COMMUNITY COLLEGE PLACEMENT: HOW EMERGING POLICY AND PRACTICE RELATE TO SUCCESS AND PERSISTENCE

by

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ABSTRACT

DONNA JOHNSON HELGET. Community college placement: How emerging policy and practice relate to success and persistence. (Under the direction of DR. MARK M. D'AMICO)

The purpose of this quantitative study was to examine whether the method of course placement for the first attempted English and mathematics courses was independent of the student demographic variables of gender, race/ethnicity, and Pell Grant eligibility. The study also analyzed if course success and semester-to-semester persistence were dependent upon the method of course placement into the first attempted English and mathematics college-level courses for all students in the study and among demographic groups identified as interdependent. The population for this study was community college students ages 18 to 25-years old who were enrolled in gateway mathematics and English courses during the Fall 2013, Fall 2014, and Fall 2015 semesters. A Chi-Square analysis was utilized to accept or reject the null hypothesis that no relationship existed between the independent and dependent variables. The results of the study found dependence between method of course placement and student demographic variables of race/ethnicity and Pell Grant eligibility. The study also found dependence between method of course placement and course success, as well course placement and semester-to-semester persistence.

DEDICATION

I would like to dedicate this work to my daughter, Hannah, who encouraged me throughout my educational endeavors. I could not have been as successful without her support. To Jeff, my husband, who gave me the motivation I needed to complete this project. To my friends and colleagues, Matt and Renita Peeler, I dedicate this work as an offering of my thanks for your encouragement, support, and friendship. Thank you also to my mom and grandmother, who have been a constant support. I also dedicate this work to the many outstanding professors, especially my chair, Dr. D'Amico and Dr. Dika, who have graciously given of their time and talent to make this project a reality; the knowledge and insights I acquired in your courses have greatly increased my leadership capacity in the field of higher education.

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CHAPTER I: INTRODUCTION

Community colleges are among the most open access of all educational institutions (Cohen & Kisker, 2010); the "open-door" admissions policy at public two-year colleges ensures that prospective students from all educational backgrounds can enroll regardless previous academic achievement and begin the coursework necessary to obtain an associate's degree, diploma, or certificate. To begin taking courses at community colleges, prospective students need only complete an application and take a placement test to determine their academic proficiency most commonly in the areas of reading, writing, and mathematics. "Open-door" does not mean open-access to college-level courses, however. In fact, the majority of incoming students are deemed academically underprepared by placement tests; the U.S. Department of Education (2009) reported that as many as 68% of students who enroll at public two-year colleges are prescribed one or more developmental courses following their initial placement test. Students do not receive academic credit toward degrees, diplomas, and certificates for developmental courses even though they are required for students who do not demonstrate academic readiness for the rigors of curriculum-level courses. In some states, English remediation, which encompasses reading and writing, can require as many as three developmental courses depending on the students' placement, but in mathematics, students may require up to as many as eight developmental mathematics shells or modules to gain access to credit bearing courses. Though developmental course

progression can serve as a foundational gateway to curriculum-level coursework for underprepared students, course success rates are particularly low among the considerable number of students who are required to complete developmental course sequences (Hughes & Scott-Clayton, 2011).

Standardized placement testing is the most frequently used method of placing students into appropriate coursework because placements tests are relatively economical for schools to purchase in bulk and require little time and administrative support to administer and score (Broek, Dadgar, Finklestein, Mundry, & Bugler, 2014). Additionally, standardized placement tests provide colleges with consistent measurements that can easily be compared across student populations, departments, institutions, and states. Around 92% of two-year institutions employ high-stakes placement testing to determine students' academic readiness for college-level coursework (Hughes & Scott-Clayton, 2011), but recent research on placement testing indicated that as many as 24% to 33% of students are inaccurately placed into developmental courses when entering college, thus creating unnecessary barriers to post-secondary success (Scott-Clayton, 2012). Course placement limits the open-access mission of community colleges because students do not have equal access to college-level courses. Minority and Pell Grant eligible students traditionally place lower on placement tests causing at a greater need for remedial coursework among these populations before they are eligible to begin college-level coursework (Katsinas & Tollefson, 2009).

As a result of high attrition associated with developmental courses, legislators and institutions are re-assessing the benefits of remedial education and the placement methods used to determine if students will benefit from developmental coursework rather

than direct placement into credit bearing courses (Broek et al., 2014). Course placement assessments used by community colleges are considered inaccurate by some researchers not just because of poor placement accuracy but because of inconsistent standards defining the levels of competence which constitute college-ready skills (Hodara, Jaggers, & Karp, 2012). Belfield and Crosta (2012) found that up to one-third of students placed into college courses through placement tests were "severely mis-assigned" or misplaced. Their research suggested the placement error rate could be decreased by half if colleges used students' high school grades and GPA (Grade Point Average) instead of placement test scores.

Unlike selective institutions which admit students based on their ability to meet specific criteria, the open-access mission of the community college presents colleges with the unique challenge of identifying incoming students who are underprepared for college-level coursework. More than half of community college students register for at least one remedial course, but many more students are recommended for remedial coursework but never enroll (Bailey, 2009; Bailey, Jeong, & Cho, 2010). Initial course placement is often determined solely on the basis of whether a placement test score is above or below a certain cut-off score. Though not as common at community colleges, students may also be placed directly into curriculum-level classes based on high school GPA and/or prior coursework or by their SAT or ACT scores. Students may also gain access to credit bearing courses by completing the prescribed developmental course progressions or repeating the course if the credit bearing course was not successfully completed based on prior placement into the course.

As of Fall 2013, students in the Florida community college system were no longer required to take developmental courses even if their skills were considered deficient by placement test standards and counselors recommended developmental courses based upon students' demonstrated academic deficiency. Students entering the Florida community college system from high school were not required to take the placement test at all because their high school diploma deemed them college-ready, according to newly approved state guidelines (Fain, 2013). The outcome of the developmental exemption policy does not indicate increased retention in college-level courses as legislators and college leaders had anticipated. Students who demonstrated the need for developmental coursework by placement test or by low GPA yet chose to go on to the college-level course were consistently more likely to fail. In fact, the course failure-rate for Miami-Dade students went from 46.8% from 55.8% during the time of the implemented policy, and enrollment in developmental mathematics courses decreased by 42% (Smith, 2015). Initiatives in Tennessee have had better results in their efforts to reduce the need for remediation and expedite degree completion. Their model places students directly into college-level courses despite academic deficiencies but provides them with supplemental academic support for those who are struggling. Since the start of this model, the retention rate in college-level courses has increased from 43.3% to 57.4% (Denley, 2015).

A recent multi-state initiative, *Core to College*, has sought to reinvent the placement process and decrease the number of students recommended for remediation by advocating for greater alignment between K-12 and community college standards so students are better prepared for the rigors of curriculum-level courses (Broek et al, 2014). Each of the ten states participating in the *Core to College* initiative developed a unique

state-wide definition for college readiness and created conditions in which the K-12 Common Core State Standards assessments may be used to quantify students' readiness for credit bearing coursework at the community college. North Carolina is one of the *Core to College* states that is monitoring the number of students recommended for developmental education within their community college system and implementing placement options that grant students swifter access to credit bearing coursework while maintaining the necessary level of academic foundations necessary for success in college-level coursework. While the criteria for college readiness may differ among states, many two-year institutions are experimenting with alternatives to the single standardized placement test as the sole indicator for placement into college-level courses (Broek et al., 2014). These alternatives, commonly referred to as "multiple measures," include academic and non-cognitive forms of measurement that give a more comprehensive representation of a student's ability and preparedness for college-level courses. Essentially, multiple measures is the utilization of various indicators to determine the extent to which a student is academically ready for college-level courses. While GPA is an indicator of students' cognitive capabilities, for example, it is also considered by some researchers as a non-cognitive measure because it can also account for persistence and perseverance during high school, which are considered non-cognitive variables associated with student success (Beaver, Duffy, Park, & Schott, 2014).

Community colleges within the North Carolina Community College System (NCCCS) have begun addressing academic placement concerns by adopting a multiple measures approach to course placement that assesses students' readiness for curriculum-level coursework based on a variety of variables, like high school coursework, GPA, and

SAT/ACT scores. Colleges anticipate greater placement accuracy and increased access to credit bearing coursework by supplementing or substituting students' placement test scores with other measures of student achievement and evidence of prior academic performance.

As a participating *Core to College* state, North Carolina has developed a customized placement approach that includes the use of information from multiple masures, like high school grades and GPA for students who graduated from high school within the past five years, to make course placement decisions (Burdman, 2012). Community colleges expect the shift to multiple measures placement will increase students' immediate access to credit bearing coursework and improve course success rates and persistence (Belfield & Crosta, 2012).

Statement of the Problem

The completion agenda initiative endorsed by fomer-President Obama sought to increase the number of students holding associate degrees by 50%, or 5 million students, by the year 2020 (Obama, 2009). To increase the rates of course success and degree completion, the most expedient course placement must be considered, as well as which placement methods are working effectively and which methods are hindering student progress. All higher education initially involves the classification and placement of students into the courses that best fit their academic abilities and career goals, yet researchers disagree on key practices for providing accurate course placement (Noble & Sawyer, 2004).

Based on 2011 ACT scores, however, only 25% of students who took the ACT exam demonstrated college readiness (ACT, 2011), but some researchers and policy

makers believe this number is inaccurate and contend that students are prescribed unnecessary developmental course sequences far too frequently (Bailey, 2009; Complete College America, 2012). Further research asserts that a single score on an academic proficiency test is not a thorough or accurate representation of student's readiness for college-level coursework (Conley, 2008; Scott-Clayton, 2012). The use of prior coursework, like the number and level of high school courses, grades in high school courses, and the highest level of courses taken, has proven to be a more effective indicator of college achievement than singular placement test scores (Duckworth, Quinn, & Tsukayama, 2012). Other intrinsic factors, such as attitude, perseverance, mindset, learning strategies, and social skills, have been identified as equally important to academic success and persistence; these factors may be more evident by the examination of students' high school performance records than by placement test scores (Sedlacek, 2004).

Due to disparities surrounding the sole use of placement testing, the implementation of multiple measures to make placement decisions is gaining increasing acceptance at many two-year colleges with the objectives of correcting the disparate proportion of students recommended for remediation and increasing students' immediate access to credit bearing coursework. While recent research has indicated that high school GPA and high school courses completed are positively associated with college success, there is little evidence indicating the use of these measures to make placement decisions is more effective than using placement score when relating students' success in their first college-level English and mathematics courses with how they were placed. Fewer studies examine the effect of placement on semester-to-semester persistence for students who

completed their first college-level English and mathematics courses (Belfield & Crosta, 2012; Scott-Clayton, 2012).

Gaps in Literature

The federal government's focus on degree completion has prompted community college leaders to reconsider placement methods to increase students' access to credit bearing coursework and raise course success rates. In the North Carolina Community College System, the multiple measures placement policy has only been required since August 2015, though several community colleges in the state began implementation as early as August 2013. Therefore, research investigating whether secondary educational achievement is a reliable indicator for college success when taking postsecondary achievement into account for placement purposes is limited.

While empirical research has focused on the predictive validity of college exams, like the ACT and SAT, only a few studies have examined college placement exams and their ability to predict student outcomes in credit bearing courses and persistence in subsequent courses (Scott-Clayton, 2012). According to Scott-Clayton (2012), a low placement test score does not necessarily indicate that a student should be recommended for developmental courses, for factors other than cognitive ability negatively impact students' test results. Though standardized placement tests are considered predictive of academic success in college-level courses, they fail to address whether students who assigned to remediation based on their test scores actually benefit from required developmental courses or if they would have performed just as well in the credit bearing course (Bailey, 2009).

Research on course placement suggests that remedial referral based on placement test scores is not improving student performance outcomes or retention (Scott-Clayton, 2012); in fact, Bailey, Jeong, and Cho (2010) found students who bypassed remedial placement recommendations and directly enrolled in college-level courses had only slightly lower grades than students who placed directly into the college-level courses. The students who disregarded the prescribed remedial placement demonstrated significantly higher pass- and retention-rates than students who completed their developmental course progression. Still, not as much is known about how course success and persistence is dependent upon the method of placement, and even less is known about the relationship between the method of placement and course success when varied by gender, race/ethnicity, and socioeconomic status. Students who bypassed developmental courses are a difficult population for researchers to identify and study because few students are allowed the opportunity to circumvent developmental course requirements and enroll directly in credit bearing courses. Students placed using the multiple measures policy provide a slightly similar population and may provide valuable information about the extent to which developmental education is needed for success in college-level courses.

Purpose of the Study

As states consider the cost of providing remedial education and the inaccuracy in which students are placed in developmental courses, alternatives to test-based placement must be considered (Bostian, 2012). The decision to broaden options for course placement beyond a single placement test score requires a compromise between institutional and state stakeholders. Accurate course placement is crucial for community

college students because retention and persistence are adversely affected by lengthy developmental course sequences, but access to courses in which students are underprepared can have negative effects on retention and persistence, as well (Bailey, Jeong, & Cho, 2010). To make the most comprehensive placement determinations, community colleges in states like California and Tennessee reformed traditional placement practices by allowing students greater autonomy in deciding if they were prepared for gateway English and math courses rather than relying on placement testing as the sole measure of college readiness.

The California Community Colleges System spearheaded the reform to incorporate multiple indicators of student performance to make college-level placement decisions in 1986. Community colleges in the state were given autonomy to determine which inputs of student information they deemed best for making placement decisions, but the policy mandated that more than one input must be considered. Though access was increased to college-level courses, significant placement variation existed among colleges making the policy difficult to measure. Legislation passed in 2011 called for greater uniformity in the placement process and required community colleges to adopt a common assessment system as one of the inputs considered. This assessment system has yet to be developed, however (Beaver et al., 2014).

Developmental education reform in Florida community colleges allows students to bypass developmental courses, even if placement test results and/or high school GPA indicate the need for developmental course intervention. Students entering the Florida community college system from high school are not required to take a placement test at all, regardless of high school GPA (Fain, 2013). Community colleges in Tennessee allow

students to opt out of developmental courses; however, Tennessee community colleges provide students with low placement scores and high schools GPAs with supplemental academic support to enhance their college-level coursework (Denley, 2015).

Recent efforts to implement a multiple measures placement policy in North Carolina are intended to address the number of students erroneously placed into developmental courses and simultaneously improve community college rates of courses success. North Carolina's policy for regulating multiple measures placement incorporates the K-12 Common Core State Standards required for high school course completion so that students' high school GPA and coursework may be used to determine college readiness in lieu of placement test scores for students who graduated high school with a five-year period (NCCCS, 2013).

The NCCCS multiple measures initiative began in 2013, so not a great deal of research about the outcomes of the initiative's efforts to utilize multiple measures placement to reduce the number of students referred for remediation is available. The initial implementation in August 2013 was voluntary, but all community colleges in North Carolina were required to comply with the multiple measures placement policy by August 2015 (NCCCS, 2013). Whether the students that benefit from the placement by way of multiple measures policy are successful in credit bearing courses remains undetermined.

The purpose of the study proposed herein is first to examine whether the method of course placement for the first attempted English and mathematics courses is independent of the student demographic variables of gender, race/ethnicity, and Pell Grant eligibility. The study will then analyze if course success and semester-to-semester

persistence is dependent upon course placement in the first attempted English and mathematics college-level courses for all students in the study and among students in demographic groups based on identified interdependence with one or both dependent variables.

Research Questions

Ngo and Kwon (2015) found two factors in particular, high school GPA and information about achievement in high school courses taken, to be the most useful in making placement decisions. These factors increased access to credit bearing English and mathematics courses and ensured that students were successful in the courses, yet many developmental education researchers, support compulsory placement testing as a "best practice" and insist that course placement through testing most accurately predicts the course-level students require (Boylan, 2002).

This study draws upon the outcomes of a recent state-wide placement policy shift in the NCCCS to determine the effect of the newly implemented multiple measures placement method. The study will examine course success and semester-to-semester persistence are dependent upon course placement method among community college students who enroll in courses at the community college within five-years of completing high school. The following research questions will guide this study:

RQ1**:** Is course placement method for the first attempted English and math college-level courses independent of student demographic characteristics (gender, race/ethnicity, Pell Grant eligibility)?

RQ2**:** Is course success in the first attempted English and math college level-course dependent upon the method of course placement for all students and among students in different demographic groups based on the results of RQ1?

