate strong academic success, since they are not earning credit toward a degree (Oudenhoven, 2002), potentially reinforcing the idea that students do not need to work to their maximum potential while enrolled in community college.

Purpose of this Study

The purpose of this quantitative study was to identify whether changing the math placement strategy at a suburban New York State community college was associated with improved course grades among students enrolling in introductory math classes. New York Community College (NYCC)—a pseudonym—is a single-campus suburban institution and the focus of this study. In 2017, NYCC changed from using the ACCUPLACER for math course placement to using the New York State Algebra 1 Regents exam. In the years in which they used the ACCUPLACER, students were exempted from taking the exam if they had previous college credit in English or math, achieved a 550 in each section of the SAT Critical Reading and math sections, or achieved a 24 on the ACT English or math sections.

Using secondary data from NYCC, this study first examined the Regents and the ACCUPLACER exams' ability to predict course grades among first-time, full-time first-year students. It then used an interrupted time series to explore the impact of the policy change (from using ACCUPLACER to Regents in math course placement) on average math course grades and whether that impact was different for various subgroups (gender or ethnicity).

Theoretical and Conceptual Framework

Student success in college-level work is impacted by many factors, including their prior academic performance in high school, while also making sure the students are in the appropriate courses to challenge them for the future. Vygotsky (1978) asserted that learning is not simply cognitive but social; it takes place in a shared context (the classroom) with teachers and peers. As such, we need to think about not what the student

can do alone, but what they can do with support. Vygotsky (1978) theorized three zones exist for each learner: what a learner can do autonomously, what a learner can do with support—called the Zone of Proximal Development (ZPD), and what a learner cannot do. He further theorized that most student academic growth occurs in their ZPD, which begins just beyond their currently mastered knowledge. This theory relates to course placement in that students must be placed into courses that cover material which is just beyond their current knowledge. In these courses, students would be able to experience the most growth when supported by a faculty member and working with peers. If course placement results in a student being placed too far above their current knowledge level, for example, placing a student who has mastered general math into a calculus course, the student may not be able to grow academically, even with teacher and peer support. This underscores the need for placement mechanisms to accurately assess the current knowledge base of the student.

This study evaluated whether the change from using the ACCUPLACER to using the New York State Algebra 1 Regents Exam for course placement yields higher course grades. I theorized that New York State Algebra 1 Regents Exam results could better identify a student's current knowledge and therefore, be better for course placement than traditional placement results from tests like the ACCUPLACER. Fundamentally, the Regents exam is a more accurate depiction of students' prior ability to learn in a course setting, as it is tailored to their Algebra 1 high school course. In contrast, the ACCUPLACER is a general exam, which is not closely tied to a particular learning setting and requires very little preparation. An expansion of this framework is provided in Chapter 2.

Significance of this Study

A more accurate placement measure could reduce students' misplacement into courses, likely reducing the total number of developmental classes in which a student enrolls and a community college offers. This change would allow students to graduate with their associate's degree or possibly transfer to a four-year institution earlier than if they were misplaced. Another benefit for students is that they will not use any of their financial aid on classes that do not count toward their degree. This is important since students can only receive limited amounts of federal and New York State financial aid as undergraduates. Moreover, some students have to pay an additional fee to community colleges for their placement tests. These students could save administrative costs that typically range from $15.00-$50.00, depending on the community college fee structure.

Savings can also accrue to the community college by reducing the number of developmental courses offered during semesters. Faculty can be reassigned from developmental courses to credit-bearing courses, allowing the colleges to reduce their salary costs by not hiring as many full-time or part-time faculty. Breneman and Haarlow (1998) estimated that developmental education's national annual cost is approximately $1 billion. Moreover, using existing data for placement will help colleges reduce the need for placement tests (like the ACCUPLACER), which come at an additional cost. Community colleges could save approximately $200,000 on ACUPLACER licensure exams costs depending on how many exams a community college offers, and another $200,000 in savings from not paying for proctoring these exams. There are also additional savings by not paying a stipend to community college faculty for reviewing and grading in-house placement exams. Depending on how many placement tests are

administered and proctored during the fall and spring semesters, community colleges can see drastic savings in their budgets.

Connection to the Vincentian Mission

Historically, community colleges have served highly diverse student bodies. The open-admissions academic requirements, in particular, promote student enrollment from underrepresented high schools and towns. These underrepresented students may already face multiple barriers to college work. The need to register and take the community college placement tests adds yet another barrier to obtaining a college degree. Removing this barrier, by using data that already exists in place of an exam, could help these students easily enroll in community college and, hopefully, place them in more appropriate coursework to meet their educational goals.

Research Questions

This study investigated the relationship between a student's New York State Algebra 1 Regents exam result and her/his grade in the first semester's introductory credit-bearing math course at a suburban community college in New York (NYCC). The following research questions were examined in this study:

> **Research Question 1**: Is there a relationship between New York State Algebra 1 Regents math results and first-semester math course grades among first-year community college students? Does this relationship hold when controlling for students' gender, ethnicity, and course taken?
>
> **Research Question 2**: How does the association found in Research Question 1 compare to that between the math ACCUPLACER exam and a student's first-

semester math grades? Does this relationship hold when controlling for students' gender, ethnicity, and course taken?

Research Question 3: Did the implementation of New York State Algebra 1 Regents as a replacement for the placement test in the academic years of 2017-2018 and 2018-2019 affect first-year community college students' first-semester math course grades relative to prior years?

Research Question 4: Does the change in the placement mechanism affect course grades differently for various subgroups of students (e.g., racial/ethnic, gender)?

Definition of Terms

ACCUPLACER	A comprehensive exam given to some prospective college students to help colleges determine proper course placement. This is an untimed, multiple-choice exam taken on a computer and consists of three sections-reading comprehension, sentence skills, and math.
Academic Success	Refers to receiving a grade of "C" or higher at New York Community College in a credit-bearing math course.
Developmental Education	Refers to pre-college level courses that address fundamental deficits in reading, writing,

	mathematics, and/or study skills and do not provide credit toward graduation.
New York State Regents Exam	A statewide standardized examination in core high school subjects that students need to pass to obtain a Regents Diploma.

CHAPTER 2

Theoretical Framework

Vygotsky: Course Placement for Optimal Learning

The core goal of placement testing and mechanisms is to match students to appropriate and supportive learning contexts. Vygotsky (1978) introduced the sociocultural theory, which states that social interaction plays a fundamental role in cognition development. Vygotsky (1978) stated that "every function in the child's cultural development appears twice: First at the social level through relationships with others, and later, at the individual level as an internal process" (p. 57). Vygotsky distilled this idea into the zone of proximal development (ZPD). A simple way to explain the ZPD theory is by using three nested circles. The largest circle defines what a student cannot do (with or without assistance), the middle circle (inside the larger circle) explains what a student can do with assistance. The smallest inner circle (or bullseye) defines what a student can do with no assistance. The ZPD is the middle circle; what a student can do with help or guidance. This is the space in which learning is optimal, with appropriate teacher/adult help and/or peer interaction.

In the context of this study, community colleges would ideally place students into math courses that are not too easy (that the student can do with no help) or too hard (that the student cannot do with or without assistance) – i.e., in courses that align with their ZPD. The assumption here is that students will achieve their greatest learning potential and academic success in this course. Vygotsky's theory illustrates that a student's course placement should be just above the student's prior academic knowledge of the subject in order to maximize potential. This would allow for students to experience the academic support of their professors and their fellow students. If new students are over or under

placed in introductory college courses, the students may not be able to grow as much academically, even with the assistance from teachers and peer support since the material may be above or below their knowledge level. To figure out what the course should be, we need information about the student that accurately measures what they do and do not know. This information may come from measures like standardized tests, placement tests, or GPAs, among others.

Tinto: Course Placement for Future Success

Tinto (1993) shows how an optimal matching of students to courses can lead to future success in college – beyond that of the immediate academic setting (e.g., current math class). Tinto's theory of student engagement (1993) stresses how students need to be part of the college's educational process and that this engagement must begin in the classroom. Involvement at the school leads to students seeking out contact with faculty and their peers after class, leading to higher retention and other outcomes (Tinto, 1993). Therefore, as the placement mechanism improves and students take appropriate courses, they will be more engaged and successful in those classes and potentially throughout their higher education. According to Tinto (1993), the more students engage inside and outside the classroom, the more likely it is for them to experience greater academic success.

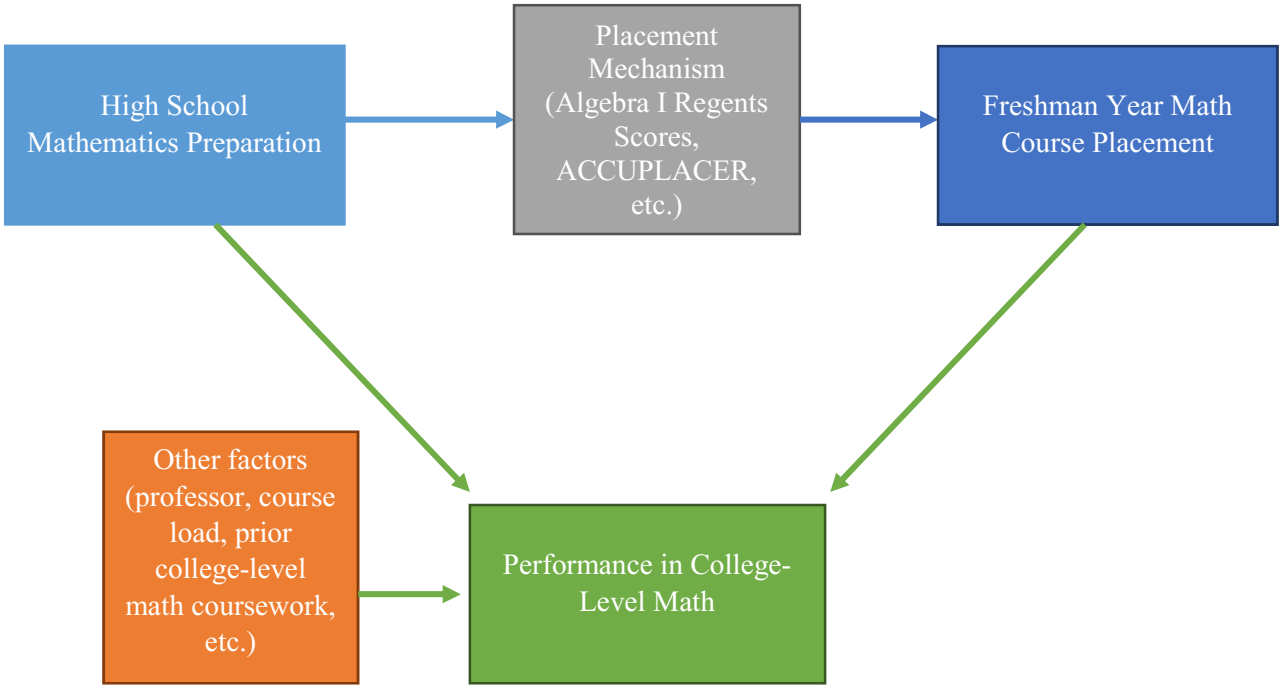
Conceptual Framework

The above theories highlight the importance of course placement and performance in college-level mathematics for academic success. The conceptual framework for my study is shown in Figure 1. Success in college-level mathematics is the end-goal (shown in green). This is affected by two primary factors: prior mathematics achievement (shown in light blue) and course placement (shown in dark blue), as well as other factors outside

of the scope of this study (shown in orange). I conceptualize that prior achievement and course placement are, however, related via the placement mechanism (shown in gray) such that: A high-quality placement mechanism will lead to better placements and improved success, while a low-quality placement mechanism will lead to suboptimal placements and, subsequently, low performance.