RQ3**:** Is semester-to-semester persistence following the first attempted English and math college-level courses dependent upon the method of course placement for all students and among students in different demographic groups based on the results of RQ1?

Significance

Until August 2013, course placement determinations at most North Carolina community colleges were based upon a singular placement test cut-off score. While cost-effective and efficient, this placement method resulted in large numbers of students assigned to remedial courses. Remedial course sequences provide valuable foundations for students who need to refresh their skills, but course sequences can be lengthy and result in as many as two additional years of coursework leading to high attrition and low rates of course success. The *Core to College* initiative has established policies for participating states that encourage greater alignment between the states' K-12 Common Core State Standards and community colleges' standards for college readiness with the intent that fewer students will require remediation upon entering the community college within five years of graduating high school.

Course placement deserves attention because accurate course placement results in students spending less time and money in non-credit bearing courses and expediting degree, diploma, and certificate completion. The focus on course placement and student success in credit bearing courses inform broader discussions on developmental education

reform and the accuracy of placement practices to improve student success in credit bearing courses.

Traditionally, placement into college-level courses has not been associated with high school performance, and, most students entering community college, regardless of high school achievement, took a placement test to determine their readiness for college-level coursework (Scott-Clayton, 2012). Recent studies suggest that placement tests are not the most accurate predictor of college GPA and course success, however (Armstrong 2000; Scott-Clayton, 2012). While the relationship between college outcomes and measures like high school GPA, prior course achievement, and non-cognitive measures are recognized, two-year colleges have not typically utilized these measures as determinants for college readiness; therefore, few studies have examined whether implementing these measures to determine course placement improves the accuracy of placement recommendations. This is significant because a recent North Carolina study on the ACCUPLACER (see Appendix A for sample questions), a common placement test, found that students with higher placement test scores had only a slight grade advantage in curriculum-level courses compared with students who completed the course following the developmental course progression (Michaelides, 2005).

Erroneous placement negatively impacts students, as demonstrated by high attrition and increased cost and time spent in the program. Studies suggest using multiple measures, like high school GPA and prior coursework, render a more accurate representation of students' academic ability than those suggested by placement testing, but these methods of placement have not been broadly implemented on a state-wide or federal level (Armstrong, 2000; Collins, 2008; Scott-Clayton, Crosta, & Belfield, 2014).

There is little empirical evidence to suggest that using multiple measures to make course recommendations supports student success and persistence in college-level courses. Although a positive correlation exists between high school GPA and success in the first credit bearing course in which a student enrolls, an inference cannot be made that the same correlation would occur if that student was placed into a course based on a placement policy that utilized GPA as the placement measure (Ngo & Kwon, 2014). This study will examine the effectiveness of course placement methods as they relate to academic performance in the first college-level English and mathematics courses attempted and students' persistence in subsequent coursework.

Definitions

This section includes definitions and terminology often used to discuss various types of college courses, course placement options, placement testing, and other frequently referenced terms in higher education.

Associate in Applied Science (or AAS) refers to community college or trade school programs that are vocational science two-year programs. Many courses in these programs do not currently transfer to four-year institutions (NCCCS, 2013).

College-Level Courses, also referred to as gateway or gatekeeper courses, are high enrollment courses that are foundational in content and are required for degrees, diplomas, and certificates. At most two- and four-year institutions, students must demonstrate readiness to take gateway courses by placement test scores, high school courses and /or GPA, or by SAT/ACT score (Eagan & Jaeger, 2008). This study will examine the following college-level, or gateway courses: ENG 102 (Applied

Communications II); ENG 111 (Writing and Inquiry); MAT 143 (Quantitative Literacy); MAT 152 (Statistical Methods I); MAT 171 (Pre-calculus Algebra).

Direct Placement is the process by which college students enroll in college-level college without the need for remediation based on satisfactory placement test scores, prior coursework completion, or sufficient high school GPA.

Indirect Placement is the process by which students progress into college-level courses through the completion of remedial courses or sequences of courses. Indirect placement may also occur if the student repeats the course following a previously unsuccessful attempt.

Methods of Course Placement are the means by which colleges and universities determine students' readiness for college-level courses. For the purposes of this study, placement include the following methods:

> Developmental Education refers to the field of practice and research in higher education aimed at improving students' basic skills and preparing them for the rigors of curriculum-level coursework ("Transforming Developmental Education," 2014). In the NCCCS, developmental English courses are sequenced DRE 096, DRE 097 and DRE 098; each course is offered in an eight-week mini-mester. Students are prescribed the course sequence depending on their placement results; students with higher placement scores may only need DRE 098, while students with very low scores may require all three DRE courses. Developmental math courses are offered in self-paced lab modules or shells ranging from 010 to 050 for the associate in applied science mathematics and statistics courses and 060 to 080 for students who eventually want to take Pre-Calculus Algebra and

above. Students are placed in the appropriate module or shell based on their placement test results or multiple measures placement (NCCCS, 2013).

High School Coursework and GPA are less commonly used methods of placing students into college-level courses at community colleges, yet student transcript information has been proven to provide accurate placement decisions that lead to student success in college-level courses (Ngo & Kwon, 2015). High school coursework considered for course placement includes the level of mathematics and English courses taken and the cumulative GPA of their combined high school coursework. Many community colleges, including those in the NCCCS system, require a minimum of four mathematics and four English courses.

Multiple Measures Placement (or Multiple Measures) criteria for course placement is defined in a variety of ways based on state guidelines. Some community colleges can use placement test scores in conjunction with students' GPA and prior coursework to determine the student's optimal placement. Other examples of multiple measures placement are the use of SAT/ACT scores with high school achievement. A more holistic approach to placement includes standardized placement test scores and prior coursework like, high school transcripts, as well as feedback from high school guidance counselors and teachers (Belfield & Crosta, 2012); however, this method requires time and is not always conducive to resources available at most high school and two-year institutions.

This study uses the NCCCS policy to define multiple measures (NCCCS, 2013). The policy instructs community colleges to place students using a

hierarchy of measures to determine readiness for college-level coursework. To be eligible for multiple measures placement into credit bearing courses, the student must have graduated from high school within five years of enrolling at the community college. Students must have successfully completed the following high school mathematics courses with a GPA of 2.6 or higher: Algebra I, Geometry, Algebra II (or equivalent). An additional mathematics course approved by the North Carolina State Board of Education is also required: Technical Mathematics 1 and 2, Advanced Functions and Modeling, Discrete Mathematics, Pre-Calculus, Advanced Placement Calculus, or Advanced Placement Statistics (North Carolina Board of Education, 2015). For access to all other credit bearing courses, students must have an unweighted high school GPA of 2.6 or greater. Students with less than a 2.6 high school GPA are eligible for credit bearing courses with the following test scores: ACT: Math 22, English 18 or Reading 22; SAT: Math 500, Writing 500 or Critical Reading 500. Course placement for students who did not meet multiple measures criteria is determined by subject-area State Board approved assessments, like the ACCUPLACER or COMPASS. Standardized Placement Tests are the most frequently used methods of course placement at community colleges (Scott-Clayton, 2012). Commonly utilized tests are the ACCUPLACER, ASSET, and COMPASS tests but community colleges may use their discretion to determine the test that best meets the placement needs of their institutions. Colleges develop cut-off scores to determine academic ability and to distinguish students who are prepared for curriculum courses and those

who need pre-college coursework in reading, writing and/or mathematics (Broek et al., 2014)

Success, for the purposes of this study, utilizes the NCCCS definition of course success as a student having earned a grade of C or higher in a gateway English or Mathematics course (NCCCS, 2013).

Remedial Education is another term used to refer to developmental education or courses required for students to gain the expected competencies to enter into credit bearing courses.

Limitations

This study is limited to a multi-year sample from one community college in North Carolina classified as a two-year, medium-sized, Associate's College: High Career & Technical-Mixed Traditional/Nontraditional according to the Carnegie Foundation classifications for colleges and universities (Association of College and Research Libraries, 2016). Because a singular institution is represented in the study, results may lack generalizability and transferability to other student populations and institutions. Additionally, during the time the data was collected, Fall 2013 to Fall 2105, the NCCCS's admissions application limited gender category options to male and female; therefore, students who identified other than male or female were unable to be recognized, as this option was unavailable at the time.

The institution in this study was among the first NCCCS institutions to implement multiple measures placement in Fall 2013. The institution was at the forefront of implementing the policy because it wanted to expedite students' access to curriculum courses and remove unnecessary barriers to course success and degree completion. Other

community colleges in the state were not required until Fall 2015 to implement the multiple measures policy, so the sample size in this study may be larger than institutions who implemented the policy later in the allotted implementation period. The study specifically utilizes data from three fall semesters so that continuous enrollment could be clearly followed into the following spring semesters, since many students do not take classes during the summer semesters.

In the NCCCS, multiple measures placement applies only to students who graduated high school in the last five years, so results of the study do not reflect students who were not aged 18 to 25-years old during the time they took the college-level English or mathematics course. Nor does the study reflect placement alternatives for community college students who graduated high school and entered the community college after the five-year period. This study recognizes that non-traditional students whom community colleges serve in large numbers and are not represented in the sample of students placed by multiple measures because they exceeded the five-year limitation of high school coursework in lieu of placement testing. Future research might seek to identify a broader range of placement options that can advance placement accuracy and remove placement barriers for all students served by the community college.

Delimitations

A more comprehensive study of the placement methodologies would determine students' cognitive levels of college readiness, as well as academic behaviors and attitudes that have proven to be just as crucial for college success as academic competence in English and mathematics (Conley, 2010; Karp & Bork, 2012). To cover them all in this study would be extremely lengthy, if not impossible. Multiple measures

placement is just one method of placement that may alleviate barriers to credit bearing coursework for incoming community college students. This examination of community college placement practices focuses on aligning the goals of access and success when determining the most appropriate course placement. Additionally, many interpretations of multiple measures exist within various states' definitions of college readiness. This study looks specifically at community college students at one community college in North Carolina and will focus on the outcomes of course placement approaches for the first attempted college-level English and mathematics courses. A quantitative study using a Chi-Square will be employed to determine whether the method of course placement for the first attempted English and mathematics courses is independent of the student demographic variables of gender, race/ethnicity, and Pell Grant eligibility. A Chi-Square analysis will analyze if course success and persistence were dependent upon course placement methods in the first attempted English and mathematics college-level courses for all students in the study and among students in specific demographic groups based on previously identified demographic interdependence.

This quantitative study takes advantage of existing data to understand patterns and identify directions to guide future decisions and allows for the comparison of a greater number of variables. Results of the study will offer an informed understanding of the relationship between course placement methods and students' academic success and persistence.

Summary

Fostering open-access and course success while maintaining academic standards are just a few of the challenges faced by community colleges (Perin, 2006). The implementation of multiple measures placement expands the sources of academic placement information about incoming community college students to increase the number of students who have direct access to credit bearing courses. Multiple measures may also ensure that more students are placed into courses at the appropriate level of rigor in which they are likely to be successful (Scott-Clayton, 2014). This unique placement method offers more students access to credit bearing coursework and provides greater equality in the assessment process. Nevertheless, a broader understanding of multiple measures placement is needed. Because the policy was recently implemented, this research will explore how the policy relates to students' academic success and persistence so that community colleges can make the most accurate placement decisions using the most student information available.

CHAPTER II: LITERATURE REVIEW

Chapter II provides a detailed literature review of the benefits and concerns associated with course placement methods and a discussion of frequently utilized methods of course placement practices, specifically placement tests, developmental course progression, SAT/ACT scores, high school coursework and GPA, as well as multiple measures placement. Chapter II further discusses the risk factors associated with multiple measures placement and concludes with an examination of the implementation of multiple measures placement in North Carolina.

Introduction

Community colleges share the important task of providing affordable, quality education that meets 21st-century workplace and university standards, while maintaining their commitment to "open-door" access. "Open-door" access is a hallmark of public two-year institutions in the United States; the policy ensures individuals who are aged 18 and older have the opportunity to enroll in courses at community college despite previous academic performance and begin their goal of obtaining an associate's degree diploma, certificate, or course credits. Open-access does not mean all students are eligible to register for college-level courses, however. Institutions use various placement methods to determine if students are academically prepared for college-level courses. The most common method of assessing students' academic proficiency in the areas of reading, writing, and mathematics is standardized placement testing (Scott-Clayton, 2012); less commonly utilized methods of course placement at community colleges include SAT or

ACT scores, high school course work, and/or high school GPA. If students' placement results indicate they are not academically prepared for the rigors of college-level coursework, remedial or developmental courses may be required. Research, however, has suggested that placement testing results in excessive developmental placements and may not be the most accurate method of placing students into college-level courses (Perin, 2006).

Community colleges in the United States serve approximately 7.3 million students each year (AACC, 2016). Though standards and assessments of college-readiness differ among states and institutions (Jenkins & Boswell, 2002), more than half of students placed into courses by means of placement testing are referred for developmental or remedial courses (Hughes & Scott-Clayton, 2011). While developmental coursework can have befits for many students, the increasing number of students referred to developmental courses, especially those in low-income and minority groups, has caused policy makers and college leaders to question whether other means of academic placement would prove more effective in placing students into appropriate courses (Pell Institute, 2015).

Though the number of students attending community college has risen as more students gain access to higher education, so, too, has the number of students identified as in need of developmental coursework following a placement test, but students' retention and completion rates have not increased (Bailey, Jeong, & Cho, 2010). Placement testing is popular at community colleges because its efficiency and objectivity, but the required developmental course sequences from low scores can result in as many as two extra years of coursework for students with significant academic deficiencies.

The high volume of developmental courses required and low retention of developmental students have prompted critics of community colleges to refer to them as "revolving doors" (Scherer & Anson, 2014). Seventy-six percent of students who required remediation in reading and 63% of students who required mathematics remediation failed to complete a two-year or four-year degree within 6 years; conversely, 65% of students who did not require remediation earned college degrees (Perkins, 2004). Even with extensive instructional innovations in developmental education, the Southern Regional Educational Board reported that the median retention rate for second-year remedial students was only 55% (Burley, Butner, & Cejda, 2001). The markedly high attrition among developmental students placed by placement testing has prompted political and educational leaders to re-examine admission standards and the methods used to determine students' academic preparedness for college-level courses.

Appropriate course placement is crucial for student success and timely progression through coursework. Community colleges serve a diverse student population with varied backgrounds. The academic, financial, and social challenges faced by community college students places them at a higher risk of non-completion (Calcagno & Long, 2008). Graduation rates and semester-to-semester persistence at community colleges are generally low, especially among minority and first-generation community college students (U.S. Department of Education, 2008; 2009). Explanations for low or stagnant course success rates have been frequently documented in community college research and used to identify student populations who are at higher risk for non-completion (Hoachlander, Sikora, & Horn, 2003).

Community colleges enroll the largest number of low-income and first-generation college students; additionally, they enroll significantly more non-White minority, female, and non-traditional students (Bailey, Jenkins, & Leinbach, 2005). Around 58% of African-American undergraduates and 66% of all Hispanic undergraduates are enrolled in community colleges (Katsinas & Tollefson, 2009). The unique demographics of the student population and institutional mission of open access create challenges for measuring preparedness for college-level coursework and has become a key policy concern for community colleges (Bailey & Morest, 2004). Gender, race/ethnicity, and Pell Grant eligibility are all considered factors that may affect student placement and success (Bailey, Jenkins, & Leinbach, 2005; Pell Institute, 2015). According to the Pell Institute (2015), students from the top income quartile were nearly nine times more likely to have obtained a 4-year degree by age 24 than their peers in the lowest income quartile. Students from the lowest financial quartile miscalculated the cost of college by as much as 200% and were often unaware of the financial resources that were available through scholarships and grants (Ross et al, 2012).

Choy (2001), Dimaria (2006), and Hoachlander et al. (2003) identified additional risk factors that impeded many students from completing courses. These factors included postponed matriculation between high school graduation and college enrollment, first-generation status, part-time attendance, high school completion by GED, employed 35 hours or more when first enrolled in college, single parent status before or while enrolled, and financial independence, especially for adult students aged 24-years or older. At two-year institutions, 87.9% of students had at least one of the aforecited risk factors, and

almost one-third of students had four or more risk factors contributing to non-completion (U.S. Department of Education, 2012).

Compulsory placement testing is encouraged by some researchers and practitioners as a "best practice" (Boylan, 2002), and research over the last decade has found community college faculty members and administrators support mandatory assessment and placement (Berger, 1997; Hadden, 2000; Perin, 2006). However, concerns about using a singular measurement to place students into developmental or curriculum classes have recently led states and colleges from across the country to consider using other measures to inform placement decisions. Selective postsecondary institutions often use a combination of measures when making admissions decisions. These institutions rely on multiple measures of students' achievement, such as high school coursework and GPA, SAT/ACT scores, letters from teachers and guidance counselors, as well as placement tests, to distinguish students who are prepared for curriculum courses and those who need pre-college coursework in reading, writing and/or mathematics (Broek et al., 2014).

Some researchers argue that course readiness is not just about placement test scores. Saxon, Levine-Brown, and Boylan (2008) found that nearly all academic placement done in colleges and universities was based on students' cognitive ability as demonstrated by test performance and disregarded the affective characteristics of student aptitude like personal motivation, disposition toward learning, self-governance, and stress management, characteristics that may be exhibited by high school academic performance. Hodara, Jaggers, and Karp (2012) added that placement using a singular measurement of academic readiness identified only particular skill deficiencies without considering the

other limitations that contribute to inaccurate course placement and inconsistent standards.

Much less common at two-year institutions are comprehensive placement approaches that attend to multiple influencers of student placement. Many two-year colleges have only recently begun to address academic placement concerns by adopting a multi-measured approach that assesses students' readiness for curriculum coursework based on a variety of inputs, like high school coursework and GPA, SAT and/or ACT scores, as well as traditional placement test scores. Community colleges are advancing to more multi-measured methods of placing students into appropriate courses, although the use of affective characteristics in course placement is still only around 7% (Gerlaugh, Thompson, Boylan, & Davis, 2007). Innovative "best practices" for placement point to multifaceted methods that improve placement accuracy, provide consistent standards of college readiness, and increase academic access and success (Hodara, Jaggers, & Karp, 2012).

The High Stakes of Low Placement

Course placement practices impact students, colleges, and states' financial resources. Over the last decade, more students earning high school diplomas are moving on to higher education, but the rate of students leaving college without degrees has either remained the same or increased since 2009, and at two-year colleges, just one out of every three students is continuously enrolled in course work in their second year (Smith, 2014). The most significant attrition rates occur at two-year public institutions with only 21.9% of degree-seeking community college students completing their associate's degrees within three years (NCES, 2011). Colleges recognize that a greater obstacle

occurs when students are inappropriately placed at lower levels than inappropriately placed at higher levels, at least in terms of the likelihood the student will complete the course (Multiple Measures Assessment Project Research Team, 2014). As a result of high attrition, community colleges have expanded approaches to course placement to offer a greater number of students immediate access to credit bearing coursework.

The return on the investment of developmental education is questionable as recent studies on course placement and developmental education have found inconsistent outcomes for students who enrolled in remedial courses. Bettinger and Long (2005; 2009) found the completion of developmental sequences had positive effects on the retention and persistence of recent high school graduates. Calcagno and Long (2008) and Martorell and McFarlin (2009), however, used a broader sample of students and found no impact on most student success or completion outcomes as a result of students' success in remedial course sequences (Jaggars & Stacey, 2014). Nonetheless, some college leaders maintain it is in the students' best interest to repeat material they might already know than to experience failure and discouragement by taking courses that are beyond their academic capability.

Michaelides (2005) study of a state-wide community college system found the ACCUPLACER placement test inaccurately placed 33% of entering students. Based upon ACCUPLACER scores, the study found one-third of entering students were either over-placed in college-level courses and failed or under-placed in remedial courses when they could have gotten a B or better in a college-level course. The same study found that the COMPASS similarly misplaced 27% of entering community college students. The severe error rate for English was 27% to 33%, indicating that three out of every ten

students were incorrectly placed. The severe error rate in math was lower but still significant. According to Belfield and Crosta (2012), using other information like students' GPAs to make placement decisions could have reduced severe placement error rates by more than half.

Inaccurate placement is an important issue at community colleges because students' course success and completion are at greater risk when students are inaccurately placed, especially when students feel their goals are unattainable when degree completion is obstructed by excessive course work (Adams, Gearhart, Miller, & Roberts, 2009). Interestingly, one study indicated that academically underprepared students who completed developmental English passed their "gateway" English course at the same rate as students who entered the institution with college-ready skills (Bailey et al., 2010). Research further indicated students' current level of literacy skill is indicated by their highest English course completed in high school, thus their initial literacy level upon entry in college was not predictive of achievement in the content course (Goldstein & Perin, 2008). Belfield and Crosta (2012) found students who disregarded developmental recommendations and enrolled directly in "gateway" courses had only a marginally lower success rate than those who placed directly into college-level courses. However, the students who disregarded the recommendation for developmental courses were significantly more successful than those who followed the prescribed developmental course progression. Bailey et al. (2010) added that the significant success rate may be because many developmental students never attempted college-level course work after completing their developmental course sequences.

An additional consequence of inaccurate placement is the state and federal costs associated with offering developmental education courses. Exact costs are difficult to quantify because states define developmental educational costs differently within their budgets. For example, developmental education at some community colleges is de-centralized and exist within larger departments like English or Mathematics; costs for developmental courses would, in those cases, be absorbed into the overall departmental budget making the exact amount more complicated to extract. According to Scott-Clayton and Rodriguez (2012), the estimated annual state cost of developmental education is approximately $4 billion, and the annual national cost of developmental education to be near $7 billion (Scott-Clayton, 2012; Crosta, & Belfield, 2012). Proponents for developmental education argue that the cost of providing developmental education is minimal when considering the reduction of poverty, illiteracy, and unemployment that transpire from students' experiences in developmental education (Phipps, 1998). Nevertheless, researchers maintain the need for a more accurate method of course placement that results in fewer instances of improper course placement and require less state and federal expenditures to fund developmental education (Boatman & Long, 2010).

Methods of Course Placement

Course Placement Based on Placement Test Scores

Following WWII, the GI Bill gave returning veterans unparalleled access to higher education but also increased the need for community colleges to identify and serve greater numbers of underprepared students. In 1965, federally-subsidized grants, which became known as Pell Grants in 1980, offered poor and underprivileged students

financial access to higher education, further increasing the need to distinguish students who were in need of developmental education (Casazza & Silverman, 1996). Maxwell (1994) recognized that underprepared students do not usually volunteer or perceive a need for courses to remediate skill deficiencies, so colleges rely on mandatory assessment and placement to ensure students take the appropriate coursework for their skill level. Placement testing is often the first experience students have on the college campus, yet students seldom prepare to take the tests or are aware of the tests' content; nevertheless, test results significantly affect students' academic prospects because failure to meet prescribed cut-off scores means that students will be referred to remedial course sequences in mathematics, reading, and/or writing.

For a brief period during the 1970s, the mandatory testing, placement, orientation, and course prerequisites were relaxed in lieu a "student's right to fail" philosophy. Proponents for this ideal argued that community college students were adults who should have the freedom to make their own educational decisions. This ideal promoted responsibility and ownership of one's educational experience (Rounds & Andersen, 1985; Zeitlin & Markus, 1996). However, by the end of the decade, these practices were reconsidered by legislators and educators concerned with the costs of high failure and dropout rates of unprepared students (Cohen & Brawer, 2008; Rounds & Anderson, 1985).

In Fall 2013, the community college system in Florida revived the practice of allowing students to bypass developmental courses at their own discretion, even if academic counselors recommended developmental coursework based upon students' academic deficiencies according to placement test standards. Students entering the

Florida community college system from high school were not required to take any placement, as their high school diploma demonstrated college-readiness (Fain, 2013). Thus far, the results of the developmental exemption policy have not increased retention in college-level courses as legislators and college leaders had supposed. In fact, students who demonstrated academic deficiency based upon placement test scores or low GPA were consistently more likely to fail their college-level courses, if they opted out of developmental coursework. The course failure rate for Miami-Dade students went from 46.8% from 55.8% during the time of the implemented policy, and enrollment in developmental mathematics courses decreased by 42% (Smith, 2015).

Community colleges in Tennessee also sought to offer students the option to opt out of developmental courses. While their model places students directly into college-level courses despite academic deficiencies, the colleges provide with low placement scores and GPAs with supplemental academic support to supplement their college-level coursework. Since the start of this model, the retention rate in college-level courses has increased from 43.3% to 57.4% (Denley, 2015).

Despite current research findings that question the accuracy of standardized placement tests (Scott-Clayton, 2012), placement tests, like the ACCUPLACER and COMPASS tests, are considered reasonably accurate at assessing whether students have the skills necessary to be successful in college-level coursework. According to Hughes and Scott-Clayton (2011), placement tests were most useful when predicting students' success in gateway, or first curriculum-level, math courses than in gateway English courses. Their research further explained placement tests were more precise at distinguishing students who were likely to earn a B or higher than identifying students

who were at risk for failure. Hughes and Scott-Clayton (2011) found that if the placement method used to assign students to courses is inaccurate at assessing the specific skills needed for the course, students who are near the cut-score demonstrate the ability to succeed in college-level courses without remediation and should be given the option to enroll in curriculum-level courses (Hughes & Scott-Clayton, 2011).

In the last decade, placement testing debates have evolved to focus on whether institutions can best make these determinations themselves or if the process should be dictated by common state-wide assessments. Arguments sustaining state-wide standardized assessment and placement policies contend that test provide a common definition for academic proficiency, helping to align secondary and postsecondary academic requirements and expectations. Additionally, states are better able to measure retention and performance measures across different colleges and track effectiveness of remedial programs and placement initiatives (Prince, 2005).

Counterarguments to placement testing cite the importance of institutional autonomy and, in particular, the importance of maintaining the institutional freedom to set policies and practices that take into account the unique needs of colleges' local constituencies (Cohen & Brawer, 2008). Additionally, researchers have pointed out factors that negatively impact placement results' predictive validity, such as the lack of student preparation for the test, lack of understanding regarding the testing process, curriculum and test alignment issues, and the uncertainty of a single score to provide a comprehensive understanding of a student's academic capacity. Evidence supports assertions that significant numbers of incoming students are unaware of placement testing practices and test content prior to taking their placement tests and that fewer than half of

community colleges offer placement test prep or practice tests to students (Behringer, 2008; Safran & Visher, 2010; Venezia, Bracco, & Nodine, 2010). To reduce the negative effect of poor test preparation, some community colleges assess students in their junior or senior years of high school so that students are aware of the depth and breadth of material covered on the test, and students have several attempts to take the test prior to their admission to the community college removing the high stakes nature of the on-campus placement test. This method increases high schools' culpability for providing remediation and create stronger alignment between the high school and community colleges' curricula and reduces the number of students referred developmental courses (Hughes & Scott-Clayton, 2011).

Recent research has shown that standardized tests may not be the most accurate measure for placing students into credit bearing courses, however, especially considering one of the greatest problem facing community colleges is that too many new students demonstrate the need for remedial courses based on standardized test scores (Perin, 2006). The reference manuals for both major tests follow this approach and identify some of the key assumptions underlying the validity argument for the use of test scores for course placement. For example, both the COMPASS and ACCUPLACER manuals explain that to be valid, their tests must actually measure what they purport to measure and reliably distinguish between students who are likely or not likely to do well in specific gateway courses; in addition, there should be a positive statistical relationship between test scores and grades in the gate keeper courses. Though placement tests indicate strong validity to predict student success in a course, the placement test manuals

caution against the use of the placement test as a singular measure of students' ability and aptitude for success in a specific course (ACT, 2011; College Board, 2003).

Alternative Methods of Course Placement

A growing body of research concurs that utilizing multiple factors of college readiness may provide a more precise picture of a student's probability of success in curriculum coursework than the information provided by a single placement test (Maruyama, 2012; Scott-Clayton, 2012). High school record, standardized test scores, extracurricular activities, and combinations of all three have proven to be successful predictors of college performance but have not been the standard means of academic placement at two-year colleges (Kowski, 2013).

Community colleges are examining other means by which students may demonstrate college-level coursework readiness beyond traditional placement testing. Some two-year institutions are evaluating measurements that not only assess cognitive knowledge but also the metacognitive capabilities of incoming students, like students' ability to analyze, interpret, solve problems, and reason (Conley, 2008). Other two-year colleges are developing their own assessments and placement procedures due to a mistrust of commercially developed products and discomfort with placement determinations based on a singular test score (Perin, 2006). Though not as common as placement testing, incoming students at two-year colleges can demonstrate readiness for college-level courses by the completion of the prescribed developmental course sequences and by their high school coursework and/or GPA, SAT/ACT scores, or a combination of placement test scores and high school performance measures. While colleges have broadened gateways into curriculum-level courses, few studies indicate

which method of placement is most associated with students' academic success and continuous enrollment in subsequent coursework.

Course Placement Based on Developmental Progression

Regardless of high school academic performance or placement test scores, students have a pathway into college-level coursework through developmental course progression. A recent study by Complete College America reported in 2012 that 50% of community college students entered community college needed some remediation. More students required mathematics remediation than any other subject (Parsad, Lewis, & Greene, 2003). Students do not receive academic credit for remedial courses even though they are required, and for students with very low placement scores, developmental course sequences can become tedious and unfulfilling resulting in four out of ten students never completing their developmental coursework.

Traditional direct instruction-based courses were and still are a primary means of providing developmental education in English, reading, and writing courses. For developmental mathematics sequences, direct instruction, as well as self-paced modularized courses, are the most common pedagogical methods. Developmental course sequences are often lengthy and attrition is high. Remedial students are less likely to stay motivated or regard the developmental coursework as relevant to the demands of college (Grubb, 2013). Some colleges have opted for "fast track" courses to expedite remedial coursework, but sporadic offerings have produced little research to determine its efficacy. While some community colleges have prohibited developmental students from taking online classes, others have offered blended or hybrid offerings, but as Ashby and McNary (2011) noted, the blended offerings have lower success rates than solely traditional or

online, as enrolled students may or may not be technically and educationally experienced enough to succeed.

Researchers have found that improving academic performance and retention in developmental college courses requires more than modifying the traditional lecture and skills orientation (Rochford, 2004), and the notion that developmental students need more time and longer classes may be faulty (Sheldon & Durdella, 2010); in fact, some students may not need the course at all. The Community College Research Center found students who did not follow their remedial placement recommendations fared as well in college courses as those who took the developmental courses as prescribed (Jenkins, Jaggars, & Roksa, 2009).

Remedial courses are not popular among students; they can have a demoralizing and segregating effect that can lead to increased dropout rates and "cooling out" periods where students experience depression because they do not feel their goals are attainable (Adams et al., 2009). Students may experience disappointment at the prospect of having to take one or more courses that "don't count" yet still cost, and they are often annoyed by the workload required for a course they may view as an "unnecessary" barrier to their goal of degree completion. Epper and Baker (2009) suggest that students enrolled in condensed courses, self-paced courses, and/or mainstreamed developmental courses show higher rates of persistence than students taking traditional developmental courses, yet causal questions about the effects of these programs on student success and persistence remain unanswered.

A Community College Research Center study of 250,000 community college students found only 20% of developmental math students and 37% of developmental

reading students went on to complete entry-level or "gateway" college courses in English and mathematics (Bailey, Jeong, & Cho, 2010). In fact, many of these students never made it through their developmental course progression to begin curriculum-level courses. Bailey, Jeong, and Cho (2010) found only 33% of students referred to developmental math and 46% of developmental reading students completed the entire developmental sequence.

Bettinger and Long (2005), however, found positive effects of mathematics remediation on mathematics credits completed following developmental course sequences, but similar results were not found for students in English remediation. Long and Calcagno (2010) found the effects of remediation differed by student background and demographics. Women experienced more positive effects from placement into remediation than men. This gender difference is consistent with other studies that have found females to be more positively influenced by academic interventions (Belfield et al., 2006). Long and Calcagno (2010) also found older students placed into remediation experienced more positive outcomes as a result of their developmental coursework than younger students who took the same classes. Family income also appears to be related to the effectiveness of remediation. In one study, Pell Grant recipients in remediation experienced more negative outcomes than their peers in remediation not receiving Pell Grants in terms of persistence, enrollment in subsequent, and degree completion (Long & Calcagno, 2010). Because income is often associated with the quality of high school a student attended and academic resources provided by the family, lower-income students are more likely to attend high schools with less rigorous college preparatory curricula and have less access to tutors and after-school programs.