Figure 1

Conceptual Framework for this Study



The other factors are important to mention, but are much more difficult to measure, and I will attempt to control for these in my study. For example, the professor who is teaching could affect student performance: The college math course could have a highly educated professor who has difficulty relating the topics to the class in an understandable way. Another factor could be the number of courses a student is taking;

the larger the course load, the more difficult it could be for a student to manage both the academics and their non-classroom activities.

Review of Prior Research

Many United States policy efforts have aimed at increasing undergraduate college enrollment, with one of the most recent being the American Graduation Initiative (AGI) in 2009. This policy, introduced during President Obama's first term, aimed to support individual student success and national success by increasing the number of college graduates (Palmadessa, 2017). In 2015, President Obama further introduced America's College Promise (ACP), which increased access to higher education and helped support his earlier AGI policy. This policy's focus was for community colleges to meet the competitive economy's demands and provide skilled workers after graduation (Palmadessa, 2017). These two policies taken together sought to replicate the increased access to higher education formerly accomplished through President Roosevelt's GI Bill in 1944.

Community colleges have responded by employing "open admissions" platforms to ensure that as many students as possible have access to college-level courses. Open admissions typically mean that a prospective student's only criterion for admission into the community college is a high school diploma or its equivalent. However, high school graduation is not necessarily a strong indicator that a student is adequately prepared for higher education (Palmadessa, 2017). Thus, the community college system has been faced with an influx of students who are underprepared for college-level work, and many students struggle in college courses (Porter & Polikoff, 2012).

In responding to these issues, community colleges have needed to find ways to help these students transition into their system. One solution has been remediation – offering developmental courses that do not carry college credit but prepare students for college-level work. For example, many community colleges offer a course in developmental Algebra. This seeks to provide the foundation necessary to help prepare students in arithmetic, linear equations, and basic geometry. According to the National Center for Education Statistics (NCES) report, *Remedial Education at Higher Education Institutions in the Fall 1999* (United States Department of Education 1996), 100% of community colleges offer developmental course work, and 41% of community college freshmen enrolled in at least one developmental course (Oudenhoven, 2002). Research has shown that 60% of the developmental population is comprised of students who attended college immediately after graduating from high school (Oudenhoven, 2002).

Remediation is a contentious topic – it is costly for community colleges, and there are often debates over student placement into developmental course work. First, there is a debate over whether or not community colleges should take responsibility for developmental coursework. Public community colleges receive their funding proportionately from property taxes, state and federal grants, and tuition. As such, they are responsible to multiple stakeholders. Some taxpayers and state boards of education argue that developmental courses should not be taught in colleges to make up for deficiencies in the secondary school systems and call for funds to be redirected to degree programs amidst growing fiscal concerns (Oudenhoven, 2002).

Second, isolating developmental education in the community college also creates a "caste system" between the two-year and four-year colleges. The four-year colleges

may think that community colleges' education is lower quality than what they offer and may believe that most of the student body enrolls in developmental courses. The “caste system” can negatively impact community colleges by placing a negative stigma on registering there. In an extensive nationally representative survey, 80% of community college students reported their educational goal was to earn a bachelor’s degree or higher (Horn & Skomsvold, 2011). This study supports the idea that community college students know their goals and may be enrolling in a community college due to the more affordable tuition or the flexibility of class offerings. Moreover, carrying the label of “developmental” and not bearing credit has a negative impact on students’ academic success in these courses, so they may not be reaping the intended benefits of the course work (Oudenhoven, 2002).

Finally, there is evidence that students are over-placed in development education. This last point is central to the work at hand. It suggests we can reduce the burden of developmental coursework by better placing students in their first year. No matter how good the predictors, all students are subject to classification error. At its simplest, classification error refers to whether a student is correctly placed (Sawyer, 1996). In the context of college readiness, accurate placement means not placing college-ready students into developmental education courses and not placing students, who are not college-ready, into a credit-bearing classes.

Many community college students, who are assigned to developmental classes, are surprised and discouraged when they learn they must delay their college education (by taking non-credit courses) and, in effect, return to high school-level coursework. A survey of remedial students found that most believed they were prepared for college,

despite their placements (Strong American Schools, 2008). This can cause new college students to become frustrated, give up, and withdraw from college (Deil-Amen & Rosenbaum, 2002).

This background speaks to the need to place students into developmental versus. regular course work more effectively. This could generate cost savings for both community colleges and students and help students more seamlessly continue their education. The remainder of this section will provide background on placement testing, the predictive power of other measures, and the introduction to how some colleges use a multiple-measures approach to waiving students from placement testing.

Placement Tests

While community colleges continue to discuss the best method to place new students in their introductory math courses properly, the vast majority rely on some form of placement testing. Many students are unaware of the purpose and consequences of the placement exams (Venezia et al., 2010). Students may not take this test seriously or could have a form of "test anxiety," even though they are told during the proctoring session that the placement exam is not graded and is only used for course placement. Some students do not prepare for the exams or even set aside adequate time to complete the exam. Such students may have the potential to do well in a college-level course yet perform poorly on the relevant placement exam and be misplaced. Even if they perform well, there can be misalignment between the test content and academic curriculum and college courses' standards, leading to students' misplacement in classes.

Placement Testing Companies

Two primary companies have been responsible for creating the standardized tests community colleges use to determine course placements in reading, writing skills, essay writing, and mathematics: The ACT (American College Testing), which administers the Compass exam, and the College Board, which administers the Accuplacer exam.

The ACT Company, a not-for-profit testing agency, offers a college entrance exam that many high school students can complete as part of the admissions process at four-year colleges. In addition to the standardized test, the ACT company created a placement exam in 1983 called the Compass exam. The Compass exam measures a student's abilities in reading, writing, and mathematics. Over the last few years, questions have arisen regarding the Compass exam's validity, resulting in a subsequent decline in test-takers. According to ACT, over 2.2 million college-ready students sat for the Compass exam in 2012 (Scott-Clayton, 2012). This number was reduced to 1.9 million in 2013, and in 2014, decreased further still to a total of 1.7 million. After seeing the student decline and more discussion questioning this test's validity, the ACT agency has phased out the Compass exam (Fain, 2015).

The College Board has a computer-based placement test called the ACCUPLACER. This test assesses students' knowledge and skills in a variety of subject areas. This was one of the most commonly used tests at community colleges for placement purposes. For example, in 2008, more than 1,300 institutions used ACCUPLACER tests, and nearly seven million exams were administered (Mattern & Packman, 2009).

The ACCUPLACER tests measure the following six academic areas: Reading comprehension, sentence skills, arithmetic, elementary algebra, college-level mathematics, and writing. These tests are composed of multiple-choice items, except for the writing test, which requires students to compose a writing sample. For the College-Level Math, Reading Comprehension, and Sentence Skills tests, students are administered 20 items, whereas there are 17 items on the Arithmetic test and 12 on the Elementary Algebra test. The scores for these tests range from 20 to 120 (College Board, 1997). The College Board recommends that each college set their cut-off scores for course placement; they do not provide any recommendations. Colleges that administer ACCUPLACER can receive minimal relationship information between ACCUPLACER scores and first-semester course performance through the College Board Admitted Class Evaluation Services (ACES). The college has to pay additional fees to administer the ACES, and not all students return the survey (College Board, 1997).

Costs of Placement Testing

The financial costs of placement testing are shared between the college and the new students. The total annual cost of remedial placement testing ranges from around $300,000 to $875,000 (Rodríguez, O, et al., 2015). The colleges finance approximately 60 percent of the costs; the remaining costs, due to the opportunity cost of student time spent on testing and related activities, are borne by the students. The colleges' financial prices are high; almost 75 percent are for personnel, and money is being spent on faculty that are teaching non-credit classes instead of having those resources focused on teaching credit-bearing courses that count towards graduation. At the per test level, each college's spending averages less than $50 per test, and the total costs (including student costs)

average less than $75 per test. The per-test costs vary based on the content being tested (math, reading, or writing) and the scoring system. The students' fees include taking the tests, along with the costs of related activities, such as commuting to the test site, preparing for the test, and taking time off from a part/full-time job (Rodríguez, O, et al., 2015). Adding a more appropriate mechanism for placement can benefit both the college and the new students.

Validity of Placement Testing

The Community College Research Center (CCRC) at Columbia University Teachers College, the leading independent authority on the nation's nearly 1,200 community colleges, has studied the validity of placement testing for some time. This organization has released educational studies showing that placement test scores are not strong indicators of academic success. Specifically, the CCRC looked at placement testing scores from thousands of students entering an urban community college. The CCRC modeling structure estimated that one- quarter to one-third of the college students, who placed into a developmental course based on their placement test scores, could have passed a college-level English or math course with a grade of B or better (Scott-Clayton, 2014). This research supports the notion that most students should not be placed into entry-level classes based on a single standardized test.

The CCRC results also indicated that using high school information to properly place a student correlated positively with strong academic success in course work (Scott-Clayton, 2014). In addition, the CCRC also indicated that a high school transcript review could reduce incorrect college course placement for a one-third of the population who take the placement exam (Scott-Clayton, 2014).

High School Indicators for College Course Placement

Research shows that high school records are reasonable predictors of academic success in college (Hughes and Scott-Clayton 2011); high school transcripts can show academic success and effort that might not be measured by placement tests. However, there are challenges to using this type of data. For example, high schools do not have a standardized curriculum throughout the United States. Individual states may have curriculum guides, but one uniform guide does not exist at the national level. Additionally, the school districts' curriculum guides are hard to track, even if they are being followed, since there is no national standard or repository. Using high school transcripts may be a better model for placement testing. Still, since states have limited monitoring of these curriculum plans, this may not be easy to implement nationally but could be supported by states with national education tests that support the high school curriculum.

Lappan and Phillips (1984) conducted a study at Michigan State University (MSU) to determine if high school course-taking impacted students' math grades while enrolled at MSU. They sampled 4,755 students in 1977 and 4,302 students in 1982. The 4,755 students in the 1977 cohort were divided into four groups based on the courses taken in college: Students who took Elementary Algebra (451 students), students who took Intermediate Algebra (1,287 students), students who took College Algebra (2,129 students), and students who took Calculus (888 students). In 1982, 267 students took Elementary Algebra, 934 took Intermediate Algebra, 2,139 took College Algebra, and 962 completed Calculus. The researchers found that a student's grade point average was higher than their overall math grades in all cohorts but the Calculus group. In addition, in

1977, 53% of Elementary Algebra students stopped high school math after taking geometry. In 1982, 32.1% stopped after taking geometry. For students that enrolled in Algebra II, the same percentages were held. For 60% to 80% of students surveyed, the last high school course was either College Algebra or Calculus (Lappan & Phillips, 1984). Overall, nearly 70% of the students enrolled in Intermediate Algebra at a college had taken 3 to 4 years of math in high school, starting with Algebra 1 and higher. In comparison, 42% of high school students had only taken 2 to 3 years of college preparatory math. The authors concluded that students needed at least three years of college-preparatory math in high school, with at least an earned grade of B in the courses, to succeed in a college-level math course.