Colleges are examining new methods of expediting students' developmental course progression. Administration at one community college reduced the need for developmental courses for high school students through academic intervention practices with junior and senior high school students prior to graduation. Students wanting to attend community college could take developmental course sequences at no cost while in high school to facilitate the completion of developmental coursework (Dunn, 2005). Long and Calcagno (2008) reported, however, that while remediation might have promoted early persistence in college, it did not necessarily help community college students make long-term progress toward a degree. Less than one-quarter of developmental students go on successfully to complete their gateway math or English course and graduation rates from community colleges are fewer than one in ten for students who begin in developmental studies (Complete College America, 2012).

Course Placement Based on SAT and ACT Scores

The American College Testing Program (ACT) and Scholastic Aptitude Test (SAT) are the most popular measures of academic achievement for incoming four-year college students. The SAT has been correlated with college performance and lauded as the best-documented instrument of its kind (Cohen, 1985). More recent SAT/ACT validity studies verify these findings and assert that both tests generally predict undergraduate GPA and accurately reflect IQ and intelligence (Coyle & Pillow, 2008). Nevertheless, course placement using SAT/ACT scores is not common at community colleges because of the costs accompanying the administration of the tests, and the majority of students who take the ACT or SAT expect to attend four-year institutions, which require SAT/ACT scores as part of general admission requirements. Because

prospective community college students do not need SAT/ACT scores for admission, many of these students do not report SAT/ACT scores, though they often have the option to provide their scores in lieu of placement tests.

A recent national validity study found that SAT scores predict first-year college performance more accurately than students' high school GPAs (Noble & Sawyer, 2004). A study conducted by Hiss and Franks (2014) disagreed, however, and found no difference in the academic performance or graduation rates of students who submitted SAT/ACT scores and those who did not. Their research conversely favored high school GPA as the measure most often associated with success in gateway courses.

Additionally, studies over the past years have gone on to suggest that achievement scores might deter nontraditional students from attending college and that achievement tests were only one measure among many to determine college readiness (Sedlacek & Sheu, 2008). Sedlacek (2004) argued that non-cognitive measures of adjustment, motivation, and perception are equally as strong predictors of success, particularly for under-represented minority students and are just as important for course success. Several studies have replicated the finding that standardized test scores are not the strongest predictor of student success and that high school GPA is a superior predictor of college performance (Geiser & Santelices, 2007; Hickson & Dowdy, 2014).

Course Placement Based on High School Coursework and GPA

The use of high school coursework and GPA to place students into college-level courses is a relatively recent shift in community college course placement aimed at increasing students' direct access to gateway college courses. Some community college leaders are confident in the use of high school performance standards to predict college

academic performance and base their position on research findings (Maruyama, 2012; Scott-Clayton, 2012). Though community colleges have not traditionally utilized the high school transcript to determine college readiness, Gillespie (1993) noted that performance in high school courses was an obvious indicator of success in college courses on the same subject and should be utilized in making placement decisions. Fralick (1993) included that high school GPA was a predictor of both college success and persistence and added that the use of high school course in making placement decisions ensured high-risk students could be identified promptly and assisted with intervention programs while still being allowed access to gateway college courses.

High school GPA is useful for predicting many aspects of students' college performance and has a strong association with students' college GPA; students' college GPAs are typically 0.6 units below their high school GPA (Belfield & Crosta, 2012). High school GPA is also strongly correlated with college credit accumulation. In fact, each grade higher in high school GPA is equivalent to four extra credits earned each semester in college (Belfield & Crosta, 2012). Other information from high school transcripts, like the number of math and English courses taken in high school, honors courses, the number of F grades, and the number of overall credits, have proven to be useful information in determining optimal course placement. According to Scott-Clayton (2012), the sole use of high school achievement predicts fewer placement errors by precisely identifying the students who are most likely to be successful in college-level courses.

Many high schools have college preparatory, honors, and advanced placement curricula for students who plan on attending two- and four-year colleges after high

school. Adelman (1999) found that among college students, college completion rates increased when a rigorous college-prep curriculum was found to have been taken in high school; completion rates further increased based on the highest level of mathematics a student took in high school. Even if students fail to earn high grades, challenging high school courses prepare students for the college learning environment and enhance their ability to succeed in college-level classes (Adelman, 1999; Bourquin, 1999). Ngo, Kwon, Melguizo, Bos, and Prather (2013) replicated the findings about the importance of academic rigor in high school courses and added that students who were placed into a gateway college courses based solely on prior math background and high school GPA performed just as well as their peers.

Critics of this method further insist that high school graduation standards are often misaligned with standards for entry into the local community college, contributing to a difficult transition between secondary and postsecondary schooling (Venezia, Kirst, & Antonio, 2003). For high school teachers, a premium is placed on pedagogical practices, and teachers are expected to cultivate instructional strategies to meet the needs of a wide variety of student learning styles. Instructors at community colleges tend to be more content and discipline focused and may not have training in pedagogical approaches, as many instructors have professional rather than educational backgrounds. Students, regardless of the teaching style of the instructor, must be able to comprehend and interpret large amounts of information to be successful. This requires adjustment to the instructional strategies by which they had become accustomed to in high school, where the focus was on teaching, class participation, and engagement (Bambrick-Santoyo, 2014).

Historically, a wide disparity has existed in the course options students have in high school and the standards to which they are expected to perform, both of which are important predictors of future college success (Adelman, 2006). This disparity has resulted in a sizable gap between what students are expected to do in high school and in college. Roueche, Baker, and Roueche (1984) reported that most state competency exams require only a ninth-grade reading level for graduation and many college freshmen are reading below a seventh-grade level. Morante's (1989) study found that a high school diploma did not assure competency in the basic skills of reading, writing, and mathematics. Prior research by Roueche (1983) found that community colleges with successful applied sciences programs reported that high school GPA could not be used as a strong indicator of college work. Recent studies estimate that only one-quarter to one-third of America's high school students are at least minimally prepared for college academically, and this proportion is even smaller among minority students; only 20% of Black students and 16% of Hispanic students demonstrate college readiness (Chen, Wu, & Tasoff, 2010; Greene & Forster, 2003). For students seeking to attend community college, high school curricula are falling short in laying the ground work for success, especially in mathematics and English. The result is many high school graduates spend their first year in college retaking courses that were previously passed in high school, like English I and Algebra (Pugh & Lowther, 2004).

Critics of using of high school coursework and GPA to make course placement decisions warn that wide disparity exists in the types of courses students take in high school and further caution that how students actually perform in high school can be subjective and inflated (Adelman, 2006). With more than one-third of first-year college

students attending two- and four-year colleges and universities enrolling in reading, writing, or mathematics remedial courses (Achieve, Inc., 2012), an often-cited reason for high collegiate remediation rates is the apparent disconnect between secondary and postsecondary expectations. Hoyt and Sorensen (2001) found that even though students earned passing grades in college preparatory mathematics and English courses according to students' high school transcripts, these students failed to demonstrate the appropriate level of knowledge and skills on their college placement exams.

Researchers contend that students receive erroneous messages through sources like academic content standards, tests of those standards, and grading practices regarding their degree of preparedness for college (Brown & Conley, 2007; Kirst & Reeves Bracco, 2004). Because high school curricula, state tests, and exit exams are based on standards that are below college expectations, students believe that they are ready for college by receiving good grades in high school and meeting or exceeding performance standards on state tests (D'Agostino & Bonner, 2009). Because college is different in many ways from high school, college readiness differs in fundamental ways from high school completion (Conley, 2008). A key problem is that the current measures of college preparation are limited in their ability to communicate to students and educators the true range of what students must do to be fully ready to be successful in college (Conley, 2008).

According to D'Agostino and Bonner (2009), high school content and performance standards might not be as diluted as research has suggested, however. The relationship between high school GPA and college GPA is so significant that it would seem imperative for colleges consider this measure in deciding course placement. This may stem from the ability of report card grades to assess non-cognitive competencies

associated with high grades, like self-control, which provides structure to study habits, homework completion, and productive classroom behaviors (Duckworth et al., 2012). Belfield and Crosta (2012) contend that the relationship between high school grades and college successfully justifies a waiver of college placement tests, and thus developmental courses, for students who have high school GPAs at or above the agreed upon threshold.

A more comprehensive and accurate placement process would determine students' college readiness in the areas of academic behaviors, strategies, attitudes, and college awareness, attributes that may be just as important for college success as academic proficiency (Conley, 2010; Karp & Bork, 2012). Some researchers argue these cognitive and non-cognitive should be taught in high school so as to prepare students for the college experience. Bambrick-Santoyo (2014) found that familiarizing high school students with the lecture format has proven to be a key to college readiness. By exposing high school students to the lecture format and giving them strategies for learning in the lecture classroom, the instructional gap high school students often experience their first semester in college was bridged while students were still in high school. Findings from this study were significant in that participating students persisted in college at higher rates than in years past. Students entered college prepared for the method of instruction and how to navigate the material presented in meaningful ways. Bambrick-Santoyo (2014) concluded that high schools have four years to teach students strategies to inform a successful undergraduate experience.

Scott-Clayton (2012) found that using high school transcript information instead of test scores lowered serious placement errors by 10 to 15%. Using the best of either placement test scores or high school transcript information was predicted to lower the

remediation rate by 8 to 11 percentage points while reducing placement errors and increasing the rates of success in curriculum-level courses. The League for Innovation in Community Colleges (1990) has encouraged greater communication between high schools and community colleges based on the proven relationship between high school information and college academic performance and persistence. A greater number of high schools are partnering with community colleges to strengthen college prep instruction and curricula and encourage a college-ready student body. Kemple, Segeritz, & Stephenson (2013) support the strengthened relationship between and assert the importance of methodically validating the connection between high school performance and college enrollment, persistence, and success.

Course Placement Based on Multiple Measures

According to Fields and Parsad (2012), only about 10% of community colleges use information other than placement tests to make placement decisions. The consistency and efficiency of standardized tests have, until recently, made placement testing the obvious choice for most community colleges. The Completion Agenda initiated by President Obama (2009) has illuminated the role of community colleges not only to provide efficient, quality education but to provide the support students need to complete their degree requirements. Support encompasses a variety of services but access to credit bearing coursework is possibly the first support that students experience.

Multiple measures placement is among the most recent initiatives by states and colleges to expedite degree completion by removing barriers that delay some students from enrolling in curriculum-level courses (Belfield & Crosta, 2012).

On the surface, multiple measures placement appears much like course placement using high school coursework and GPA to determine students' college-readiness, but multiple measures placement or multiple measures refers to the process of using more than one criteria to determine college-readiness. Research on the effectiveness of multiple measures placement is complex because states and institutions uniquely define their application of multiple measures placement (Beaver et al., 2014). Colleges do not necessarily have to use high school information under multiple measures placement, but more than one criteria must be considered when making placement decisions. Several possibilities for multiple measures placement include the use of a placement test score with points added or subtracted for coursework in high school and/or GPA, qualitative data from high school personnel and transcripts to make direct placement decisions, and high school GPA and coursework to determine college readiness.

The California Community Colleges System led the first reform to incorporate multiple measures of student performance to make college-level placement decisions in 1986 following a landmark court decision to include more than one input of student information to determine a student's readiness for college-level courses (Beaver et al., 2014). The policy allowed individual community colleges to determine which student information to use in making placement determinations. Though access to college-level courses was increased, significant placement variations existed among community colleges, which made the policy's impact difficult to assess. Legislation passed in 2011 has required community colleges to adopt a common assessment system as one of the inputs, but the assessment system has not been developed (Beaver et al., 2014).

Many factors influence a students' success or failure in a college-level course beyond their performance on placement tests, and multiple measures allow for greater placement accuracy for students who have difficulty demonstrating their skills on tests or were unable to prepare adequately for the test content. Though research has encouraged the practice of utilizing a variety of inputs to make placement decisions (Fralick, 1993; Gillespie, 1993), community colleges have not traditionally utilized multiple inputs due to time and human resource constraints (Hodara et al., 2012). Allowing more students direct access to college-level coursework could considerably increase the numbers of students who complete college-level coursework and continuously enroll in subsequent semesters, however, even if pass rates in those courses do not necessarily improve (Scott-Clayton, 2012). Bowen, Chingos, and McPherson (2009) point to the strong predictive power of the GPA to indicate more than just academic proficiency in math or writing proficiency but also a reliable measure of students' motivation and perseverance.

According to Scott-Clayton (2012), utilizing multiple measures in placement decisions could reduce the remediation rate up to 12%, while maintaining or increasing student success in gateway courses. Researchers matched the college transcripts of about 20,000 NCCCS students with students' high school transcripts and found that high school GPA and coursework provided a better relationship to success in college-level courses than the standardized assessments used by NCCCS (Morrissey & Liston, 2012). Duckworth et al. (2012) and Sedlacek (2004) also found that GPA included undetected information about students' attitudes about college, effort, self-control, and determination to obtain long-term goals.

The California Community College system was among the first colleges to implement a multi-measured approach to course placement. In 1991, the Mexican-American Legal Defense and Educational Fund contested the systems' placement system, which placed inordinate numbers of Latino students into developmental course sequences. The case was settled out of court, but Title 5 in the California Code of Regulations was modified to mandate the use of multiple inputs when making determinations about course placement (Melguizo, Kosiewicz, Prather, & Bos, 2014). The state-wide implementation mandate provided some opportunity to validate measures in terms of their usefulness for course placement. The results of one study indicated that students who were placed into credit bearing courses using multiple measures, in this case from high school GPA and high school math courses taken, performed no differently from their peers who earned higher placement test scores (Ngo & Kwon, 2014). Students assigned to multiple-measures pilot groups for the NCCCS were placed into curriculum-level courses based on high school GPA and high school coursework. The students in the pilot group were less likely to be assigned to remediation and performed no worse in the college-level class than students who were assigned on the basis of test scores or high school preparation alone (Marwick, 2004).

Scott-Clayton's (2012) research supports the validity of multiple measures approaches to placement and suggested that even in mathematics, the validity of placement tests is weak compared to that of high school information. The same study indicated that in both mathematics and English placement, the use high school GPA as a placement input resulted in better outcomes than using placement test scores alone; this was especially true in writing placement. Conley's (2008) research noted similar findings

that point to writing as the single overarching academic skill most closely associated with college success (Conley, 2008).

Risk Factors of Multiple Measures Placement

Practical concerns surround the use of multiple measures to make placement decisions. Some students have incomplete transcripts or no transcripts at all. Students who completed high school many years ago may find significant disparities between their high school performance and their current knowledge and academic performance. Evaluating transcripts individually requires additional staff and can delay the admission and placement process. There are also issues of consistency standards required for high school graduation causing the measurement not to be as widely accepted evidence of college readiness due to the of the broad variability in the quality of high school experiences (Sommerville & Yi, 2002).

The expectation of colleges utilizing high school GPA and other data in making placement decisions is that multiple measures will expand students' access to credit bearing courses and improve colleges' ability to identify students who can succeed in gateway college-level courses. Some evidence does not support this approach, and further examination of the research found that high school GPA only marginally improved student placement when compared to that of placement exams, and high school transcript data proved no more effective than high school GPA in predicting college-level course success (Complete College America, 2012). While consideration of both transcripts and GPA is optimal, the use of these inputs to make placement decisions fails to increase or predict students' success in gateway college-level courses in any significant way (Porter & Polikoff, 2012). Grades and summative assessments from high schools vary both in

rigor and breadth of content, making them more difficult for colleges to use systematically as college readiness indicators (Maruyama, 2012). Further, no common metric or meaning exists across high schools in regards to student performance and course values (Porter & Polikoff, 2012). Prior research has shown that there is substantial variability in the degree to which the SAT and high school GPA predict 1st-year college performance at different institutions (Kobrin & Patterson, 2011). Brown and Conley (2007) found that state high school assessments only included the very basic skills required of college students and were not well-aligned with collegiate standards. High school exams covered also failed to infer the complexity of critical skills needed for college-level course success.

Hodara et al. (2012) concluded that many colleges adopting a multi-measured approach addressed the issue of increased access to credit bearing courses without addressing other inadequacies that contribute to the overall problem of inaccurate course placement and inconsistent standards. Complete College America (2012) suggested the optimal approach to using multiple measures placement is to provide a placement range with co-requisite courses to support students who only marginally reached the cut-scores for reading, writing, and/or mathematics course. Their findings advocated for the use of points to determine co-requisite interventions rather than developmental courses to support student achievement for students placed by multiple measures. Success rates for the co-requisite model have shown success rates three to four times greater than the traditional developmental progression.