Studies have shown that the level of a student's high school math preparation correlates with the ACT math exam results, and also correlates with a student's grade point average (GPA) in college. These two mechanisms might prevent the need for placement tests. Hoyt and Sorenson (2001) studied 887 high school students from two separate school districts attending Utah Valley State College, an open admission public college. The high school transcripts of these two groups were reviewed. The study examined the hypothesis that a student's high school math preparation level would impact results on the math section of the ACT. Academic math preparation ranged from minimal to Advanced Placement Calculus (Hoyt & Sorensen, 2001). The researchers compared students who completed two or more years of traditional high school math to those who completed fewer than two years. They also collected data on the students' race, gender, math courses taken, and the highest high school math grade received. As

expected, students completing higher levels and longer periods of math study earned higher scores on the math section of the ACT exam.

Ultimately, a student's level of math courses taken in high school and the grades received were better predictors of accurate math course placement in college than the results of the ACT itself. A majority of students who took algebra, trigonometry, and pre-calculus in high school were eligible for college-level algebra because they received ACT scores that indicated preparation for college course work. It was an indicator that the students were prepared for college work. The evidence supports the idea that was using multiple measures, namely the high school record, can better predict academic performance in college than a single placement exam given by the college (Hoyt & Sorensen, 2001). In the community college setting, measures of introductory math courses taken, such as the number of high school math subjects completed, the grades obtained in those courses, as well as the highest level of high school math completed, are stronger indicator of academic achievement in college than placement testing (Lewallen, 1994).

Examples of Multiple Measure Placement Systems

While standardized placement tests have been the most common measures that community colleges use to assess student ability and placement into course work upon entry (Burdhman, 2012), the debates over placement testing have led several states to adopt other measures for course placement.

The City University of New York

After twenty-five years of using a standard testing practice, which resulted in high remediation rates and low graduation rates, the City University of New York (CUNY)

Board of Trustees, responding to political pressure from the city government, passed a resolution in 1999 that phased out developmental education at CUNY's four-year colleges, and reduced the developmental education requirement to one year at all CUNY community colleges (Oudenhoven, 2002). As part of this resolution, CUNY community colleges now allow students, who score "proficient" on the math sections of the SAT/ACT or New York State Regents exam, to register for courses without taking a math placement exam. These measures have helped reduce the number of students placed into developmental classes (Smith Jaggars & Hodara, 2011). Unlike CUNY, the State University of New York has not had a system-wide discussion regarding universal placement testing to determine course placement.

California

The Matriculation Act of 1988 promoted the usage of placement testing in all of California's community colleges. The growth and importance of the tests led some groups to believe that "test anxiety" may impact results. This act was found to be important among state and local community college officials, faculty members, testing experts, and activist groups regarding how standardized placement tests would be used interpreted, and applied at community colleges (Armstrong, 2000). In 1988, the Mexican-American Legal Defense Fund (MALDEF) filed a lawsuit alleging that several community colleges were using the placement test scores to force students to take developmental course work before enrolling in credit-bearing classes (Cage, 1991). This lawsuit was settled three years later. The State Chancellor's Office of the California Community Colleges (SCOCCC) agreed to require that every community college produce evidence of the criterion-related validity of each test it was using for placement

purposes (Cage, 1991). In other words, they needed to demonstrate that students testing above a specific minimum score have a greater likelihood of academic success compared to students who fell below that score. The SCOCCC regulations included a state-prescribed correlation coefficient of at least .35 between the placement test score and criterion (course grades). Also, the state required community colleges to use a companion measure in addition to the placement test score. These measures included a student's high school grade point average and educational goals, along with any other factors that affect a student's academic performance (Cage, 1991).

A 2016 survey conducted by California community colleges indicated that they effectively use a portion of a standardized placement exam as a part of their process. Still, they also use other elements in their assessment process (Rodriguez, Mejia, & Johnson, 2016). In particular, it showed that one-third of colleges use high school grade point average to assess the student's math readiness (Rodriguez, et al., 2016).

North Carolina

In 1993, the North Carolina General Assembly mandated that the State Board for Community Colleges conduct a study to identify which placement tests and performance thresholds should be used to help determine academic success in college. The working group conducting the study included the Educational Testing Service (ETS), the ACT Company, and the College Board. All North Carolina community colleges were required to submit their student data from fall 2001-2003 to the ACT, including course grades from the community college over a four-semester period. Results indicated that they were doing things differently as far as the performance thresholds were concerned. It was not until 2005 that the ACT could complete the validation study, evaluate the validation

outcomes, and make recommendations. As a result, North Carolina developed an assessment process that includes multiple measures, such as high school grades and non-cognitive measures (Burdman, 2012).

Conclusion

While practices vary by state and even by college, an increasing number of states have mandated placement testing or the use of a standard assessment tool, viewing placement policies as a potential opportunity for increasing student success (Collins, 2008). Despite the clear evidence of over-placement in developmental education, only some states appear to have been proactive in developing a multiple indicator platform that draws on both testing and high school records.

In the current study, I explored whether the New York State Regents exam results can place students more appropriately. The New York State Regents Exam is closely tied to the high school curriculum and sets a minimum graduation standard. In other words, it may provide a way to incorporate more standardized high school grade information into placement – overcoming some of the challenges from using high school grade point average (GPA).

CHAPTER 3

Introduction

This study first investigated the relationship between a student's New York State Algebra 1 Regents exam results and their grade in the first semester's introductory credit-bearing math course at a suburban community college in New York (NYCC). It then evaluated the effectiveness, in terms of course grades, of the policy that changed course placement based on the Algebra 1 Regents Exam in place of the ACCUPLACER exam.

Research Questions and Null Hypotheses

The following research questions were examined in this study:

Research Question 1: Is there a relationship between New York State Algebra 1 Regents math results and first-semester math course grades among first-year community college students? Does this relationship hold when controlling for students' gender, ethnicity, and course taken? For this study, ethnicity was defined as white and non-white students.

H_0: $\beta_1 = 0$; there is no association between the Algebra 1 Regents scores and math grades.

Research Question 2: How does the association found in Research Question 1 compare to that between the math ACCUPLACER exam and a student's first-semester math grades? Does this relationship hold when controlling for students' gender, ethnicity, and course taken?

H_0: $\beta_1 = 0$; there is no association between ACCUPLACER scores and math grades.

Research Question 3: Did the implementation of NYS Algebra 1 Regents grade as a replacement for the placement test in the academic years of 2017-2018 and 2018-2019 affect first-year community college students' first-semester math course grades relative to prior years?

H_0: $\beta_2 = \beta_3 = 0$; the policy had no effect on the average math grade or the trend in math grades.

Research Question 4: Does the change in the placement mechanism affect course grades differently for various subgroups of students (e.g., racial/ethnic, gender)?

H_0: $\beta_2 = \beta_3 = 0$; the policy had no effect on the average math grade or the trend in math grades for each subgroup.

Research Design

The researcher explored these research questions using a quantitative, *ex post facto* study. First, the researcher used secondary data from NYCC to estimate a series of simple linear and multiple regressions identifying the predictive power of the Regents Algebra 1 exam (RQ1) and the ACCUPLACER exam (RQ2) for explaining college math performance and the effect of transitioning between the two placement methods on college math performance. The researcher compared these results to determine whether the Regents Algebra 1 exam is more or less predictive of course grades than the ACCUPLACER exam. Second, the researcher used an interrupted time series analysis, a quasi-experimental analysis, to explore RQ3 and RQ4. This analysis involved tracking trends in course grades over a period of time before and after an intervention occurred. This method evaluated whether the change in placement method impacted the average student's first-semester math grade. Subsequently, the model was estimated by subgroup

to determine whether the policy impact varied by student subgroup (gender and ethnicity).

Subjects and Setting

NYCC is part of the State University of New York (SUNY) system. The SUNY system includes 64 college campuses throughout New York State. The selected college is one of 30 community colleges within the SUNY system and is among the largest within the state system. The college offers over 80 associate degrees and certificate programs, with a focus on liberal arts education.

Before the fall 2017 semester, NYCC used the ACCUPLACER for college math course placement. Students who did not meet the following criteria had to take the math placement exam: (1) achieved an SAT math score of 550 or higher, (2) achieved an ACT math score of 24 or higher, (3) scored a three or higher on the AP Calculus exam, or (4) passed a three-or-four-credit, college-level math course with a grade of C or above. Starting in the fall 2017 semester, NYCC began using Regents scores as a mechanism to aid in proper math course placement for incoming students. If a student did not meet a minimum Algebra 1 Regents score set forth by NYCC, the new student would have to sit for the ACCUPLACER exam. For the fall 2019 semester, NYCC administered approximately 3,800 ACCUPLACER exams to new students. About 1,500 of the incoming new students only needed the math portion of the placement test.

This study used all first-time, full-time students who enrolled into NYCC during the fall semesters from 2015-2019 and took an introductory math class during their first semester. The math courses selected were MAT 100-A Topical Approach to Mathematics, MAT 101-Concepts of Mathematics, and MAT 102-Introduction to

Statistics. Students entering NYCC are not limited to a particular introductory math course; the class sequence typically depends on their academic focus.

To avoid any data integrity issues, the researcher removed any student data from students who did not directly enroll in NYCC after graduating from high school. Students who obtained a high school equivalency diploma (the NYS TASC or NYS GED) were removed from the study. Additionally, students were removed from this study if they did not graduate from a New York State high school. Finally, students entering in 2017 or later were excluded if they did not have Regents exam results in math on their official high school transcript.

The researcher was granted IBR approval from both SJU and NYCC, the document that reflects NYCC IRB approval was not included in the appendix in order to remain confidentially for NYCC.

Data and Variables

Administrative data was requested from the NYCC Office of Institutional Research and extracted from the NYCC *Banner* Student Information System. This study's core data included students' enrollment year, gender, ethnicity, New York State Algebra 1 Regents scores (in years available), ACCUPLACER scores (in years available), first-semester math course at NYCC, and grade earned in that course. The dependent variable in all analyses was the first-semester math grades at NYCC. The grades range from A to F. For this study's purpose, the grades were converted into a numerical format (A=4.0, B+=3.5, B=3.0, C+=2.5, C=2.0, D+=1.5, D=1, F=0) and treated as a ratio scale variable. Table 1 represents more information regarding the sample size. The gender breakdown was very similar, both pre- and post-policy. The gender breakdown between male and

female students at NYCC in this study was 46% female and 53% male. This make-up was consistent between both the pre- and post-policy implementation. The pre-policy sample included 513 females and 593 males, while the post-policy sample included 829 females and 953 males. The sample population included five (.5%) American Indians students pre-policy and seven (.4%) American Indian students post-policy. The number of students that identified as Asian pre-policy was 53 (4.8%), while post-policy, it was 97 students (5.4%). One student identified as Hawaiian/Island Pacific (.1%) pre-policy and four students post-policy (.2%). 308 (27.8%) students identified as Hispanic in the pre-policy period and 598 (33.6%) students identified as Hispanic in the post-policy period. 8 (.7%) students identified as two or more races pre-policy, and 45 (2.5%) students identified post-policy. 29 (2.6%) students in the pre-policy sample did not disclose their race/ethnicity pre-policy and 82 (4.6%) did not disclose their race in post-policy sample. 513 (46.4%) students identified as white in the pre-policy sample, while 708 students (39.7%) identified as white in the post-policy sample. Because of the small samples of many racial/ethnic groups, the researcher grouped the race/ethnicity into two categories, white and non-white, for this study.

Students were able to enroll in one of three courses: 286 students (25.9%) enrolled in MAT 100 pre-policy, while 371 students (20.8%) enrolled post-policy. MAT 101 enrolled 278 students (25.1%) pre-policy, while 386 students (217%) enrolled in MAT 101 post-policy. Lastly, 542 students (49%) enrolled in MAT 102 pre-policy, while 1025 students (57.5%) enrolled in the same course post-policy. These numbers are reflected in Table 1 below. When it came to the math classes that first-year students

enrolled in during their first semester, MAT 102 had approximately double the numbers of registered students compared to MAT 100 and MAT 101, both pre and post policy.

Table 1

Demographic Characteristics of NYCC Students Taking Credit-Bearing Math Courses

		Pre-Policy Frequency	Pre-Policy Percentage	Post-Policy Frequency	Post-Policy Percentage
Gender					
	Female	513	46.4	829	46.5
	Male	593	53.6	953	53.5
Race Ethnicity					
	American Indian	5	0.5	7	0.4
	Asian	53	4.8	97	5.4
	African-American	189	17.1	241	13.5
	Hawaiian/Island Pacific	1	0.1	4	0.2
	Hispanic	308	27.8	598	33.6
	Two or More Races	8	0.7	45	2.5
	Unknown	29	2.6	82	4.6
	White	513	46.4	708	39.7
Math Course					
	MAT 100	286	25.9	371	20.8
	MAT 101	278	25.1	386	21.7
	MAT 102	542	49	1025	57.5

Note. There were 2,888 students in the sample

What is the New York State Regents Exam?

The Regents exams are required tests administered to public and some private school students in New York. Passing these exams is required for a student to receive a high school diploma. The New York State Algebra 1 Exam was established in 2008 (New

York State Education Department, 2019) and is developed by the New York State Education Department, under the Board of Regents of the State University of New York.

The exam is prepared by a selected group of New York state teachers in appropriate academic disciplines. Exams are typically created three years before they are administered to allow students to learn any new subject material and refine evaluation methods to determine if the test questions are appropriate. Most tests include 35 multiple choice test questions and short answer/essay questions that require the student to show their work. The Integrated Algebra 1 exam covers both introductory Algebra and Geometry, which is course work that is covered in either eighth or ninth grade.

The New York State Algebra 1 Regents exam places the questions on a scale according to their difficulty level. The scoring system is between 0-100. A score of 65 is considered passing. The exam score is not a percentage of the questions answered correctly, but rather a raw score created and curved to report the test exams. Each year a new curve is made, as each year, the test is different. Typically, the Algebra 1 Regents exam is offered in June of the student's eighth or ninth-grade year (corresponding to when the student takes Algebra 1) and is scored by licensed and trained New York State teachers who are required to follow scoring policies from the New York State Department of Education. All Regents score results are displayed on the student's high school transcript.

Reliability and Validity

To help determine the New York State Regents exams' validity, they were piloted throughout New York State. In May 2014, The Department of Education took a sample

population that included urban and suburban students. The agency tried to identify a sample population that would mimic the entire test-taking population.

According to Appendix A in the *2014 Field Analysis, Equating Procedures, and Scaling of Operational Test Form Technical Report*, Cronbach's alpha, a measure of reliability, for the Algebra 1 exam ranged between .49-.70 (New York State Education Department, 2014). Additionally, approximately 10% of all tests are scored by two independent readers to determine scoring consistency. These are called "second reads," compared to most tests that are read via the traditional "first reads." In the Algebra 1 exam, the percentage of exact matches between the first and second readers ranged from 63 to 100%. The percentage of first and second readers that were exact or adjacent matches ranged from 82.9 to 100.0% (New York State Education Department, 2014).

The ACCUPLACER Exam

The Educational Testing Services (ETS) develops and administers the ACCUPLACER on behalf of the College Board. The purpose of the ACCUPLACER is to determine which course placements are appropriate and determine if remedial work is needed; it is not meant to serve as an admission test. The math portion of the ACCUPLACER includes 16 questions from three broad categories: 1) operations of whole numbers and fractions including addition, subtraction, multiplication, division, recognizing equivalent fractions, and mixed numbers; 2) operations with decimals and percent's including addition, subtraction, multiplication, division, percent problems, decimal recognition, fractions, percent equivalencies, and estimation problems; and 3) application and problem-solving including rate, percent, measurement problems, and geometry (College Board, 1997).

A study of ACCUPLACER results was conducted by the Educational Testing Service, where data from 50 colleges was analyzed (College Board, 2003). The correlation coefficient between ACCUPLACER results and high school math grades ranged between .31 and .38 in Arithmetic. In Elementary Algebra, the correlation coefficient ranged between 0.19 and 0.38. In College-Level Mathematics, the correlation coefficient ranged between 0.25 and 0.53. This suggests that the ACCUPLACER has low to moderate validity in predicting student course outcomes. The primary function of the ACCUPLACER test is to assist high school and college personnel with determining whether students are ready for college-level courses or would benefit from developmental courses. The most effective college-readiness strategy, suggested by the College Board, occurs when colleges partner with local high schools to assess student readiness by comparing their high school ACCUPLACER scores with those recommended by the colleges. The scoring system of the ACCUPLACER exams ranges from 0-120 in the math section. The most recent ACCUPLACER exam, named the Next Generation, uses a scoring system from 100-300 in math, the newer scoring was not used in this study since it had not been implemented.

NYCC Course Grades

NYCC math grades were entered into the College's student information system by the student's math professors. Course grades are determined by a departmental rubric, since faculty members follow a course syllabus, but teach at their speed based on the classes ability to learn the material. Math grades may vary, since each faculty member is

able to teach the math course with different daily lessons and have different teaching styles.

Descriptive Statistics of Test Scores and Grades

Table 2 provides a summary of the course grades, Regents Algebra 1 test scores, and ACCUPLACER test scores available in this sample. Course grade data is available for the 2,888 students. On average, students earned a mean math grade point average of 2.189 after their first semester at NYCC. The mean math grade point average for students who sat for the ACCUPLACER placement exam was 84.26, while the math grade point average for students who were placed with their New York State Regents placement was 74.88.

Table 2

Descriptive Statistics of Math Course Grades, ACCUPLACER Test Scores, & NYS Algebra 1 Regents Exam Scores

	NYCC Math Course Grades	ACCUPLACER Test Scores (Pre- Policy Years Only)	NYS Algebra 1 Regents (Post-Policy Years Only)
N	2888	1106	1782
Mean	2.189	84.26	74.88
Std. Deviation	1.436	14.13	5.876
Minimum	0	29	47
Maximum	4	120	96

Note. The sample sizes are smaller for ACCUPLACER and NYS Algebra 1 Regents scores because the test was only used in pre-policy (ACCUPLACER) or post-policy (Regents).

Models

The data was analyzed using SPSS version 24. The methods used are shown below by research question:

Research Question 1. To answer research question one, I first estimated two regressions of the form using student-level data from fall 2017, 2018, and 2019:

$$grade_i = \beta_0 + \beta_1(regents_i) + \epsilon$$

$$grade_i = \beta_0 + \beta_1(regents_i) + \mathbf{\Gamma}_i\mathbf{B} + \mathbf{C} + \epsilon$$

$grade_i$ is the student's course grade and $regents_i$ is the student's Regents exam score. The key coefficient of interest is β_1. This captured the predictive power of Regents scores on first-semester math grades. The first regression investigated this association unconditionally, while the second controlled for student demographics, $\mathbf{\Gamma}_i$, and course fixed effects, $\mathbf{C}$, to remove any potential omitted variable bias.

Research Question 2: To answer question two, the following regression was estimated:

$$grade_i = \beta_0 + \beta_1(accuplacer_i) + \epsilon$$

$$grade_i = \beta_0 + \beta_1(accuplacer_i) + \mathbf{\Gamma}_i\mathbf{B} + \mathbf{C} + \epsilon$$

$grade_i$ is the student's course grade and $regents_i$ is the student's Regents exam score. The key coefficient of interest is β_1. This captured the predictive power of ACCUPLACER scores on first-semester math grades. The first regression investigated this association unconditionally, while the second controlled for student demographics, $\mathbf{\Gamma}_i$, and course fixed effects, $\mathbf{C}$, to remove any potential omitted variable bias.

Research Question 3: To answer question three, it estimated the impact of switching to using the New York State Regents results for placement on students' course grades using an interrupted time series model.

$$grade_i = \beta_0 + \beta_1(t_i - t^*) + \beta_2(P_i) + \beta_3(P_i)(t_i - t^*) + \epsilon$$

$grade_i$ is the course grade of student *i;* (t_i -*t**) was time, centered at the policy implementation time; and, P_i was an indicator that the student is in the post-policy period. $\beta_1$is the trend in math grades in the years before using the New York State Algebra 1 exam results as a placement result; β_2 was the change in math grades during the first-year New York State Algebra 1 Regents results were being used; and β_3 was the change in math grades after NYCC started using Algebra 1 results as a placement result.

Research Question 4: To answer question four, the same statistical equation as research question three was used, and models were estimated for subgroups of sufficient size. The researcher determined if differences occurred when estimating the regression separately for different racial/ethnic (white/non-white students) or gender subgroups (male/female).

The following chapter describes the results of these analyses.

CHAPTER 4

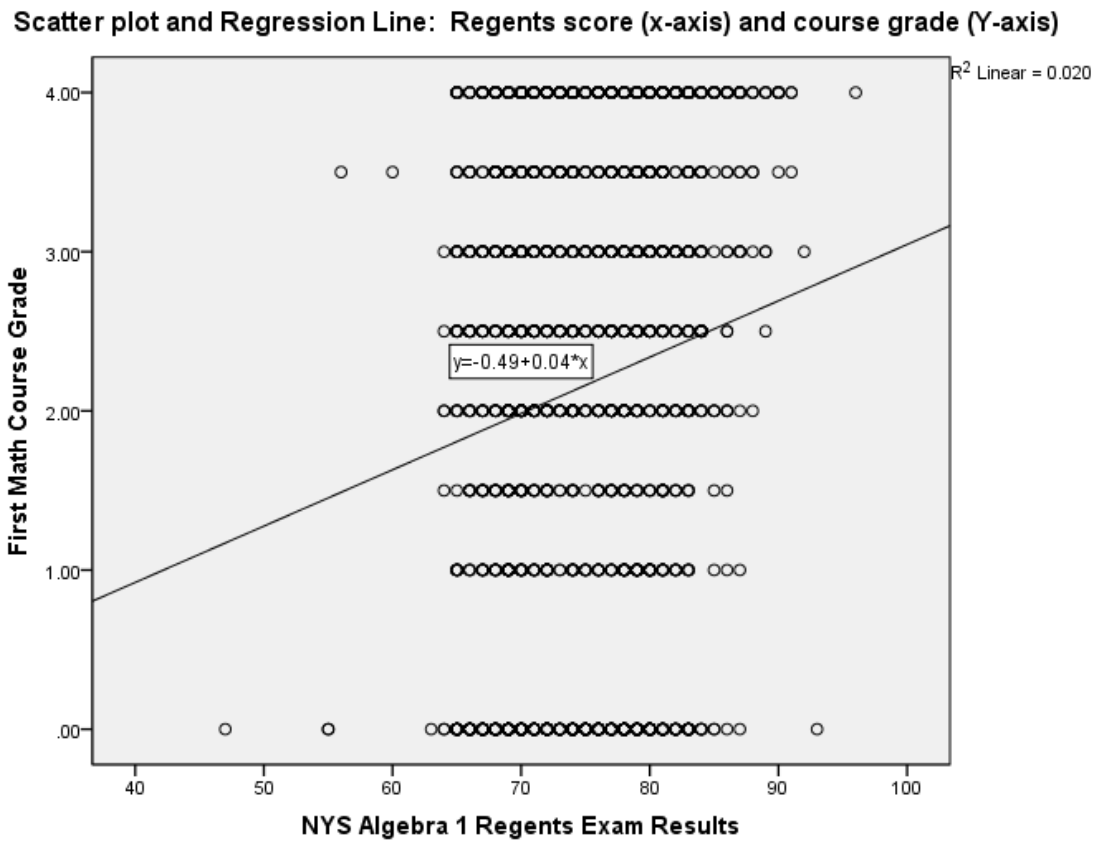
This chapter the results of the analyses corresponding to each of the four research questions.