Multiple Measures Implementation in North Carolina

Collins (2008) summarized placement policy deliberations in North Carolina that preceded the implementation of the multiple measures placement policy, noting the growing internal and external pressures on the state to develop a consistent placement assessment policy that maximized student information to make placement decisions. Internal issues emerged from current placement policies included varying admission standards and confusing course progression. External pressures emanated from the national discussions on post-secondary and high school alignment and concerns surrounding the cost of providing developmental education and the alarming drop-out rate at two-year institutions.

Measures have been taken by colleges to meet the unique needs of at-risk populations of developmental students and to find strategies to increase their developmental course success rates (Adams, Gearhart, Miller & Roberts, 2009). As of 2009, NCCCS colleges were mainly using the COMPASS and ACCUPLACER tests for student placement. Community college leaders were concerned that too many students were requiring developmental courses and national research conducted by the Community College Research Center had shown that students who were prescribed developmental courses were unlikely to complete their remedial sequences and enroll in credit bearing courses (Morrissey & Liston, 2012).

North Carolina community colleges implemented an official state-wide placement strategy, multiple measures placement, in Fall 2013 on a voluntary basis. By Fall 2015, all NCCCS community colleges were in compliance with the use of multiple measures placement standards. The NCCCS policy instructs community colleges to place students

using a hierarchy of measures to determine readiness for college-level coursework. To be eligible for multiple measures placement, students must have graduated from high school within five years of enrolling at the community college. Students must have successfully completed the following mathematics courses with a GPA of 2.6 or higher: Algebra I, Geometry, Algebra II (or equivalent), and one additional mathematics course. For access to all other credit bearing courses, students must have an unweighted high school GPA of 2.6 or greater. Students with less than a 2.6 high school GPA are eligible for credit bearing courses with the following test scores: ACT: Math 22, English 18 or Reading 22; SAT: Math 500, Writing 500 or Critical Reading 500. Course placement for students who did not meet multiple measures criteria is determined by subject-area State Board approved assessments, like the ACCUPLACER or COMPASS test (NCCCS, 2013).

The use of multiple measures for placement is one of the policy changes that arose from North Carolina's comprehensive Developmental Education Initiative, which was established in 2009 by Scott Ralls, then-President of the North Carolina Community College System (NCCCS). This reform created state-wide policy teams to focus on implementing strategies to increase community colleges' student enrollment and assist students in gaining access and completing college-level courses (Broek, Dadgar, Finklestein, Mundry, & Bugler, 2014).

Conclusion

Community colleges improve the lives of students. The open-admissions policy offers students, regardless of prior academic experiences, a clean slate to being the opportunity of achieving the credentials necessary for a rewarding and fulfilling career. Attending college has other benefits for students as well, like increased confidence and

social mobility (Park & Pascarella, 2010). On average, students who attended community college earned significantly more income over their lifetime than those who did not attend (Belfield & Bailey, 2011). Although students come to community colleges with diverse challenges, accurate course placement is the first step to ensuring that students have access to the courses they need without spending valuable time and resources in courses they do not. Research in educational psychology suggests that a variety of factors beyond academic ability should be utilized to predict student success in college-level coursework and degree completion, but many of these measurements have been underutilized at two-year institutions (Duckworth et al., 2007; Sedlacek, 2004). Community colleges recognize the importance of providing swifter access to curriculum-level courses, however, and are expanding their capabilities to assess college-readiness beyond students' cognitive abilities to include attitudes and behavioral characteristics like personal motivation and persistence (Conley, 2005).

Researchers disagree on the key practices for providing accurate course placement, however. Noble and Sawyer (2004) argued that one placement method is insufficient to make such weighty decisions as course placement and that test scores, high school grades, and other measures should be mutually considered to identify students ready for college-level work and those who would benefit from remediation. Belfield and Crosta (2012) agreed with these findings and theorized that the optimal decision for placement is to combine information from a placement test with the students' high school transcript. As colleges seek an ideal placement approach for students, researchers caution not to avoid affective characteristics that influence success and may be less evident without a personal interview or feedback from high school teachers and counselors.

Aspects of personal characteristics like motivation, determination, resourcefulness, and persistence are important traits that affect students' success in college-level courses, as well as completion (Conley, 2008).

Though placement testing remains the most prevalent means of course placement, multiple measures is the most recent effort by community colleges to examine a variety of student information to make course placement decisions, yet varying definitions of multiple measures pose challenges for developing algorithms for comparing placement using the multiple measures approach. As multiple measures placement becomes conventional within community colleges systems, administrators can better explore the effectiveness of multiple measures placement and conduct further research to determine whether the practice is providing appropriate placement that results in course success and persistence.

CHAPTER III: METHODOLOGY

Chapter I of this study provided an overview and background information about community college course placement and various methods implemented by colleges to eliminate as many barriers as possible to college-level course access. Chapter II presented a review of literature about the various methods of course placement, as well as how variables like gender, race/ethnicity, and Pell Grant eligibility affect student's course success and completion. Chapter III explains the methodology used to conduct the study and described the research questions, setting, participants, data collection procedures, and the analysis approach.

Introduction

Open-access admission policies present community colleges with the unique challenge of preparing students for academic success, despite previous levels of academic achievement. In order to accomplish this, an evaluation of students' current knowledge must be considered to ensure students are placed into courses that most align with their current skills and address any deficiencies. Enrollment at two- and four-year colleges involves the sorting of students into appropriate courses based upon major and academic readiness. Placement is most often accomplished by placement testing, though many community colleges are now looking at high school coursework and GPA to determine if students are academically prepared for curriculum-level courses. Course placement is an important issue for community colleges because the method of course placement impacts

students' access, success, and persistence (Armstrong, 2000; Collins, 2008; Hodara et al., 2012; Scott-Clayton, Crosta, & Belfield, 2014).

The purpose of the study was first to examine whether the method of course placement for the first attempted English and mathematics courses is independent of the student demographic variables of gender, race/ethnicity, and Pell Grant eligibility. The study will then analyze if course success and semester-to-semester persistence is dependent upon course placement in the first attempted English and mathematics college-level courses for all students in the study and among students in demographic groups based on identified interdependence with one or both dependent variables.

Research Questions

Research on course placement has yielded mixed results regarding which placement methods relate to the greatest student success in mathematics and English gateway courses and which method of placement most relates to continuous enrollment in the semester following the gateway courses (Belfied & Crosta, 2012; Duckworth et al., 2012; Scott-Clayton, 2012). Approximately 92% of two-year colleges use placement testing as sole determiner of student course placement, but recent research points to high school GPA and information about courses taken in high school as having a significant association with college success that should be taken into account when determining student's preparedness for college-level courses (Ngo & Kwon, 2015).

Community colleges have not historically included GPA and high school coursework as success indicators or determinants of readiness for credit bearing coursework. This study examined student records after a recent state-wide placement policy shift in the NCCCS (2013) to determine the effectiveness of the newly

implemented multiple measures placement method, which incorporates the use of students' high school GPA and coursework in making placement decisions. The following research questions guided this study:

RQ1: Is course placement method for the first attempted English and math college-level courses independent of student demographic characteristics (gender, race/ethnicity, Pell Grant eligibility)?

RQ2: Is course success in the first attempted English and math college level-courses dependent upon the method of course placement for students in the sample and among demographic groups based on the results of RQ1?

RQ3: Is semester-to-semester persistence following the first attempted English and math college-level courses dependent upon the method of course for students in the sample and among demographic groups based on the results of RQ1?

Setting

This quantitative study was conducted using data from a two-year, medium-sized Associate's College: High Career & Technical-Mixed Traditional/Nontraditional according to the Carnegie Foundation classifications for colleges and universities (Association of College and Research Libraries, 2016). The College is a multi-campus institution with a two-county service area. The institution is regionally accredited, has been in operation since 1963, and is instrumental in workforce development and assisting displaced workers with obtaining competitive credentials. The College offers 36 degrees, 30 diplomas, and 141 certificates. As of 2015-2016, it served approximately 8,500 curriculum students per year; 48% of students were full-time students who took 12 or more semester hours of coursework per semester, and 52% of students were part-time

students. Sixty-three percent of students were female and 37% were male. The average age of students at the College was 28-years old. Of students who reported their race/ethnicity for the 2015-2016 semester, 68% identified as White; 25% Black; 10.1% Hispanic; 1.4% Foreign; 1.3% Asian; 3.5% Multi-race; 0.5% Alaskan/Native American; 0.2% Unknown; 0.1% Hawaiian/Pacific Islander; 0.7% of students did not respond. Approximately 60.5% of students are eligible for financial aid through the Pell Grant program, but 22% of students did not apply for the Free Application for Federal Student Aid (FAFSA), so no financial information is known about these students.

The College has an open-admissions policy consistent with the mission of community colleges; new students are admitted to the College three times per year: fall, spring, and summer. College-level course placement for students may be done directly or indirectly (Figure 1). Direct placement occurs when a student academically prepared for college-level courses based upon satisfactory placement test scores or ACT/SAT scores, sufficient high school GPA, and successful prior coursework. Students placed directly into college-level courses bypass developmental or remedial courses. Indirect placement occurs when students are required to complete remedial or developmental coursework prior to progressing into college-level courses in English and mathematics due to insufficient placement test scores or low high school GPA. Indirect placement may also result when students repeat a course following a previously unsuccessful attempt.

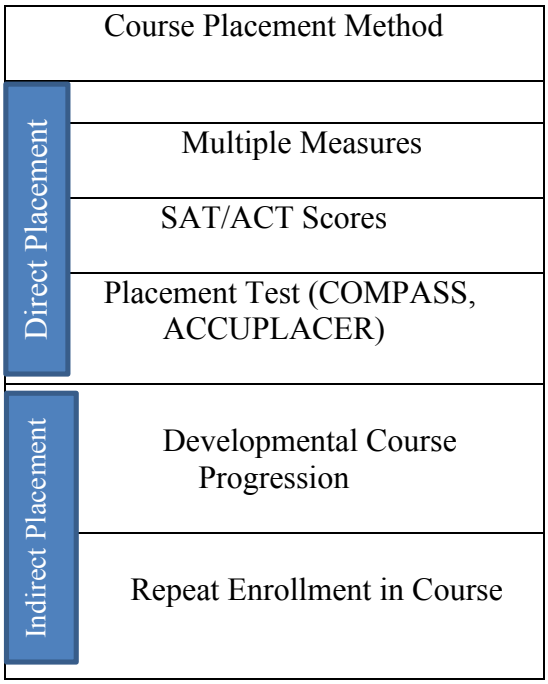

Figure 1. Community College Course Placement Methods

If students do not meet minimum placement policy standards upon admission, they are required to enroll in developmental education courses to improve their reading, writing, and/or mathematics skills prior to enrolling in gateway courses.

Course placement determinations at North Carolina community colleges have historically been based upon placement test cut-off scores. In August 2013, a state-wide policy shift encouraged community colleges to implement the multiple-measures placement policy for incoming students who graduated within five-years of enrollment at the College; this policy allowed students with the prescribed GPA and coursework to bypass the placement test and enroll directly enroll in gateway courses. By August 2015, the NCCCS required all community colleges to implement the multiple measures policy to determine course readiness for students who graduated high school within five-years of enrollment at the College. The policy shift was a unique effort by the state system to expand admissions standards, thereby increasing students' access to credit bearing

courses and reducing the need for developmental education. The College in this study began its implementation of the multiple measures policy in Fall (August) 2013. This study specifically examined the following college-level, or gateway courses: ENG 102 (Applied Communications II); ENG 111 (Writing and Inquiry); MAT 143 (Quantitative Literacy); MAT 152 (Statistical Methods I); MAT 171 (Pre-calculus Algebra) (Figure 2).

First College-Level Writing Courses	First College-Level Mathematics Courses
ENG 102: Applied Communications II	MAT 143: Quantitative Literacy
ENG 111: Writing and Inquiry	MAT 152: Statistical Methods I
	MAT 171: Pre-calculus Algebra

Figure 2. First Attempted College-Level Courses at the Research Site

Participants

This study utilized convenience sampling to identify students who were placed into college-level mathematics and English courses by multiple measures placement, ACCUPLACER scores, SAT/ACT scores, and developmental progression, who were between the ages of 18-25, since students can only be placed by multiple measures if they graduated from high school within five-years of enrolling at the college. Students in this study were enrolled in gateway English and math courses during fall 2013, 2014, and 2015.

According to Emerson (2015), convenience sampling is a nonrandom sampling method in which individuals who fit the criteria of a study were deliberately identified by the researcher to obtain information on a representative sample of a group. The researcher utilized archived student records to identify students who took gateway mathematics and

English following the implementation of multiple measures placement policy (Fall 2013, Fall 2014, Fall 2015). During the semesters in which data was obtained, the available gender categories on the NCCCS admission form for community colleges were male and female. Of the students who took gateway English and math courses in Fall semesters 2013, 2014, and 2015 and met the age limitations for the study, 58.2% were female and 41.8% were male in the math sample; 55.7% were female and 44.3% were male in the English sample. The researcher referenced the gender and race/ethnic terminologies used by the College. The following race/ethnic categories were available for selection on the student admission form at the time data were collected for the study: no response, Alaskan/Native American, Asian, Black, Foreign, Hispanic, Hawaiian/Pacific Islander, Multi-Race, Unknown, and White (Table 1). This study limited the sample to race/ethnicities who represented 10% or more of the overall student population. Table 1 provides the race/ethnicity of students who were enrolled in gateway math and English courses for Fall 2013, 2014, and 2015 semesters.

Table 1

Percentages and Frequencies, Race/Ethnicity

Race	*N*	Percent
No Response	29	0.7%
Alaskan/Native American	22	.5%
Asian	54	1.3%
Black	565	14.1%
Foreign	55	1.4%
Hispanic	404	10.1%
Hawaiian/Pacific Islander	4	0.1%
Multi-Race	139	3.5%
Unknown	9	0.2%
White	2736	68.1%
Total	4017	100.0%

Based on the students included in convenience sample, the following table provides Pell Grant eligibility status among the students in the sample. Pell Grant eligibility was used as a proxy for students' socio-economic status. Financial information was not available for students who did not complete the FAFSA application (Table 2). Table 2 provides the Pell Grant eligibility of students who were enrolled in gateway math and English courses for Fall 2013, 2014, and 2015 semesters.

Table 2

Percentages and Frequencies, Pell Grant Eligibility

Pell Grant Eligibility	*N*	Percent
Did Not Complete FAFSA Application	884	22.0%
Yes	2429	60.5%
No	704	17.5%
Total	4017	100.0%

Students in the study were placed in college-level courses by one of the following placement methods: placement test, multiple measures placement, SAT/ACT, or development course progression (Table 3). Community colleges serve a diverse student population. During summer semesters, students from 4-year colleges often attend community college to expedite their general education coursework. Approximately 1.5% of students at the College are special credit students; these students typically bypass traditional placement methods with transfer credit or proof they completed the equivalent of the pre-requisite for the course at another institution. In about 4% of cases, there is no placement information for students. This could be due to clerical errors, departmental decisions to override the pre-requisite requirement, or missing pre-requisite paperwork (Table 3).

Table 3

Percentages and Frequencies, Placement Method for Full Dataset

College-Level Course	Method of Placement	*N*	Percent
Math	Developmental Course Progression	533	33.4%
	Multiple Measures	584	36.6%
	Placement Test	318	19.9%
	SAT/ACT	79	4.9%
	Transferred in Credit	14	0.9%
	No Placement Information Available	69	4.3%
Total		1597	100%
English	Developmental Course Progression	446	18.4%
	Multiple Measures	988	40.8%
	Placement Test	737	30.5%
	SAT/ACT	130	5.4%
	Transferred in Credit	45	1.9%
	No Placement Information Available	74	3.0%
Total		2420	100%

Data Collection Methods

The study used archived data collected from the College's student information database. The data collected for this study were taken from the following gateway courses for academic years 2013, 2014, and 2015: ENG 111, ENG 102, MAT 143, MAT 152, and MAT 171. Information retrieved from the archived data described student age, gender, race/ethnicity, Pell Grant eligibility, method of placement in the college-level mathematics or English course (multiple measures, placement test, SAT/ACT; developmental course progression); students' final grade in the course; and enrollment status in the following semester. Students' final grades were recoded as a dichotomous

variable of yes if the student passed the course with a C or higher or no if the student did not receive a final grade of C or higher.