Research Question 1

A simple linear regression was estimated to determine if students' New York State Algebra 1 Regents scores were predictive of their credit-bearing math course grades. A scatterplot of course grades on Regents scores, shown in Figure 2 below, illustrates that there is a lot of variability in course grades by Regents score, suggesting that the predictive power of this test will be somewhat limited.

Figure 2

Scatterplot of Course Grades vs New York State Regents Scores



Estimation results are shown in Table 3. Regents scores were standardized before inclusion in the model. The regression was significant, $F(1, 1780) = 36.924$, $p < .001$, $R^2 = .020$, suggesting that Algebra 1 Regents scores are predictive of community college students' first term math course grades. On average, each one Standard Deviation (SD), increase in Regents scores (approximately 2.157 points) is associated with a .208-point increase in math grades (about 20% of a letter grade). However, only 2% of variance in course grades is explained by Regents scores.

A multiple regression analysis was estimated to see if the same results held when controlling for student gender, race/ethnicity, and math course is taken. The regression was again significant, $F(5, 1776) = 13.776$, $p < .001$, $R^2 = .035$. Adding the controls to the models explained an additional 1.5% of the course grades variance but did not affect the association between Regents scores and course grades. On average, for each one SD increase in Regents scores (approximately 1.901 points), math grades increased by approximately .194 points (about 19% of a letter grade).

Table 3

Regression of Math Course Grades on Regents Scores

	Model 1		Model 2	
Intercept	2.157		1.901	
	(.034)		(0.088)	
Regents Score	.208	***	0.194	***
	(.034)		(0.034)	
White			0.146	*
			(0.069)	
Female			0.369	***
			(0.069)	
MAT101			0.007	
			(0.105)	
MAT102			0.028	
			(0.088)	

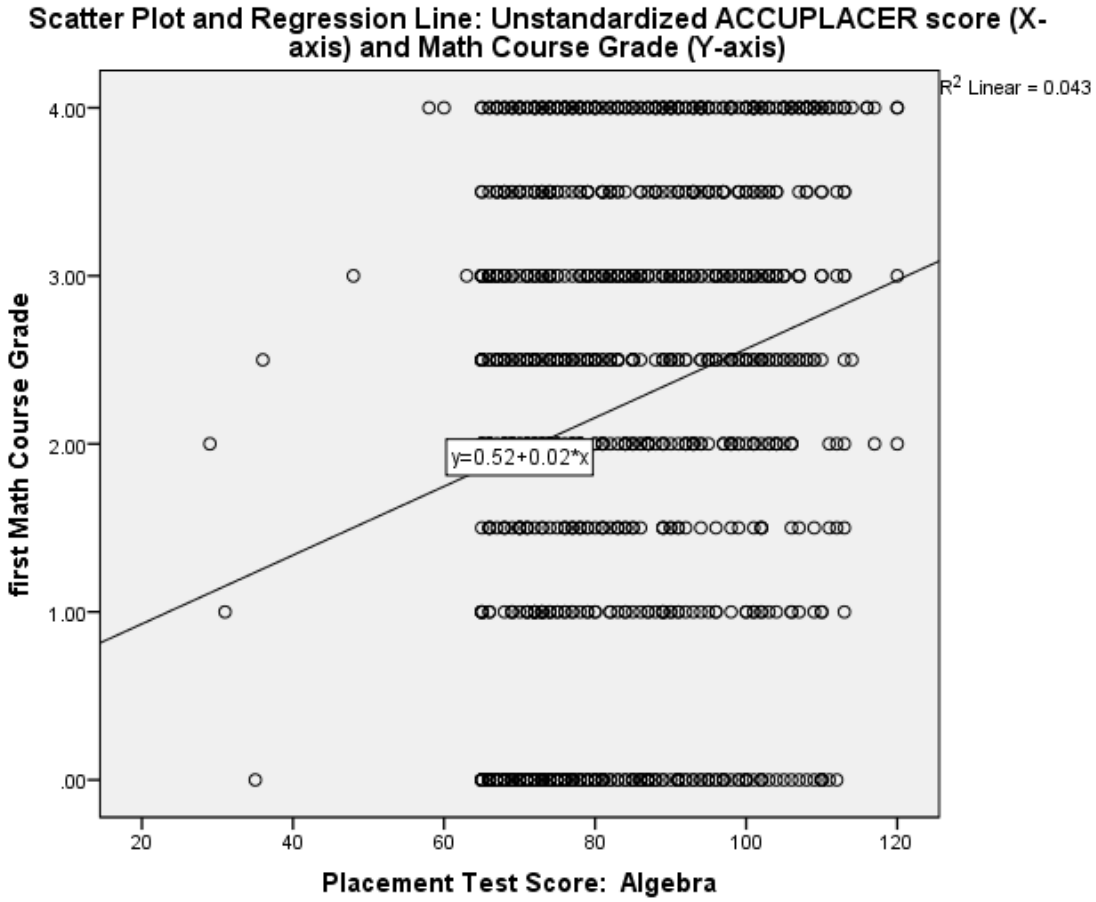
Note. *p<.05, **p<.01, ***p<.001. Standard errors in parentheses.

Research Question 2

A simple linear regression was estimated to determine if a student's math ACCUPLACER test results were predictive of their credit-bearing math course grades. The scatterplot of course grades on ACCUPLACER scores, as shown in Figure 3, is similar to that shown above for Regents scores. For any given ACCUPLACER scores, there is significant variability in course grades earned.

Figure 3

Scatterplot of Course Grades vs. ACCUPLACER Scores



The estimation results are shown in Table 4. The regression was significant, $F(1, 1104) = 49.162$, $p < .001$, $R^2 = .043$. On average, for each one SD increase in

ACCUPLACER Scores (approximately 14.130 points), math course grades increased by .289 points (29% of a letter grade).

The model remained significant when controlling for gender, race/ethnicity, and math course placement, $F(5, 1100) = 11.930$, $p < .001$, $R^2 = .051$. Adding the controls to the models explained an additional 1% of the course grades variance but did not affect the association between ACCUPLACER scores and course grades. On average, for each one SD increase in ACCUPLACER scores, math grades increased by approximately .278 points (28% of a letter grade).

Table 4

Regression of Math Course Grades on ACCUPLACER Scores

	Model 1		Model 2	
Intercept	2.243		2.207	
	(.041)		(.098)	
ACCUPLACER Math Score	.289	***	0.278	***
	(.041)		(.041)	
White			0.160	
			(.082)	
Female			.117	
			(.083)	
MAT101			-.241	*
			(.115)	
MAT102			-.080	
			(.100)	

Note. *p<.05, **p<.01, ***p<.001. Standard errors in parentheses

Comparing these ACCUPLACER results with those from Research Question 1 (New York State Algebra 1 Regents results) indicated that ACCUPLCER students received 2.89 higher points in math grades (approximately 28% of a letter grade) compared with New York State Regents students who received 2.08 higher points (approximately 20% of a letter grade) in their first math course. When controlling for subgroups, ACCUPLACER students continued have higher math course grades compared to New York State Algebra 1 Regents students by gender, race/ethnicity and math courses taken.

Research Question 3

An interrupted time series model was used to predict whether there were changes in math course grades related to the change in placement testing policy. Recall that the math ACCUPLACER results were used for placement through fall 2016, and the New York State Algebra 1 Regents exam results were used in fall 2017 and beyond. Before the new policy change, the regression showed that course grades were declining, β_1= -.324, p =.001. There was a jump at the policy change onset (in fall 2017), β_2= .607, p =.001. This suggests that there was an immediate, positive effect of changing the placement test on course grades. The change in the trend post-policy (fall 2017-fall 2019) was marginally significant, β_3= -.189, p =.070. This indicates that math scores continued to decline at a rate of .189 points ($\beta_1+\beta_3$) after implementing the policy.

A visualization of this time series is shown reflected in Figure 4; the vertical dotted line reflects the year NYCC adopted the new policy change. Overall, the change in placement testing could be considered positive: Math grades at NYCC did increase at the onset of the policy and the decline in course grades apparent prior to the policy was

slowed (the slope in the post-policy period is less steep). A second model was estimated to control for course placement of the students. This did not have a significant effect on the coefficients. All results are shown in Table 5.

Figure 4

Time Series Plot of All NYCC Students' Math Course Grades by Year

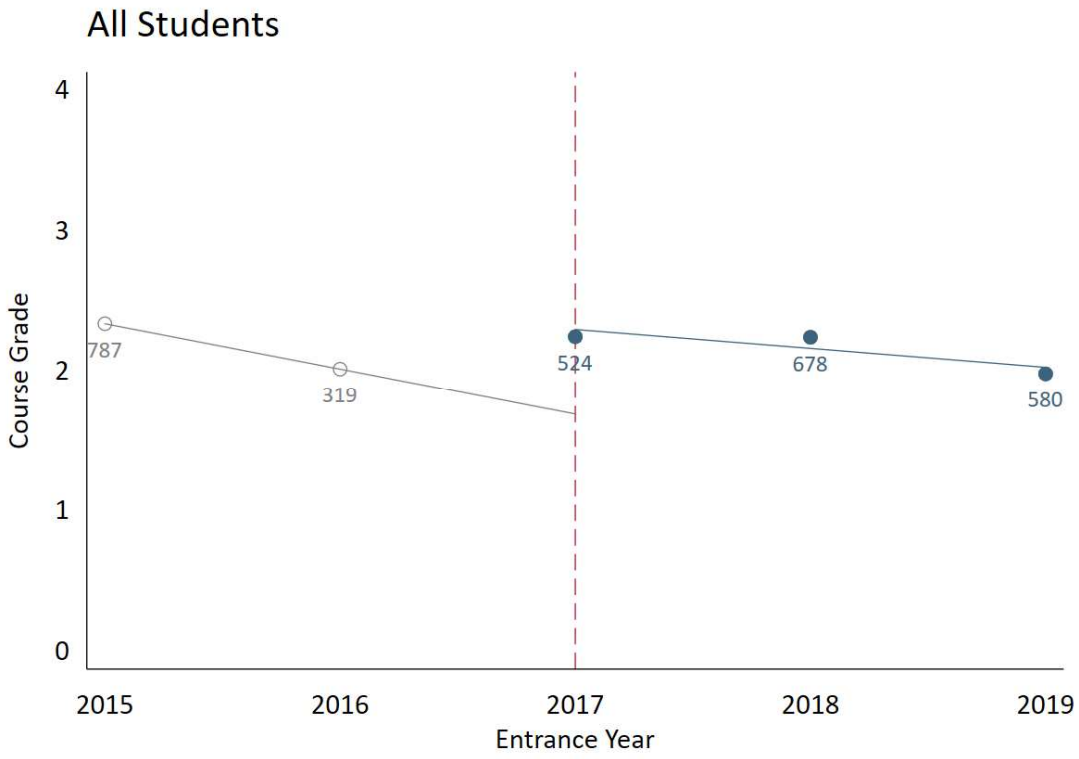


Table 5

Interrupted Time Series Regression of Math Course Grades on Policy, All Students

	Model 1		Model 2	
Intercept	1.688	***	1.685	***
	(.168)		(.174)	
Pre-Policy Trend	-.324	***	-.334	***
	(.095)		(.095)	
Indicator of Policy	.607	***	.621	***
	(.177)		(.177)	
Change in Trend Post Policy	-.189	+	0.194	+
	(.104)		(.104)	
MAT101			-.124	
			(.079)	
MAT 102			0.037	
			(.067)	

Note. $^{+}p<.10$, *$p<.05$, **$p<.01$, ***$p<.001$. Standard errors in parentheses

Research Question 4

The same interrupted time series model was estimated by subgroup (male, female, non-white, white) to determine if there were any differences in the policy effects for subgroups of students. Due to data limitations, only gender (male/female) and ethnicity (white/non-white) subgroups could be analyzed.

Male Students

In the models without course fixed effects, male students' trend pre-policy showed a significant decline in scores, β_1= -.272, p =.032. This indicated that male math test scores declined by -.272 points per year before the policy change. There was a marginally significant jump at the policy change onset for males, β_2= .429, p =.067. The difference in the trend post-policy was nonsignificant, β_2= .100, p =.476. A visualization of this time series is shown reflected in Figure 5; the vertical dotted line reflects the year NYCC adopted the new policy change. Overall, the effects of the policy appear smaller or non-existent for male students, with only a marginally significant gain at the onset of policy and no change in the trend in scores post-policy. Adding course fixed effects did not strongly change the model's results (as shown in Model 2 of Table 6).

Figure 5

Time Series Plot of Male Students' Math Course Grades by Year

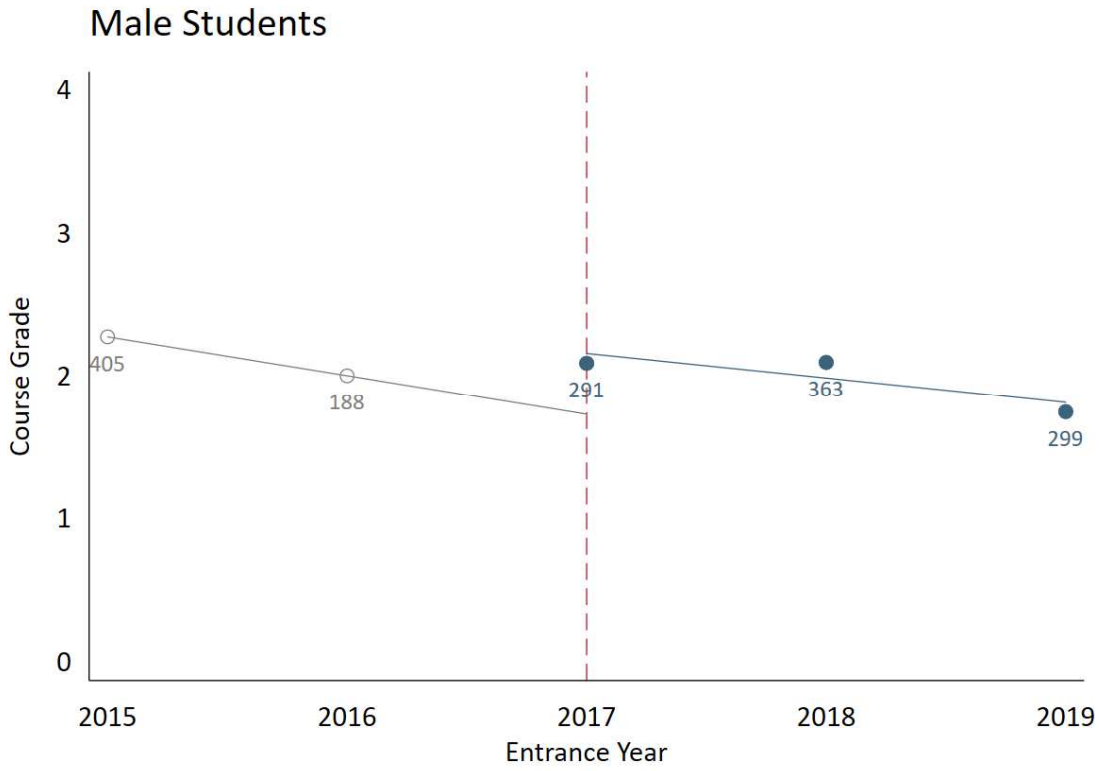


Table 6

Interrupted Time Series Regression of Math Course Grades on Policy, Male Students

	Model 1		Model 2	
Intercept	1.733	***	1.792	***
	(.221)		(.230)	
Pre-Policy Trend	-.272	*	-.272	*
	(.127)		(.127)	
Indicator of Policy	.429	+	.434	+
	(.234)		(.234)	
Change in Trend Post Policy	.100		.097	
	(.140)		(.140)	
MAT101			-.118	
			(.102)	
MAT102			-.061	
			(.090)	

Note. *p<.05, **p<.01, ***p<.001. Standard errors in parentheses

Female Students

In the models without course fixed effects, the trend pre-policy for female students shows a significant decline in scores, β_1= -.376, p =.009. This indicated that female math test scores declined by -.376 points per year before the policy change. There was a significant jump at the onset of the policy change for females in fall 2017, β_2= .818, p =.002. The difference in the trend post-policy was marginally significant, β_2= .269, p =.085. This suggests that female students' math grades continued to decline post-policy, at a rate of -.107 ($\beta_1 + \beta_3$) points after the policy was created. A visualization of this time series is shown reflected in Figure 6; the vertical dotted line reflects the year NYCC adopted the new policy change. Overall, the jump in scores at the onset of policy appears larger for female students than male students and there is marginally significant evidence that their test scores declined less slowly post-policy compared to pre-policy. Adding course fixed effects did not strongly change the model's results, as shown in Model 2 of Table 7.

Figure 6

Time Series Regression of Female Students' Math Course Grades by Year

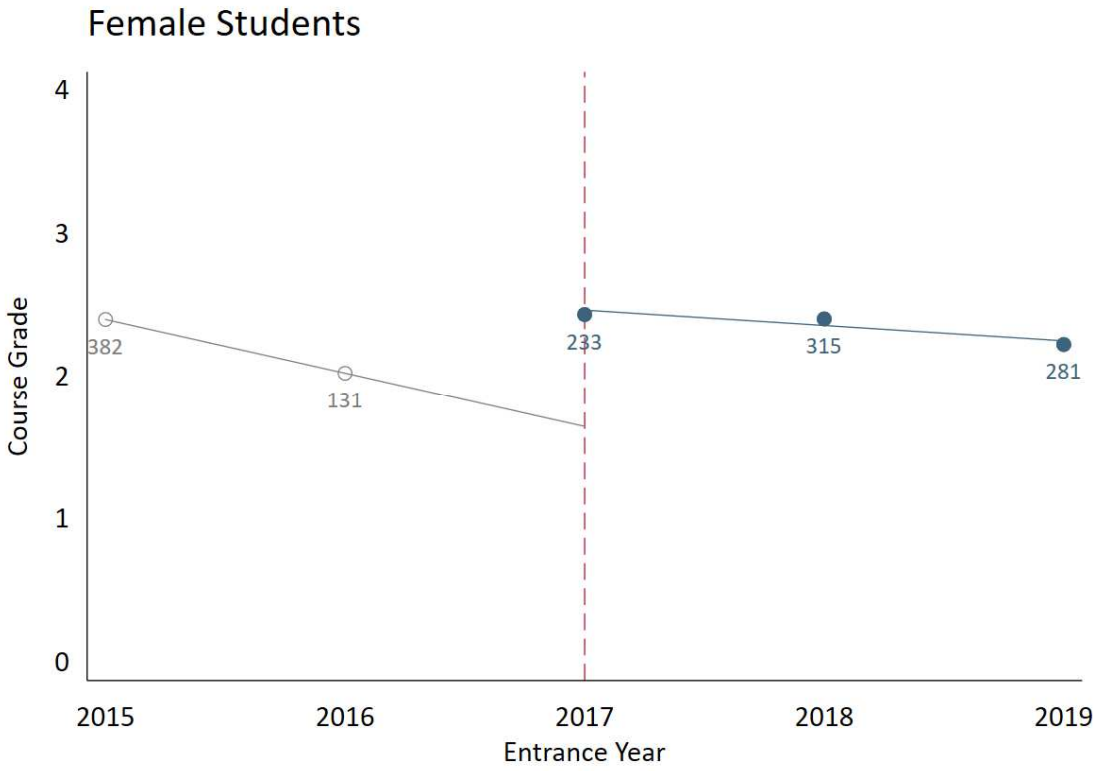


Table 7

Interrupted Time Series Regression of Math Course Grades on Policy, Female Students

	Model 1		Model 2	
Intercept	1.647	***	1.590	***
	(.257)		(.264)	
Pre-Policy Trend	-.376	**	-.397	**
	(.143)		(.143)	
Indicator of Policy	.818	**	.838	**
	(.270)		(.271)	
Change in Trend Post Policy	.269	+	.290	+
	(.156)		(.156)	
MAT101			-.124	
			(.123)	
MAT102			.090	
			(.099)	

Note. *p<.05, **p<.01, ***p<.001. Standard errors in parentheses

Non-White Students

In the models without course fixed effects, the trend pre-policy for non-white students shows a significant decline in scores, β_1= -.390, p =.004. This indicated that non-white students' math test scores declined by -.390 points per year before the policy change. There was a significant jump at the onset of the policy change for non-white students in fall 2017, β_2= .751, p =.003. The difference in the trend post-policy was marginally significant, β_2 = .265, p =.070. The results show that non-white students' math grades continued to decline post-policy, at a rate of -.125 ($\beta_1 + \beta_3$) points after the policy was created. A visualization of this time series is shown reflected in Figure 7; the vertical dotted line reflects the year NYCC adopted the new policy change. Overall, it appears that non-White students benefitted from this policy with an immediate jump in scores and slower decline in scores (post-policy). Adding course fixed effects did not strongly change the model's results, as shown in Model 2 in Table 8.