The dataset was obtained by the College's data analyst technician and reported to the Director of Institutional Effectiveness in a de-identified folder to check for accuracy before delivery to the researcher. Student names and identification numbers were not available to the researcher to protect students' privacy and ensure student anonymity. Student placement data were requested for the following fall semesters: 2013, 2014, and 2015. Since the site is a two-year institution, most students in the data set were enrolled in an associate degree program or were taking courses to transfer to a four-year institution.

Data Sources

For this study, the dependent variables were success in the college-level math and/or English course as evidenced by final course grade in the first attempted college-level mathematics and/or English course and continuous enrollment in the following semester after the class census date. Grades of A, B, and C were defined as successful completion. Grades of D, F, I (Incomplete), R (Retake), and W (Withdrawal) were considered unsuccessful attempts. The demographic variables for this study derived from gender and race/ethnic categories reported by students during the admissions process. The independent variables for this study were gender, race/ethnicity, Pell Grant eligibility, and the method of placement (placement test scores, ACT/SAT scores, multiple measures, or developmental course progression).

Placement Method: Placement Tests

Community colleges use placement testing as an indicator of college-readiness for college-level courses. Common placement tests are the ACCUPLACER, COMPASS, and ASSET tests. The validity of such tests is based upon their use and how they are interpreted and scored. For the purpose of placing students into courses, placement test scores are given meaning by the College through cut-off scores which signify readiness for curriculum-level courses. Cut-off scores for placement tests are approved by the state legislature and upheld by the NCCCS; scores cannot be modified by individual colleges. Despite current research findings that question the accuracy of standardized placement tests (Scott-Clayton, 2012), placement tests, like the ACCUPLACER and COMPASS tests, are considered reasonably accurate at assessing whether students have the skills necessary to be successful in college-level coursework.

The ACCUPLACER is the placement test used by the College in this study. To obtain direct placement into gateway English courses, students must obtain a score of 129 or higher on the test. Eligibility for direct placement into MAT 143 requires minimum ACCUPLACER scores of 55 in Arithmetic and 55 Elementary Algebra. Direct placement into MAT 171 requires minimum scores of 55 in Arithmetic and 75 in Elementary Algebra.

Placement Method: SAT/ACT Scores

Community college students in the NCCCS have the option to use their SAT or ACT scores in lieu of placement testing to determine gateway course eligibility. This is the least common method of placement at community colleges because the SAT and ACT tests are not required for admission; therefore, many community college students do

not elect to take either test prior to enrolling at the community college. Validity studies on the SAT/ACT verify that both tests generally predict undergraduate GPA and accurately reflect IQ and intelligence, however (Coyle & Pillow, 2008), and a small percentage of community college students do submit their SAT/ACT scores as an alternative to the placement test.

A student in the NCCCS is directly placed into gateway English courses with the following ACT scores: 18 English or 22 Reading. Students using SAT scores must demonstrate a score of 480 or higher on the Evidence-Based Reading and Writing portion. Students with SAT scores of 530 or higher are given direct placement into MAT 143, MAT 152, and MAT 172; students with ACT scores of 22 or higher are directly placed in the aforementioned gateway mathematics courses.

Placement Method: Multiple Measures Placement (High School Transcript and GPA)

High school transcripts are the most recent alternative to placement testing at community colleges. High school GPA has proven to be useful for predicting many aspects of students' college performance and has a strong association with students' college GPA; other information from high school transcripts, like the number of math and English courses taken in high school, honors courses, number of F grades, and number of overall credits, also offer reliable in information in determining college readiness (Belfield & Crosta, 2012).

The NCCCS recently began in 2013 to utilize student information from high school transcripts to make placement decisions in a policy shift know as multiple measures placement. This study used the NCCCS policy to define multiple measures (NCCCS, 2013). The policy mandates that community colleges place students in

appropriate courses by using a hierarchy of measures to determine readiness for college-level coursework. To be eligible for multiple measures placement into college-level courses, the student must have graduated from high school within five-years of enrollment at the community college. Students must have successfully completed the following mathematics courses with a GPA of 2.6 or higher: Algebra I, Geometry, Algebra II (or equivalent), and one additional mathematics course. For access to all other credit bearing courses, including gateway English courses, students must have an unweighted high school GPA of 2.6 or greater.

Placement Method: Developmental Sequence Progression

Though developmental course placement is binary in outcome, developmental courses vary in the level and degree in which they are offered. In the NCCCS, developmental English courses are sequenced DRE 096, DRE 097 and DRE 098; each course is eight weeks. Students are prescribed the course or sequence of courses depending on their placement results or by meeting multiple measures criteria; students with higher placement scores may only need DRE 098, while students with very low scores may require all three DRE courses. Developmental math courses are offered in self-paced lab modules or shells ranging from 010 to 050 for the associate in applied science mathematics course (MAT 143) and Statistics (MAT 152), and 060 to 080 for students who eventually want to take Pre-Calculus Algebra (MAT 1717) and above.

Students at the College under study were graded based on a 10-point grading scale. A grade of C or higher was required for students to pass all developmental courses.

Data Analysis

For this study, the dependent variables were success as defined by course grade and continuous enrollment in the following semester. Grades of A, B, and C were defined as successful completion. Grades of D, F, I, R, and W were considered unsuccessful completion. The independent variable for this study included the method of placement (ACCUPLACER scores, ACT/SAT scores, multiple measures, developmental course progression). Other independent variables considered in this study included gender, race/ethnicity, and Pell Grant eligibility status. Each research question was analyzed using a Chi-Square analysis to determine the probability of student success in the English or mathematics gateway course as demonstrated by a final grade of C or higher and continuous enrollment in the semester following the successful completion of the gateway course. The following research questions were examined:

RQ1: Is course placement method for the first attempted English and math college-level course independent of student demographic characteristics (gender, race/ethnicity, Pell Grant eligibility)?

Hypothesis 1: There is no interdependence among gender and course placement method in the first attempted English and math college-level course.

Hypothesis 2: There is no interdependence among race/ethnicity and course placement method in the first attempted English and math college-level course.

Hypothesis 3: There is no interdependence between students' Pell Grant Eligibility and course placement method in the first attempted English and math college-level course.

RQ2: Is course success in the first attempted English and math college level-course dependent upon the method of course placement for students in the sample and among demographic groups based on the results of RQ1?

Hypothesis 1: Couse success is not dependent on the method of course placement in the first attempted college-level English courses for students in the sample and among demographic groups identified in RQ1.

Hypothesis 2: Couse success is not dependent on the method of course placement in the first attempted college-level math course for students in the study and among demographic groups identified in RQ1.

RQ3: Is semester-to-semester persistence following the first attempted English and math college-level course dependent upon the method of course placement for students in the sample and among demographic groups based on the results of RQ1?

Hypothesis 1: Semester-to-semester persistence is not interdependent on the method of course placement in the first attempted college-level English course for students in the sample and among demographic groups identified in RQ1.

Hypothesis 2: Semester-to-semester persistence is not interdependent on the method of course placement in the first attempted college-level math course for students in the sample and among demographic groups identified in RQ1.

Data Analysis Methods

The Chi-Square analysis is a conventional method used for analyzing binary outcomes, such as success versus non-success in a college course or continuous enrollment in a subsequent semester. A Chi-Square analysis offers a method of determining the likelihood of a relationship or dependence between the dependent and

independent variables (Gay, Mills, & Airasian, 2009). This study used a Chi-Square analysis to determine if any interdependence existed between the dependent variables and independent variables of gender, race/ethnicity, and Pell Grant eligibility. The Chi-Square analysis was additionally utilized to determine the probability of course success and continuous enrollment in the following semester based on the method of course placement. The study examined course placement for three-years following the implementation of the multiple measures policy (Fall 2013, Fall 2014, Fall 2015) to examine the relationship between course success and persistence based on method of course placement, as well as the relationship between method of placement and demographic characteristics of gender, race/ethnicity, and Pell Grant eligibility.

Data Quality and Accuracy

This study was limited to records from one community college in North Carolina classified as a medium, suburban community college. Because a singular institution is represented in the study, results may lack generalizability and transferability to other student populations and institutions. The institution in this study was among the first NCCCS institutions to implement multiple measures placement in Fall 2013; other community colleges in the state had until Fall 2015 to implement the multiple measures policy, so the sample size in this study may be larger than institutions that implemented the policy later in the allotted implementation period. The study specifically utilized data from three fall semesters prior to and after the implementation of the multiple measures policy so that continuous enrollment could be clearly tracked into the following spring semesters, since many students do not take classes during the summer semesters.

For North Carolina community colleges, the multiple measures placement is specific to students who graduated high school within five-years of enrolling at the College, so results of the study do not reflect placement alternatives for community college students who graduated high school and entered the community college after the five-year period. Non-traditional students, or students who enrolled at the community college after the five-year period, were not represented in the sample of students in this study because they have exceeded the five-year limitation. The average age of students at the College is 28-years old, so the researcher acknowledges the population studied does not represent the majority of students at the College. Future research should identify a broader range of placement options that can advance placement accuracy and remove placement barriers for all students served by the community college.

The Office of Student Affairs at the study's site is responsible for entering student demographic and placement data into the College's student management database; as data is entered by administrative staff, the registrar and registrar's assistant review the records for accuracy, and program chairs in English and mathematics check placement scores for students entering first college-level English and mathematics courses. The researcher in this study is employed by the institution; therefore, data was acquired and de-identified by the College's data analyst. Data delivery was overseen by the Director of the Office of Institutional Effectiveness to ensure the quality and accuracy of the raw data.

Summary

Accurate course placement is the first step to ensuring students' success in college courses and persistence in future coursework. This study utilizes Chi-Square analyses to examine whether the method of course placement for the first attempted English and mathematics courses is independent of the student demographic variables of gender, race/ethnicity, and Pell Grant eligibility. The study also analyzes whether course success and semester-to-semester persistence is dependent upon course placement methods in the first English and mathematics college-level courses for all students in the study and among students in specific demographic groups identified as indicating interdependence. The research questions, setting and population, data collection procedures, data analysis and limitations of the study are included. Findings and descriptive statistics are discussed in Chapter IV.

CHAPTER IV: ANALYSIS OF THE DATA

The purpose of this study was to examine whether the method of course placement for the first attempted English and mathematics courses was independent of the student demographic variables of gender, race/ethnicity, and Pell Grant eligibility. The study then sought to analyze if course success and semester-to-semester persistence was dependent upon the method of course placement (placement test scores, ACT/SAT scores, multiple measures, or developmental course progression) in the first attempted English and mathematics college-level courses for students in the sample and among students in specific demographic groups found to have interdependence. Chapter IV discusses the findings of the study, which used a Chi-Square to determine relationships between the dependent and independent variables.

Description of Sample

The initial sample discussed in Chapter III was comprised of 4,017 students, who were enrolled in gateway mathematics courses: MAT 143 (Quantitative Literacy), MAT 152 (Statistical Methods I), MAT 171 (Pre-calculus Algebra), and/or gateway English courses: ENG 102 (Applied Communications II) and ENG 111 (Writing and Inquiry) during the Fall 2013, Fall 2014, and Fall 2015 semesters. The age range of the participants was 18 to 25-years old.

Upon exploration of the demographic data (gender, race/ethnicity, Pell Grant eligibility) in Chapter III, the researcher made the decision to limit the sample based on

the category of race/ethnicity because small frequencies in cell values may negate the validity of a Chi-Square analysis. Because all other race/ethnic categories at the College were below 10%, the researcher determined that placing all other race/ethnicities in an "other" category would not be meaningful because each race/ethnic group is a unique population. The researcher, therefore, limited the sample to the following race/ethnic categories because these race/ethnicities represented 10% or more of the sample population: White, Black, Hispanic (Table 4).

Because this study examined the relationship between course placement method and course success and persistence, students for whom no placement information existed were not included in the study. An examination of the data found 4.1% of the sample did not have any information about how students were placed into the gateway course. This can be attributed to clerical errors, departmental decisions to override the pre-requisite requirement or missing pre-requisite paperwork (P. Smith, personal communication, January 11, 2017). In 0.9% of placements courses, students transferred into the College with the pre-requisite credit and were not placed by a conventional method of placement utilized by the College. This is not unusual especially among students taking summer classes while attending a 4-year college during the fall and spring semesters. Students who transfer into gateway courses often bypass traditional placement methods with transfer credit or proof of equivalent pre-requisites from another institution. The researcher elected not to include students who transferred into gateway courses by transfer credit and for students for whom no placement information was available because these observations were unable to provide information about placement methods standard for the College.

Description of the Analyzed Sample

This study analyzed White, Black, and Hispanic students enrolled in gateway mathematics and English courses during the following academic semesters: Fall 2013, Fall 2014, Fall 2015. The age range of students in the sample remained 18 to 25-years old because multiple measures placement is a placement method exclusively for students who graduated high school within five-years of enrollment at the College. Because math and English are separate disciplines, demographic data and analyses are presented separately for each discipline. Table 4 provides demographic variable percentages for students in the analyzed sample.

Table 4

Demographic Characteristics of Final Analytic Sample for Gateway Math and English

		Math Sample (*N*=1,403)	English Sample (*N*=2,117)
Race/Ethnicity	% White	74.2%	73.6%
	% Black	14.3%	15.9%
	% Hispanic	11.5%	10.5%
Gender	% Female	58.2%	55.7%
	% Male	41.8%	44.3%
Pell Eligibility	% No FAFSA	23.8%	21.3%
	% FAFSA Eligible	58.9%	60.1%
	% FAFSA Not Eligible	17.3%	18.6%

The study investigated course success and semester-to-semester persistence related to the following placement methods: developmental course progression, multiple measures placement, placement testing, and SAT/ACT scores. Tables 5 and 6 provide the percent and frequency of the sample's method in first attempted college-level English and

math courses. The most frequently utilized method of course placement for English and math for the overall sample was multiple measures.

Table 5

Percentages and Frequencies of Placement Method in College-Level English

College-Level Course			*N*	Percent
English	Placement Method	Developmental	410	19.4%
		Multiple Measures	900	42.5%
		Placement Test	688	32.5%
		SAT-ACT	119	5.6%
	Total		2,117	100%

Table 6

Percentages and Frequencies of Placement Method in College-Level Math

College-Level Course			*N*	Percent
Math	Placement Method	Developmental	498	35.5%
		Multiple Measures	534	38.1%
		Placement Test	296	21.1%
		SAT-ACT	75	5.3%
	Total		1,403	100%

The dependent variables for this study were course success, as demonstrated by a final grade of C or higher, and semester-to-semester persistence, as demonstrated by enrollment in the spring semester following enrollment in the gateway math or English course. Tables 7 and 8 provide the percent and frequency of course success and persistence in gateway math and English courses by method of placement.

Table 7

Course Success and Persistence by Placement Method, Gateway English

Placement Method	*N*	Course Success by Placement Method	Persistence by Placement Method
Developmental	498	55.9%	70.7%
Multiple Measures	534	62.3%	82.0%
Placement Test	296	61.3%	75.0%
SAT/ACT	75	78.2%	81.5%
Total	1,403	61.6%	77.5%

Table 8

Course Success and Persistence by Placement, Gateway Math

Placement Method	*N*	Course Success by Placement Method	Persistence by Placement Method
Developmental	410	58.8%	69.7%
Multiple Measures	900	62.0%	82.4%
Placement Test	688	66.6%	73.0%
SAT/ACT	119	73.3%	77.3%
Total	2,117	62.4%	75.6%

Analyses of Research Questions

Three research questions guided this study. The first research questioned examined the data for interdependence between method of placement and each of the following demographic variables: gender, race/ethnicity, and Pell Grant eligibility using a Chi-Square analysis to identify dependence between method of placement and demographic variables. Research questions two and three examined interdependence between course success and persistence in the first attempted English and math college level-courses respectively for students in the sample and for students in demographic groups exhibiting dependence on the method of placement in research question 1. All Chi-Square analyses were conducted to determine statistical significance with an alpha level of .05; adjusted standardized residuals were also analyzed to examine post-hoc

differences for significant omnibus Chi-Square analyses and evaluated with the *z*-critical value of 1.96 as recommended by Sharpe (2005).

Research Question 1

Is course placement method for the first attempted English and math college-level courses independent of student demographic characteristics (gender, race/ethnicity, Pell Grant eligibility)? Research question 1 examined the relationship between gateway course placement and demographic characteristics of students to determine if independence existed between the method of course placement and students' demographic characteristics. This is important because if dependence occurs, the relationship compels further exploration of interdependency in research questions 2 and 3. A Chi-Square statistical analysis determined if a relationship existed between the methods of course placement and each of the following demographic variables: gender, race/ethnicity and Pell Grant eligibility.