Figure 7

Time Series Plot of Non-White Students' Math Course Grades by Year

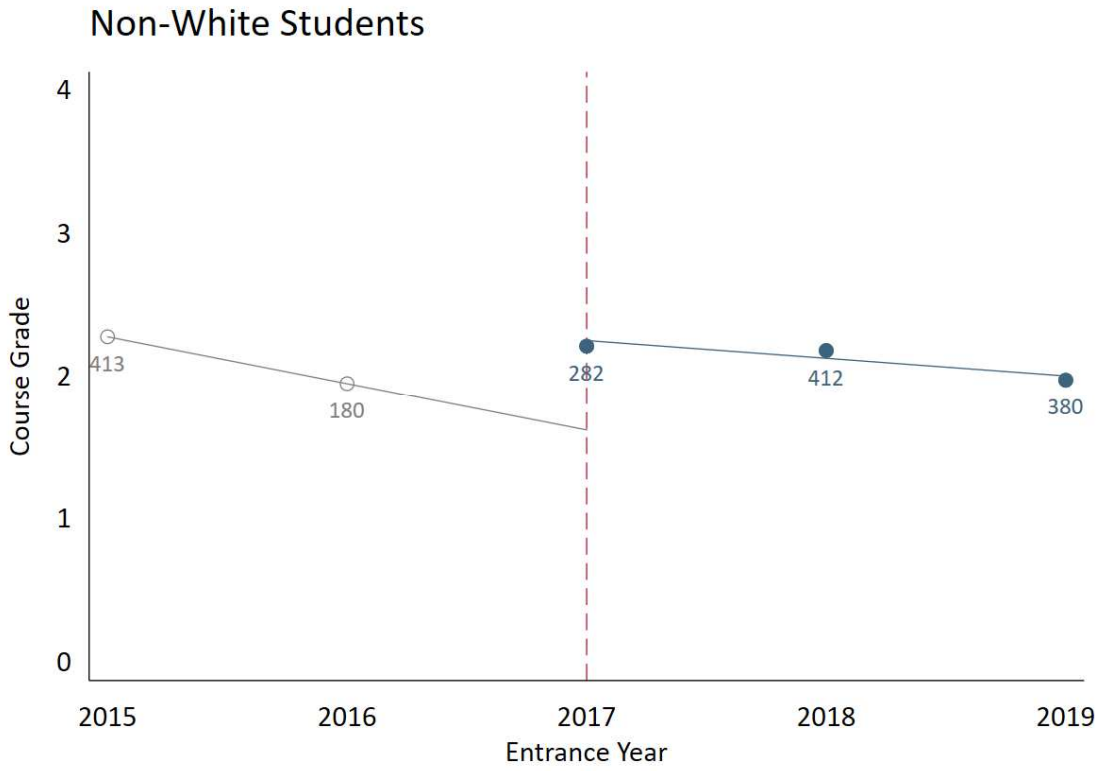


Table 8

Interrupted Time Series Regression of Math Course Grades on Policy, Non-White Students

	Model 1		Model 2	
Intercept	1.479	***	1.424	***
	(.236)		(.244)	
Pre-Policy Trend	-0.390	**	-.405	**
	(.134)		(.134)	
Indicator of Policy	.751	**	.772	**
	(.249)		(.249)	
Change in Trend Post Policy	0.265	+	0.272	+
	(.146)		(.146)	
MAT101			-0.105	
			(.109)	
MAT102			0.113	
			(.093)	

Note. *p<.05, **p<.01, ***p<.001. Standard errors in parentheses

White Students

In the models without course fixed effects, the trend pre-policy for white students shows a marginally significant decline in scores, β_1= -.250, p =.064. This indicated that white students' math test scores declined by -.376 points per year before the policy change. There was a marginally significant jump at the onset of the policy change for white students in fall 2017, β_2= .452, p =.074. The difference in the trend post-policy was nonsignificant, β_2= .118, p =.430. This suggests that white students' math grades continued to decline post-policy, at a rate of -.132 ($\beta_1 + \beta_3$) points after the policy was created. A visualization of this time series is shown reflected in Figure 8; the vertical dotted line reflects the year NYCC adopted the new policy change. Overall, the results for White students are very similar to those for non-White students. Adding course fixed effects does not strongly change the model results, as shown in Model 2 of Table 9.

Figure 8

Time Series Plot of White Students' Math Course Grades by Year

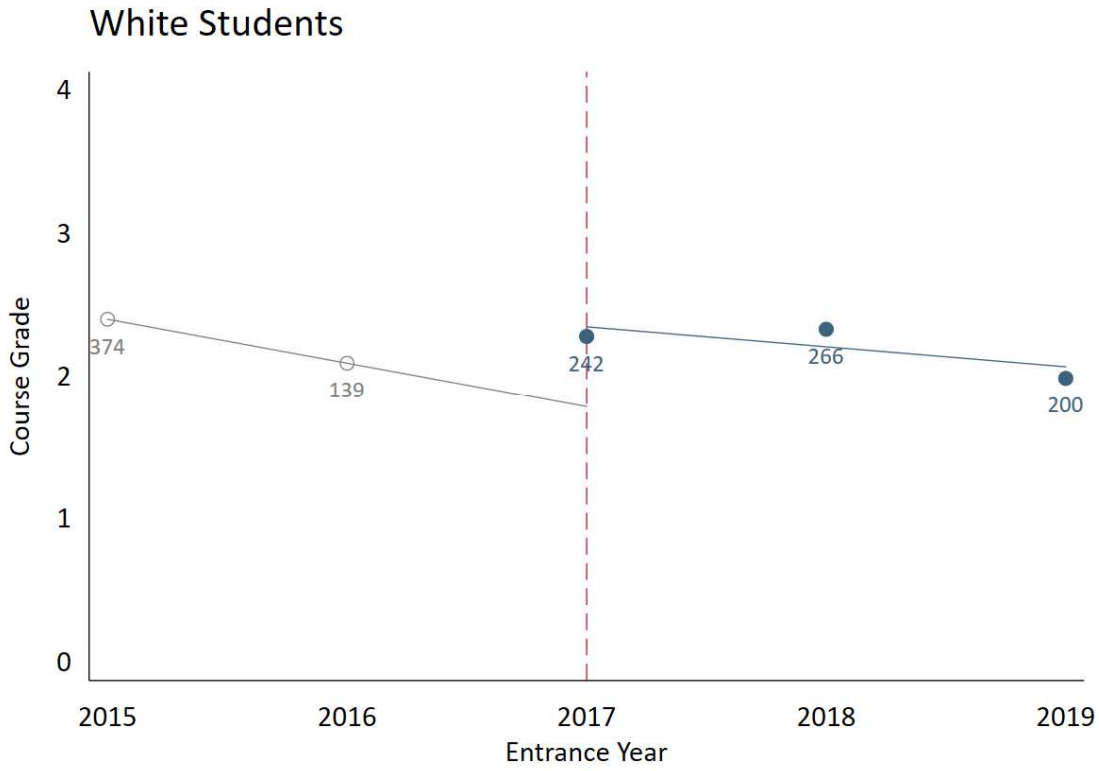


Table 9

Interrupted Time Series Regression of Math Course Grades on Policy, White Students

	Model 1		Model 2	
Intercept	1.908	***	1.947	***
	(.240)		(.247)	
Pre-Policy Trend	-.250	+	-.257	+
	(.135)		(.135)	
Indicator of Policy	.452	+	.462	+
	(.253)		(.253)	
Change in Trend Post Policy	.118		.124	
	(.149)		(.149)	
MAT101			-.132	
			(.114)	
MAT102			-.035	
			(.096)	

Note. *p<.05, **p<.01, ***p<.001. Standard errors in parentheses

Conclusion

This study examined how two different math exams (ACCUPLACER and the New York State Algebra 1 Regents) could help with placement into credit-bearing math courses. While significant predictors, neither the Regents exam nor the ACCUPLACER was a *strong* predictor of course grades. They explained little variance in course grades among students. Based on the data, it was identified that math grades were declining on average before the change in the placement policy. During the year the policy was adopted (Fall 2017), there was an increase in average math grades overall and for most subgroups. This positive trend did not continue for most student's post-policy as overall math grades decreased for all students, similar to what they were two years pre-policy. However, the grades post-policy did not decline at the same rate as would be predicted by the pre-policy trend. Overall, this suggests that there were positive gains from the policy implementation; however, they are limited. The implications of these findings are discussed in the following chapter.

CHAPTER 5

Introduction

This quantitative study investigated whether the introduction of a new math placement process—using a student's New York State Algebra 1 Regents scores to determine his or her first math course—in the fall of 2017 at New York Community College impacted average math course grades. This chapter summarizes the major findings of the study and the recommendations for colleges and universities, particularly community colleges, that these findings imply for math course placement.

Implications of Findings

There are three key findings that merit in-depth discussion. First, the New York State Algebra 1 Regents exam and ACCUPLACER exam were similarly predictive of math course grades (Research Question 1 and 2), which suggested that they are equally valid when predicting future math performance. Or, in other words, that there may not be tremendous technical losses or gains when switching between the two tests for math course placement. However, it should be noted that each test only explained about 2-4% of the variance in course grades. This means that there is a lot left unexplained that is unrelated to these two tests and that other measures may be necessary to improve course placement. This finding ran contrary to the author's hypothesis that the Regents Algebra 1 score would be a better predictor of course grades than the ACCUPLACER score and has critical implications for how course placement is done both at NYCC and other colleges.

Second, this new placement policy had an immediate positive effect on math course grades (Research Question 3). Notably, however, course grades declined after

the policy took effect, albeit by smaller amount than the decline in the years leading up to the policy change. In 2018 (two years post-policy), average course grades were similar to 2013 (two years pre-policy), suggesting that there may not be lasting effects. Importantly, evaluation of the long-term effects of this policy should be revisited as NYCC compiles additional years of data both pre- and post-policy. This study was had data limitations since it occurred only three years after the start of the new testing policy.

Finally, the effects of the policy were similar across all subgroups studied. Each subgroup experienced a jump in average math grades at the time of the policy (although this was only marginally significant for male students) and all groups continued declining average grades post-policy. This suggests that the policy was equally impactful (or equally not impactful) for all groups and did not cause any unexpected inequities among groups.

In the context of NYCC, enabling the use of Regents Algebra 1 exams for course placement, did not appear to have negative or unintended consequences for students. Moreover, it had logistical benefits, which were not studied or evaluated as part of this dissertation. By opting to use Regents Algebra 1 scores for math course placement, students could be admitted to NYCC quicker, received their financial aid sooner, and were able to register for their upcoming semester faster. In addition, they did not need to schedule or sit for a placement tests, which has a limited number of seats per test and is only offered on specific dates set by the college. NYCC also benefitted from reducing the number of placement tests administered, as the college lowered the number of exams that they purchased from the College Board as well as

lowered their exam administration costs (e.g., salaries for proctors).

That said, college administrators or faculty may argue that using the New York State Algebra 1 Regents exam may not be a good placement measure. Not all students will have covered the math course material in the same format in high school. Some teachers/professors may have over-prepared students, while other districts and teachers may have skipped over important course material that was a focal point of the exam. Moreover, passing grades do not necessarily mean that the student did not struggle and need extra assistance in their course, and failing grades may be due to other factors than solely academic rigor. Support for this argument can be seen in the limited predictive validity of the Algebra 1 Regents for course grades. This suggests that it should only be used as part of a portfolio of data for course placement.

Relationship to Prior Research

Prior research on the College Board's ACCUPLACER exam and similar tests indicate that placement tests have low predictive validity and are not significantly correlated with students' college outcomes, such as college GPA or credit completion (Armstrong, 2000). That was confirmed in this current study, as ACCUPLACER scores explained only 4% of the variance in course grades. It was further shown that Regents Algebra 1 scores suffer from the same low predictive power. The College Board needs to take a more active role with the course placement assessments with the colleges that administers the ACCUPLACER exams. Currently, the College Board recommends that each college create their own course placement scores and provides very limited data regarding the math placement and student achievement in the course can create course misplacement (College Board, 1997). The College Board not only needs to assist with

course placement but needs to expand their assessment on the student success in math classes. Expanding this research and working closer with the colleges will attempt to make the ACCUPLACER a more comprehensive exam. This collaboration would allow for not only better course placement but could also help promote providing student success data by college.