Hypothesis 1: There is no interdependence among gender and course placement method in the first attempted English and math college-level courses.

A Chi-Square analysis examining the relationship between gender (male/female) and method of course placement indicated no interdependence between gender and the method of course placement for gateway mathematics $\chi^2(3, N=1{,}403)=5.159$, $p=.160$ as well as for English courses $\chi^2(3, N=2{,}117) = 6.387$, $p=.094$. The null hypothesis was accepted.

Hypothesis 2: There is no interdependence among race/ethnicity and course placement method in the first attempted English and math college-level courses.

A Chi-Square analysis examining the relationship between race/ethnicity (White/Black/Hispanic) and method of course placement indicated interdependence between race/ethnicity and the method of course placement for English courses $\chi^2(6, N=2,117)=65.622$, $p=.000$ and gateway math courses $\chi^2(6, N=1,403)=26.217$, $p=.000$. The null hypothesis was rejected.

In Table 9, adjusted standardized residuals above the z-critical value of 1.96 indicated significant differences in the proportions of participants in each method of placement based on race/ethnicity for gateway English courses. For developmental course placement, there were fewer White students than would be expected by chance (-7.0<-1.96) and a greater number of Black students than would be expected by chance (6.3>1.96). For multiple measures, this pattern was reversed – greater numbers of White students (2.9>1.96) and fewer Black students (-3.5<-1.96). For placement by ACT/SAT, there was a larger-than-chance proportion of White students (4.1>1.96) and smaller-than-chance proportions of Black and Hispanic students (both -2.7<-1.96). There were no differences among racial/ethnic groups in placement by placement test as all standardized residuals were below 1/-1.

Table 9

Placement Method by Race/Ethnicity, Gateway English

Race/Ethnicity	*N*	Placement Method (adjusted standardized residual) DEV	MM	PT	SAT/ACT	*Total*
White	1,563	15.8% (-7.0)	44.3% (2.9)	33.0% (0.8)	6.8% (4.1)	100.0%
Black	328	32.0% (6.3)	33.8% (-3.5)	31.7% (-0.3)	2.4% (-2.7)	100.0%
Hispanic	226	25.7% (2.5)	42.5% (0.0)	30.1% (-0.8)	1.8% (-2.7)	100.0%
Total	2,117	19.4%	42.5%	32.5%	5.6%	100.0%

Placement method was dependent upon race in gateway math courses, as well. In Table 10, adjusted standardized residuals above the z-critical value of 1.96 indicated significant differences in the proportions of participants in each method of placement based on race/ethnicity for gateway math courses. For developmental course placement, there were fewer White students than would be expected by chance (-3.4<-1.96) and a greater number of Black students than would be expected (3.5>1.96). For multiple measures, this pattern was again reversed – greater numbers of White students (2.2>1.96) and fewer Black students (-2.7<-1.96). For placement by ACT/SAT, there was a larger-than-chance proportion of White students (6.6>1.96) and smaller-than-chance proportions of Black (-2.2<-1.96) and Hispanic (-2.4<-1.96) students. There were no differences among racial/ethnic groups in placement by placement test as all standardized residuals were below 1/-1.

Table 10

Placement Method by Race/Ethnicity, Gateway Math

Race/Ethnicity	*N*	Placement Method (adjusted standardized residual) DEV	MM	PT	SAT/ACT	*Total*
White	1,047	33.0% (-3.4)	39.7% (2.2)	20.7% (-0.6)	6.6% (6.6)	100.0%
Black	197	46.7% (3.5)	29.4% (-2.7)	21.8% (0.3)	2.0% (-2.2)	100.0%
Hispanic	159	38.4% (0.8)	37.7% (-0.1)	22.6% (0.5)	1.3% (-2.4)	100.0%
Total	1,403	35.5%	38.1%	21.1%	5.3%	100.0%

Hypothesis 3: There is no interdependence between students' Pell Eligibility and course placement method in the first attempted English and math college-level courses.

A Chi-Square analysis examining the relationship between Pell Grant eligibility (did not complete the FAFSA/Yes (eligible)/No (ineligible) and method of course placement indicated interdependence between the method of course placement and Pell Grant eligibility in gateway mathematics $\chi^2(6, N=1{,}403) = 44.132$, $p=.000$ and English courses $\chi^2(6, N=2{,}117) = 87.467$, $p=.000$. The null hypothesis was rejected.

Placement method was dependent upon Pell Grant eligibility in gateway English courses for all placement methods. In Table 11, adjusted standardized residuals above the z-critical value of 1.96 indicated significant differences in the proportions of participants in each method of placement based Pell Grant eligibility. For developmental course placement, there were significantly more Pell Grant eligible (3.9>1.96) and ineligible (3.2>1.96) students that would have been expected by chance. Multiple measures placement showed a similar pattern; there were greater numbers of Pell Grant eligible

(3.0>1.96) and ineligible (4.8>1.96) than would be expected by chance. For placement by placement test, there was a smaller-than-chance proportion of Pell Grant ineligible students (6.6>1.96). Significantly more students who did not provide FAFSA information were placed by SAT/ACT (6.8>1.96).

Table 11

Placement Method by Pell Grant Eligibility, Gateway English

Pell Grant Eligibility	*N*	Method of Placement (adjusted standardized residual)				*Total*
		DEV	MM	PT	SAT/ACT	
No FAFSA Information	441	16.60% (-1.7)	40.40% (-1.0)	30.80% (-0.8)	12.20% (6.8)	100.00%
FAFSA Eligible	1,276	22.10% (3.9)	39.90% (3.0)	35.10% (-3.1)	2.90% (1.3)	100.00%
FAFSA Ineligible	400	13.80% (3.2)	53.30% (4.8)	26.00% (-3.1)	7.00% (1.3)	100.00%
Total	2,117	19.40%	42.50%	32.50%	5.60%	100.00%

Placement method was dependent upon Pell Grant eligibility in gateway math courses, as well. In Table 12, adjusted standardized residuals above the *z*-critical value of 1.96 indicated significant differences in the proportions of participants in each method of placement based on Pell Grant eligibility for gateway math courses. For developmental course placement, there were fewer Pell Grant ineligible students than would be expected by chance (-2.5<-1.96). Fewer students who did not provide FAFSA information were placed by multiple measures than expected (-3.8<-1.96) and larger-than-chance proportions of Pell Grant ineligible students were placed by multiple measures. The proportion of students placed by SAT/ACT was greater than expected among students

who did not provide FAFSA information (3.2>1.96), but was significantly smaller-than-chance among students who were Pell Grant Eligible (-3.9<-1.96).

Table 12

Placement Method by Pell Grant Eligibility, Gateway Math

Pell Grant Eligibility	*N*	Placement Method (adjusted standardized residual) DEV	MM	PT	SAT/ACT	*Total*
No FAFSA Information	330	39.1% (1.6)	29.1% (-3.8)	23.0% (1.0)	8.8% (3.2)	100.0%
Pell Grant Eligible	827	36.2% (0.6)	38.0% (-.10)	22.5% (1.5)	3.4% (-3.9)	100.0%
Pell Grant Ineligible	246	28.5% (-2.5)	50.4% (4.4)	13.8% (-3.1)	7.3% (1.5)	100.0%
Total	1,403	35.5%	42.5%	32.5%	5.6%	100.0%

Research Question 2

Is course success in the first attempted English and math college level-courses dependent on the method of course placement for all students in the sample and among students in demographic groups based on the results of RQ1? Research question 2 utilized a Chi-Square analysis to examine the relationship between students' course success demonstrated by a final course grade of C or higher in the first attempted math or science courses. Because race/ethnicity and Pell Grant eligibility were found to have interdependence in research question 1, the researcher ran separate Chi-Square tests to determine interdependence between course success and placement method among demographic groups. Calculated residuals identified specific cells that contributed to significance of the Chi-Square results.

Hypothesis 1: Couse success is not dependent on the method of course placement in the first attempted college-level English courses for all students in the sample and among students in demographic groups identified as having dependence in RQ1.

A Chi-Square analysis of the sample examined the relationship between course success, as defined by completion of the gateway English course with a grade of C or higher, and method of course placement found interdependence between course success and the method course placement in gateway English courses $\chi^2(3, N=2{,}117) = 19.736$, $p=.000$. The null hypothesis was rejected.

The sample for SAT/ACT placed students was particularly small, however, and not a typical placement method at the community college in which the study occurred. Though the sample was too small to make generalizations, 78.2% of students placed by the SAT/ACT were successful in the first attempted gateway English course; the effect size of the SAT/ACT and course success was significant (3.8>1.96). Students placed into gateway English courses by developmental course progression showed fewer instances of success in the course than those placed by other placement methods. The rate of course success was similar (61-62%) between multiple measures and placement testing both of which are more common forms of placement utilized by community colleges (Table 13). In Table 13, adjusted residuals above the z-critical value of 1.96 indicated differences in course success – greater or less than chance proportions based on placement method for gateway English courses. Developmental course progression showed less than chance proportions (-2.7<-1.96) in course success. Among observations of course success, SAT/ACT placement showed larger-than-chance proportions (3.8>1.96).

Table 13

Course Success and Placement Method, Gateway English

Placement Method		Course Success Yes	Course Success No	Total
DEV	Percent (*N*)	55.9%(229)	44.1%(181)	100.0%(410)
	Adjusted Residual	-2.7	2.7	
MM	Percent (*N*)	62.3%(561)	37.7%(339)	100.0%(900)
	Adjusted Residual	0.6	-0.6	
PT	Percent (*N*)	61.3%(422)	38.7%(266)	100.0%(688)
	Adjusted Residual	-0.2	0.2	
SAT/ACT	Percent (*N*)	78.2%(93)	21.8%(26)	100.0%(119)
	Adjusted Residual	3.8	-3.8	
Total	Percent (*N*)	61.6%(1,305)	38.4%(812)	100.0%(2,117)

Table 14 provides the percentages and adjusted residuals of course success by race/ethnicity. A Chi-Square analysis found completion of the gateway English course with a grade of C or higher and method of course placement based on race/ethnicity were interdependent among White students in gateway English courses $\chi^2(3, N = 1{,}563) = 10.899$, $p = .012$. This relationship may be attributed to the much greater proportions of course success than by chance for White students placed by SAT/ACT scores (3.1>1.96) and the known strong relationship between SAT/ACT scores and course success (Coyle & Pillow, 2008). Among Black students $\chi^2(3, N = 328) = 5.916$, $p = .116$, course success was lower than expected by chance (-2.3) among those in developmental course placement. Among Hispanic students $\chi^2(3, N = 226) = 6.320$, $p = .097$, lower proportions of course success than expected were found for students placed by placement testing (2.1>1.96). In Table 14, adjusted residuals above the z-critical value of 1.96 indicated significant differences in observed versus expected proportions of course success based on placement method by race/ethnicity.

Table 14

Course Success and Placement Method by Race/Ethnicity, Gateway English

Race/ Ethnicity	Placement Method		Course Success: Yes	Course Success: No	*Total*
White	DEV	Percent (*N*)	60.7%(150)	39.3%(97)	100.0%(247)
		Adjusted Residual	-1.4	1.4	
	MM	Percent (*N*)	63.8%(442)	36.2%(251)	100.0%(693)
		Adjusted Residual	-0.7	0.7	
	PT	Percent (*N*)	64.9%(335)	35.1%(181)	100.0%(516)
		Adjusted Residual	0.1	-0.1	
	SAT/ACT	Percent (*N*)	78.5%(84)	21.5%(23)	100.0%(107)
		Adjusted Residual	3.1	-3.1	
	Total	Percent (*N*)	64.7%(1011)	35.3%(552)	100.0%(1563)
Black	DEV	Percent (*N*)	34.3%(36)	65.7%(69)	100.0%(105)
		Adjusted Residual	-2.3	2.3	
	MM	Percent (*N*)	47.7%(53)	52.3%(58)	100.0%(111)
		Adjusted Residual	1.2	-1.2	
	PT	Percent (*N*)	46.2%(48)	53.8%(56)	100.0%(104)
		Adjusted Residual	0.7	-0.7	
	SAT/ACT	Percent (*N*)	62.5%(5)	37.5%(3)	100.0%(8)
		Adjusted Residual	1.1	-1.1	
	Total	Percent (*N*)	43.3%(142)	56.7%(186)	100.0%(328)
Hispanic	DEV	Percent (*N*)	74.1%(43)	25.9%(15)	100.0%(58)
		Adjusted Residual	1.3	-1.3	
	MM	Percent (*N*)	68.8%(66)	31.3%(30)	100.0%(96)
		Adjusted Residual	0.4	-0.4	
	PT	Percent (*N*)	57.4%(39)	42.6%(29)	100.0%(68)
		Adjusted Residual	-2.1	2.1	
	SAT/ACT	Percent (*N*)	100.0%(4)	0.0%(0)	100.0%(4)
		Adjusted Residual	1.4	-1.4	
		Percent (*N*)	67.3%(152)	32.7%(74)	100.0%(226)
TOTAL		Percent (*N*)	61.6%(1,305)	38.4%(812)	100.0%(2,117)

Course success and method of placement based on Pell Grant eligibility was significant among students who were not eligible to receive the Pell Grant $\chi^2(3, N=400) = 13.161$, $p=.004$ and for students who were eligible to receive the Pell Grant $\chi^2(3, N=441) = 16.046$, $p=.000$ in gateway English courses. Among students who

were eligible to receive the Pell Grant, proportion of course success was less than expected for developmental course progression placement (-2.2<-1.96) and greater than expected for SAT/ACT placement (3.2>1.96). For students ineligible to receive the Pell Grant, the proportion of course success was less than expected for multiple measures (-2.2<-1.96) and greater than expected (3.3>1.96) for SAT/ACT placement. In Table 15, adjusted residuals above the *z*-critical value of 1.96 indicated significant differences in observed and expected proportions of course success based on placement method by Pell Grant Eligibility status.

Table 15

Course Success and Placement Method by Pell Grant Eligibility, Gateway English

Pell Eligibility	Placement Method		Course Success: Yes	Course Success: No	*Total*
Did Not Complete FAFSA	DEV	Percent (*N*)	60.3%(44)	39.7%(29)	100.0%(73)
		Adjusted Residual	-0.7	0.7	
	MM	Percent (*N*)	68.5%(122)	31.5%(56)	100.0%(178)
		Adjusted Residual	1.7	-1.7	
	PT	Percent (*N*)	58.8%(80)	41.2%(56)	100.0%(136)
		Adjusted Residual	-1.4	1.4	
	SAT/ACT	Percent (*N*)	64.8%(35)	35.2%(19)	100.0%(54)
		Adjusted Residual	0.2	-0.2	
	Total	Percent (*N*)	63.7%(281)	36.3%(160)	100.0%(441)
(Yes) Pell Eligible	DEV	Percent (*N*)	52.8%(149)	47.2%(133)	100.0%(282)
		Adjusted Residual	-2.2	2.2	
	MM	Percent (*N*)	59.3%(302)	40.7%(207)	100.0%(509)
		Adjusted Residual	0.4	-0.4	
	PT	Percent (*N*)	59.4%(266)	40.6%(182)	100.0%(448)
		Adjusted Residual	0.4	-0.4	
	SAT/ACT	Percent (*N*)	83.8%(31)	16.2%(6)	100.0%(37)
		Adjusted Residual	3.2	-3.2	
	Total	Percent (*N*)	58.6%(748)	41.4%(528)	100.0%(1276)
(No) Pell Ineligible	DEV	Percent (*N*)	65.5%(36)	34.5%(19)	100.0%(55)
		Adjusted Residual	-0.6	0.6	
	MM	Percent (*N*)	64.3%(137)	35.7%(76)	100.0%(213)
		Adjusted Residual	-2.2	2.2	
	PT	Percent (*N*)	73.1%(76)	26.9%(28)	100.0%(104)
		Adjusted Residual	1.0	-1.0	
	SAT/ACT	Percent (*N*)	96.4%(27)	3.6%(1)	100.0%(28)
		Adjusted Residual	3.3	-3.3	
	Total	Percent (*N*)	69.0%(281)	31.0%(160)	100.0%(441)
TOTAL		Percent (*N*)	61.6%(1,305)	38.4%(812)	100.0%(2,117)

Hypothesis 2: Course success is not dependent on the method of course placement in the first attempted college-level math courses for all students in the sample and among demographic groups identified as having dependence in RQ1.