As previously discussed, the additional multiples measure placements benefit the students along with the college. The students have the ability to register for classes earlier along with not having to pay for the placement tests. The placement testing budget is typically shared between both the student and the college. The costs to coordinate placement testing ranges from $300,000 to 875,000 per year. The college finances 60 percent of the costs, while the remaining costs are paid by the student (Rodríguez, O, et al., 2015). By adding additional placement mechanism, allows the college to reduce payroll by reducing the number of proctors for testing, and students do not need to change their daily schedules in order to try and coordinate taking the placement tests. All this can be completed without sacrificing academic quality. The savings that the community college inherits can be used to help promote access, equity and post completion success for community colleges students.

Further research has suggested that better placement strategies, ones that supplement placement test scores with other information such as additional test scores, students' high school performance, and non-cognitive factors, may improve placement accuracy and, consequently increase students' chances of academic success (Belfield, 2014). The more strategies to properly place students benefit the incoming students with better grades and improve student retention. Based on the results of this

study, the author believes this to be a valid argument. For example, using the New York State Algebra 1 Regents results and high school grade point average may be a more successful placement combination. Research has shown that high school transcripts are strong predictors of college success (Hughes and Scott-Clayton 2011). Combining both Regents and high school transcripts accounts both for how a student performs on a state-wide test and for how they learn in a classroom setting—both of which are relevant for a community college education. This information is also supported by the Community College Research Center (CCRC) that discovered that using high school information to properly place a student correlated positively with an increase in a student's grade point average (Scott-Clayton, 2014). In addition, the CCRC also indicated that a high school transcript review could reduce incorrect college course placement for a one-third of the population who take the placement exam (Scott-Clayton, 2014). There can be challenges with using course grades for course placement since there is not a universal math curriculum throughout the United States. Individual states may have course syllabi, but the United States Department of Education has not created a national math syllabus for all states to follow.

Limitations of the Study

One limitation to this study was the large changes in students' demographics and enrollment over the time period studied. This is called a simultaneous events threat. It is unclear if the immediate jump was simply due to the change in student population during the Fall 2017 semester. The new placement testing policy was supposed to produce increased math grades, but the increase only occurred during the fall 2017 semester. Students may have entered with improved high school math preparation during that

semester, which could have resulted in an instant increase in math grades. The students who entered after fall 2017 semester may not have had the same math background as previous years. Every semester, the new student population changes. Some students may be more prepared, while others are underprepared. This academic profile needs to control for many variables, like prior educational knowledge, work commitments, and family obligations.

A more controlled study with a control group would be beneficial. The lack of pre-and post-policy enrollment data caused low internal validity. Including five to ten years of pre-and post-policy enrollment data could have allowed for a higher internal validity and more confidence in the results.

Another limitation to this study was using only one community college in this study. In this study, generalizability was used. This practice is when results from findings and conclusions from NYCC were used to make comparisons for the population at large. In order to avoid this, enhancing the sample size to include additional community colleges within New York State would be recommended. Since this research only involved one community college at a suburban location, in order to avoid generalizability, the sample size should be expanded to other NY community colleges. The addition of City University of New York (CUNY) community college and other SUNY community colleges would allow for a stronger and more diverse sample size.

The small sample size of this research created low power and could reduce the likelihood that a statistically significant result reflects a true effect of the study. Having more students in the sample would have increased the changes that a true outcome could have been determined. In addition, the inability to disaggregate the non-white data

impacted the results. The low numbers of students who reported themselves as non-whites could have revealed the inequalities between the sub-groups. If the sample size of non-whites increased this could have been avoided.

An additional limitation in this study was during the first year of policy implementation, NYCC student services staff may not have been accustomed to this new process and policy. A possible failure to fully comply with the new policy may have impacted math course placements. In other words, there was reason to question the fidelity of the policy implementation in the first year, and therefore the estimated coefficient on the change in course grades at the time of policy implementation. Moreover, other factors may have affected students at the time of policy implementation, which cannot be controlled for this statistical framework.

This study should have limited the sample size more than what occurred. The sample size should have excluded any students in the post-policy period who would not have needed to take the ACCUPLACER during the pre-period time frame. By using post-policy student waivers for pre-policy students would have created a better sample size.

Lastly, another limitation in this study was that the researcher could not secure all of the students' race/ethnicity data since this was not a required question for incoming students to complete when submitting their admissions application. This was the only way that NYCC was able to capture a student's race/ethnicity and not having complete student biographical data may have impacted the control groups results.

Recommendations for Future Practice

Based on the results of this study, I have two recommendations for community

colleges. The first recommendation is to increase the use of multiple measures for math placement. This can be accomplished by using additional state-wide math exams. Since the New York State Algebra 1 Regents exam did not decrease academic success, additional state-wide testing should be evaluated as a placement measure. New York State community colleges, and other community colleges across the nation should consider adding additional state-wide math exams to help with math placement in place of packaged placement tests. New York State not only offers the Algebra 1 exam, but the state requires students to test in Geometry and Algebra II. These tests are typically offered during a student's 10th and 11th grade in high school and could be a strong indicator for college success since these Regents exams are taken towards the end of a student's high school career. The information from these tests can create the educational foundation for math students to progress through their math curriculum. These tests could assist with a student's prior knowledge. States the offer multiple math exams to high school students should be reviewed to identify if those exams can be used as another multiple measure. Adding multiple measures such as New York State Regents exams, SAT/ACT scores, or even high school grade point average would provide a more holistic review of the student's prior educational experiences and aligns with previous research in this area.

Another recommendation would be to review the ACCUPLACER and New York State Algebra 1 Regents exams cut scores for math placement by campus to determine if they are promoting student success. This research only determined if the ACCUPLACER and New York State Algebra 1 Regents exam fostered academic success in credit-bearing math courses, but do not review if the scores are over or

under-placing students in courses. The placement process should be evaluated by faculty and staff at their respective community colleges every few years since the student make-up is constantly changing.

Recommendations for Future Research

There are many possible avenues for further research. The first recommendation would be to explore the impact of multiple measures placement. Can community colleges use both state-based subject testing along with overall high school math grades for course placement? To contribute further to the body of research in this area, it would be prudent to examine using overall high school grade point average or high school math averages as a placement measure at a community college. Overall performance in the content area should be reviewed as a possible measure for placement. High school students spend years in the classroom learning, and this comprehensive knowledge is essential when trying to gauge a student's level of expertise in certain subjects. Overall grade point average may be a mechanism that can help properly place students into college courses after research has been conducted. expand the use of high school math grade point average and the New York State Algebra 1 Regents scores as a placement model. Prior research has indicated that high school grade point average is a strong placement measure. Including both high school math grade point average and the New York State Algebra 1 results should be reviewed to see if this combination is a better indicator for community college success.

A second recommendation for future research would be to investigate if academic success trends are similar for students placed into math developmental courses from New York State Algebra 1 exam results. Additional research should

investigate, if a student's score below a passing score on their New York State Algebra 1 Regents exam, these students may be "at-risk" and may need additional support services and course work needs to be reinforced from high school. While not focusing on this study, there are some viable alternatives to developmental courses, including learning communities, paired courses work, and a mandatory first-year seminar or an advisement process.

A third recommendation would be to expand the NYCC student sample size. Collecting more student data during the pre and post policy years would allow for better analysis. Reviewing student data that was at least five to ten years prior to the policy change, and a similar span of years post -policy would be a future recommendation. Since the policy was changed in 2017, the five to ten years of post-policy enrollment years have not been completed and thus could not be used in this study.

The last recommendation would be to continue this research by focusing on math course placement, academic success in first an introductory math course, along with length of time to a student's degree completion. Do students with higher math grades complete their associates quicker than students with lower math grades? This recommendation would enhance the current study, and align the research with access, equity and post-completion success of our students. All these recommendations should be reviewed in the future in order to benefit our students to complete their education.

Conclusion

The need to accurately place students into the appropriate courses at a community college is critical. This is especially necessary at community colleges

since many students attend from diverse backgrounds and often attend the community college underprepared for the academic rigor. Previous literature had not extensively explored whether the NYS Regents Algebra 1 exam could be used for course placement, a gap in the literature that this study sought to fill. Using data from a suburban New York State community college, this study presented that switching from the ACCUPLACER exam scores for math course placement to using Regents Algebra 1 exam scores led to an increase in math grades, but that gain trailed off in subsequent years. This general pattern was true for all student subgroups explored.

Based on these results and the logistical gains from not having to require a separate test for placement, the switch to the new policy was deemed successful. NYCC did not need to spend considerable funds to administer the ACCUPLACER. Students were not required to take an additional test before entering NYCC, and students' math outcomes were slightly improved relative to prior years. That said, community college administrators and faculty must continue to discuss the best methods to place students in courses to properly promote academic success.

Using the New York State Regents is just one method for course placement, and it would be better if considered among other factors such as prior course subjects or overall grade point average. Colleges need to continue to assess their course placement for not only math but many other subjects. These courses are the basis for college students, especially community college students who have diverse social and educational backgrounds. Allowing community colleges to embrace new placement measures will be a key benefit for equitable access and post-completion success for their students, which is the foundation of the community college model.

APPENDIX A IRB Memo

From: irbstjohns@stjohns.edu <irbstjohns@stjohns.edu>

Sent: Thursday, October 15, 2020 1:59 PM
To: dave.follick17@stjohns.edu; fahlee@stjohns.edu
Subject: IRB-FY2021-114 - Initial: Initial - Exempt - St. John's

Federal Wide Assurance: FWA00009066

Oct 15, 2020 1:59 PM EDT

PI: Dave Follick

CO-PI: Erin Fahle

Dept: Ed Admin & Instruc Leadership

Re: Initial - IRB-FY2021-114 Using the New York State Algebra 1 Regents Results for Introductory Math Course Placement At A Suburban New York State Community College

Dear Dave Follick:

The St John's University Institutional Review Board has rendered the decision below for Using the New York State Algebra 1 Regents Results for Introductory Math Course Placement At A Suburban New York State Community College .

Decision: Exempt

PLEASE NOTE: If you have collected any data prior to this approval date, the data must be discarded.

Selected Category: Category 4. Secondary research for which consent is not required: Secondary research uses of identifiable private information or identifiable biospecimens, if at least one of the following criteria is met:

(i) The identifiable private information or identifiable biospecimens are publicly available;

(ii) Information, which may include information about biospecimens, is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained directly or through identifiers linked to the subjects, the investigator does not contact the subjects, and the investigator will not re-identify subjects;

(iii) The research involves only information collection and analysis involving the investigator's use of identifiable health information when that use is regulated under 45 CFR parts 160 and 164, subparts A and E, for the purposes of "health care operations" or "research" as those terms are defined at 45 CFR 164.501 or for "public health activities and purposes" as described under 45 CFR 164.512(b); or

(iv) The research is conducted by, or on behalf of, a Federal department or agency using government-generated or government-collected information obtained for nonresearch activities, if the research generates identifiable private information that is or will be maintained on information technology that is subject to and in compliance with section 208(b) of the E-Government Act of 2002, 44 USC 3501 note, if all of the identifiable private information collected, used, or generated as part of the activity will be maintained in systems of records subject to the Privacy Act of 1974, 5 USC 552a, and, if applicable, the information used in the research was collected subject to the Paperwork Reduction Act of 1995, 44 USC 3501 et seq.

Sincerely,

Raymond DiGiuseppe, PhD, ABPP

Chair, Institutional Review Board

Professor of Psychology

Marie Nitopi, Ed.D.

IRB Coordinator

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Vita

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Baccalaureate Degree	*Bachelor of Arts*, *University of Massachusetts-Amherst, Amherst* *Major: Political Science*
Date Graduated	*May, 1998*
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