A Chi-Square analysis of the sample found a relationship between course success, as defined by success in the first attempted gateway mathematics course as evidenced by a final grade of C or higher, and method of course placement in gateway mathematics courses $\chi^2(3, N=1{,}403) = 68.737$, $p=.033$. The null hypothesis was rejected.

In Table 16, adjusted residuals above the z-critical value of 1.96 indicated differences in course success – greater or less than chance proportions based on placement method for gateway math courses. Developmental course progression showed less than chance proportions (-2.1<-1.96) in course success. Among observations of course success, SAT/ACT placement showed larger-than-chance proportions (2.1>1.96). Similarly to gateway English courses, the sample for SAT/ACT placed students in math was small but successful. Within the sample, 73.3% of students placed by SAT/ACT scores were successful in the first attempted gateway math course.

Table 16

Course Success and Placement Method, Gateway Math

Placement Method		Course Success Yes	No	*Total*
DEV	Percent(*N*)	58.8%(293)	41.2%(205)	100.0%(498)
	Adjusted Residual	-2.1	2.1	
MM	Percent(*N*)	62.0%(331)	38.0%(203)	100.0%(534)
	Adjusted Residual	-0.3	0.3	
PT	Percent(*N*)	66.6%(197)	33.4%(99)	100.0%(296)
	Adjusted Residual	1.6	-1.6	
SAT/ACT	Percent(*N*)	73.3%(55)	26.7%(20)	100.0%(75)
	Adjusted Residual	2.0	-2.0	
Total	Percent(*N*)	62.4%(876)	37.6%(527)	100.0%(1,403)

Success in gateway math courses and method of course placement based on race/ethnicity was significant among Hispanic students $\chi^2(3, N=159) = 8.978$, $p=.03$.

A Chi-Square analysis found course success and method of course placement based on race/ethnicity were interdependent in gateway math courses. Among White students who placed into gateway math by SAT/ACT, course success was proportionally greater than expected (2.0>1.96). This relationship may be attributed to the strong relationship between SAT/ACT scores and course success (Coyle & Pillow, 2008). Among Hispanic students placed by placement tests, proportions of course success were higher than expected (2.7>1.96). In Table 17, adjusted residuals above the z-critical value of 1.96 indicated significant differences in observed versus expected proportions of course success based on placement method by race/ethnicity. There were no differences between course success and method of placement among students identifying as Black as all standardized residuals were below 1/-1.

Table 17

Course Success and Placement Method by Race/Ethnicity, Gateway Math

Race/ Ethnicity	Placement Method		Course Success: Yes	Course Success: No	*Total*
White	DEV	Percent (*N*)	62.0%(214)	38.0%(131)	100.0%(345)
		Adjusted Residual	-1.1	1.1	
	MM	Percent *(N*)	63.7%(265)	36.3%(151)	100.0%(416)
		Adjusted Residual	-0.3	0.3	
	PT	Percent (*N*)	65.4%(142)	34.6%(75)	100.0%(217)
		Adjusted Residual	0.4	-0.4	
	SAT/ACT	Percent	75.4%(52)	24.6%(17)	100.0%(69)
		Adjusted Residual	2.0	-2.0	
	Total	Percent(*N)*	64.3%(673)	35.7%(374)	100.0%(1,047)
Black	DEV	Percent (*N*)	47.8%(44)	52.2%(48)	100.0%(92)
		Adjusted Residual	-0.9	0.9	
	MM	Percent(*N)*	53.4%(31)	46.6%(27)	100.0%(58)
		Adjusted Residual	0.4	-0.4	
	PT	Percent(*N)*	58.1%(25)	41.9%(18)	100.0%(43)
		Adjusted Residual	1.0	-1.0	
	SAT/ACT	Percent(*N)*	25.0%(1)	75.0%(3)	100.0%(4)
		Adjusted Residual	-1.1	1.1	
	Total	Percent(*N)*	51.3%(101)	48.7%(96)	100.0%(197)
Hispanic	DEV	Percent(*N)*	57.4%(35)	42.6%(26)	100.0%(61)
		Adjusted Residual	-1.4	1.4	
	MM	Percent(*N)*	58.3%(35)	41.7%(25)	100.0%(60)
		Adjusted Residual	-1.2	1.2	
	PT	Percent(*N)*	83.3%(30)	16.7%(6)	100.0%(36)
		Adjusted Residual	2.7	-2.7	
	SAT-ACT	Percent(*N)*	100.0%(2)	0.0%(0)	100.0%(2)
		Adjusted Residual	1.1	-1.1	
	Total	Percent(*N)*	64.2%(102)	35.8%(57)	100.0%(159)
TOTAL		Percent(*N)*	62.4%(876)	42.6%(26)	100.0%(1,403)

The Chi-Square analysis found interdependence between course success and method of placement based on Pell Grant eligibility for gateway math students $\chi^2(3, N=1,477) = 7.7240$, $p=.027$. Among students who did not complete the FAFSA application, proportion of course success was greater than would have been expected by

chance (2.2>1.96). For students who were eligible and ineligible for Pell Grants, no differences were found as all standardized residuals were below 1/-1.

Table 18

Course Success and Placement Method by Pell Grant Eligibility, Gateway Math

Pell Eligibility	Placement Method		Course Success: Yes	Course Success: No	*Total*
Did Not Complete FAFSA	DEV	Percent (*N*)	62.0%(80)	38.0%(49)	100.0%(129)
		Adjusted Residual	-1.8	1.8	
	MM	Percent (*N*)	67.7%(65)	32.3%(31)	100.0%(96)
		Adjusted Residual	0.0	0.0	
	PT	Percent (*N*)	71.1%(54)	28.9%(22)	100.0%(76)
		Adjusted Residual	0.7	-0.7	
	SAT/ACT	Percent (*N*)	86.2%(25)	13.8%(4)	100.0%(29)
		Adjusted Residual	2.2	-2.2	
	Total	Percent (*N*)	35.3%(552)	64.7%(1011)	100.0%(330)
(Yes) Pell Eligible	DEV	Percent (*N*)	55.9%(167)	44.1%(132)	100.0%(299)
		Adjusted Residual	-1.6	1.6	
	MM	Percent (*N*)	59.6%(187)	40.4%(127)	100.0%(314)
		Adjusted Residual	0.1	-0.1	
	PT	Percent (*N*)	64.5%(120)	35.5%(66)	100.0%(186)
		Adjusted Residual	-0.7	-1.6	
	SAT/ACT	Percent (*N*)	60.7%(17)	39.3%(11)	100.0%(28)
		Adjusted Residual	0.1	-0.1	
	Total	Percent (*N*)	59.4%(491)	40.6%(336)	100.0%(827)
(No) Pell Ineligible	DEV	Percent (*N*)	65.7%(46)	34.3%(24)	100.0%(58)
		Adjusted Residual	0.1	-0.1	
	MM	Percent (*N*)	63.7%(79)	36.3%(45)	100.0%(96)
		Adjusted Residual	0.6	-0.6	
	PT	Percent (*N*)	67.6%(23)	32.4%(11)	100.0%(68)
		Adjusted Residual	-0.3	0.3	
	SAT/ACT	Percent (*N*)	72.2%(13)	27.8%(5)	100.0%(4)
		Adjusted Residual	0.6	-0.6	
	Total	Percent (*N*)	65.4%(161)	67.3%(152)	100.0%(226)
TOTAL		Percent (*N*)	62.4%(876)	37.6%(527)	100.0%(1,403)

Research Question 3

Is semester-to-semester persistence following the first attempted English and math college-level courses dependent upon the method of course placement for all students in the sample and among students in different demographic groups based on the results of RQ1?

Hypothesis 1: Semester-to-semester persistence is not dependent on the method of course placement in the first attempted college-level English courses for all students in the sample and among demographic groups identified as having dependence in RQ1.

A Chi-Square analysis examined the relationship between semester-to-semester persistence, as defined by enrollment in at least one or more courses the spring semester following gateway English course, and the method of course placement. The analysis found a significant interdependence between semester-to-semester persistence and the method course placement in the gateway English courses $\chi^2(3, N=2{,}117) = 24.799$, $p=.000$. In Table 19, adjusted residuals above the z-critical value of 1.96 indicated differences in persistence – greater or less than chance proportions - based on placement method for gateway English courses. Developmental course progression showed significant less than chance proportions ($-3.7<-1.96$) of persistence. Conversely, multiple measures placement showed larger-than-chance proportions of persistence ($4.4>1.96$). There were no significant differences among placement test and SAT/ACT placement and persistence as all standardized residuals were below 1/-1.

Table 19

Persistence and Placement Method for Gateway English

Placement Method		Retained in Spring Yes	No	*Total*
DEV	Percent (*N*)	70.7%(290)	29.3%(120)	100.0%(410)
	Adjusted Residual	-3.7	3.7	
MM	Percent (*N*)	82.0%(738)	18.0%(162)	100.0%(900)
	Adjusted Residual	4.3	-4.3	
PT	Percent (*N*)	75.0%(516)	25.0%(172)	100.0%(688)
	Adjusted Residual	-1.9	1.9	
SAT/ACT	Percent (*N*)	81.5%(97)	18.5%(22)	100.0%(119)
	Adjusted Residual	1.1	-1.1	
Total	Percent (*N*)	77.5%(1641)	22.5%(476)	100.0%(2,117)

Table 20 provides the percentages and adjusted residuals of persistence and placement method by race/ethnicity. A Chi-Square analysis found persistence and method of course placement based on race/ethnicity were interdependent among White students in gateway English courses $\chi^2(3, N = 1{,}563) = 19.073$, p=.000. This relationship may be attributed to the greater proportion of course success in gateway English courses following developmental course progression among White students (3.4>1.96). Among Hispanic students who were placed by placement test, persistence was lower than expected by chance (-2.5<-1.96). In Table 20, adjusted residuals above the *z*-critical value of 1.96 indicated significant differences in observed versus expected proportions of persistence based on placement method by race/ethnicity.

Table 20

Persistence and Placement Method by Race/Ethnicity, Gateway English

Race/Ethnicity	Placement Method		Retained: Yes	Retained: No	*Total*
White	DEV	Percent (*N*)	70.0%(172)	30.0%(74)	100.0%(247)
		Adjusted Residual	3.4	-3.4	
	MM	Percent (*N*)	82.5%(572)	17.5%(121)	100.0%(693)
		Adjusted Residual	-1.3	1.3	
	PT	Percent (*N*)	76.7%(396)	23.3%(120)	100.0%(516)
		Adjusted Residual	0.9	-0.9	
	SAT/ACT	Percent (*N*)	82.2%(88)	17.8%(19)	100.0%(107)
		Adjusted Residual	0.2	-0.2	
	Total	Percent (*N*)	78.6%(1229)	21.4(334)	100.0%(1,563)
Black	DEV	Percent (*N*)	65.7%(69)	34.3%(26)	100.0%(105)
		Adjusted Residual	-1.2	1.2	
	MM	Percent (*N*)	75.7%(84)	24.3%(27)	100.0%(111)
		Adjusted Residual	1.6	-1.6	
	PT	Percent (*N*)	69.2%(72)	30.8%(32)	100.0%(104)
		Adjusted Residual	-0.2	0.2	
	SAT/ACT	Percent (*N*)	62.5%(5)	37.5%(3)	100.0%(8)
		Adjusted Residual	-0.5	0.5	
	Total	Percent (*N*)	58.6%(230)	41.4%(98)	100.0%(328)
Hispanic	DEV	Percent (*N*)	82.8%(48)	17.2%(10)	100.0%(58)
		Adjusted Residual	0.5	-0.5	
	MM	Percent (*N*)	85.4%(82)	14.06%(14)	100.0%(96)
		Adjusted Residual	1.6	-1.6	
	PT	Percent (*N*)	70.6%(48)	29.4%(20)	100.0%(68)
		Adjusted Residual	-2.5	2.5	
	SAT/ACT	Percent (*N*)	100.0%(4)	0%(0)	100.0%(4)
		Adjusted Residual	1.0	-1.0	
	Total	Percent (*N*)	80.5%(182)	19.5%(44)	100.0%(226)
TOTAL		Percent (*N*)	77.5%(1,641)	22.5%(476)	100.0%(2,117)

Semester-to-semester persistence based upon Pell Grant eligibility was significant among students who did not receive the Pell Grant $\chi^2(3, N=400) = 11.529$, $p=.009$ and for students who did receive the Pell Grant $\chi^2(3, N=1{,}276) = 10.953$, $p=.012$. Students who did not receive the Pell Grant were more likely to persist the following semester than

students who received the Pell Grant and about more likely to persist than students who did not submit a FAFSA application. Students ineligible for FAFSA demonstrated the greatest persistence, but a significant number of students did not complete the FAFSA, so no information exists about the socio-economic status of these students to relate to their persistence in the spring.

In Table 21, adjusted residuals above the z-critical value of 1.96 indicated differences in persistence - greater or less than chance proportions - based on placement method for gateway English courses by Pell Grant eligibility. Students who were eligible (-2.4<-1.96) and ineligible (-2.5<-1.96) for Pell Grants showed smaller-than-chance proportions of persistence. Pell Grant eligible students who were placed by multiple measures placement had greater- than-chance proportions of persistence (2.9>1.96). There were no significant differences among persistence and placement method among students who did not complete the FAFSA as all standardized residuals were below 1/-1.

Table 21

Persistence and Placement Method by Pell Grant Eligibility, Gateway English

Pell Eligibility	Placement Method		Retained: Yes	Retained: No	*Total*
Did Not Complete FAFSA	DEV	Percent (*N*)	69.9%(51)	30.1%(22)	100.0%(73)
		Adjusted Residual	-1.4	1.4	
	MM	Percent (*N*)	80.9%(144)	19.1%(34)	100.0%(178)
		Adjusted Residual	1.8	-1.8	
	PT	Percent (*N*)	75.0%(102)	25.0%(34)	100.0%(136)
		Adjusted Residual	-0.5	0.5	
	SAT/ACT	Percent (*N*)	74.1%(40)	25.9%(14)	100.0%(54)
		Adjusted Residual	-0.4	0.4	
	Total	Percent (*N*)	76.4%(337)	23.6%(104)	100.0%(441)
(Yes) Pell Eligible	DEV	Percent (*N*)	70.6%(199)	29.4%(83)	100.0%(289)
		Adjusted Residual	-2.4	2.4	
	MM	Percent (*N*)	80.2%(408)	19.8%(101)	100.0%(509)
		Adjusted Residual	2.9	-2.9	
	PT	Percent (*N*)	73.9%(331)	26.1%(117)	100.0%(448)
		Adjusted Residual	-1.2	1.2	
	SAT/ACT	Percent (*N*)	81.1%(30)	18.9%(7)	100.0%(37)
		Adjusted Residual	0.8	-0.8	
	Total	Percent (*N*)	75.9%(968)	24.1%(308)	100.0%(1,276)
(No) Pell Ineligible	DEV	Percent (*N*)	72.7%(40)	27.3%(15)	100.0%(55)
		Adjusted Residual	-2.5	2.5	
	MM	Percent (*N*)	87.3%(186)	12.7%(27)	100.0%(213)
		Adjusted Residual	1.9	-1.9	
	PT	Percent (*N*)	79.8%(83)	20.2%(21)	100.0%(104)
		Adjusted Residual	-1.4	1.4	
	SAT/ACT	Percent (*N*)	96.4%(27)	3.6%(1)	100.0%(28)
		Adjusted Residual	1.9	-1.9	
	Total	Percent (*N*)	84.0%(336)	16.0%(64)	100.0%(400)
TOTAL		Percent (*N*)	77.5%(1,641)	22.5%(476)	100.0%(2,117)

Hypothesis 2: Semester-to-semester persistence is not dependent on the method of course placement in the first attempted college-level math courses for all students in the sample and among demographic groups identified as having dependence in RQ1.

A Chi-Square examined the relationship between semester-to-semester persistence, as defined by enrollment in at least one or more courses the spring semester following gateway math course, and the method of course placement. The analysis found a significant interdependence between semester-to-semester persistence and the method course placement in the gateway math courses $\chi^2(3, N=1{,}403) = 24.085$, $p=.000$. Students placed by multiple measures demonstrated the greatest frequency of persistence; they were 9.4% more likely to persist than students placed by placement testing and 12.7% more likely to persist than students placed by developmental course progression. SAT/ACT placed students persisted in 77.3% of observations, but the sample size was small and is not a representative of typical course placement at the institution. The null hypothesis was rejected.

In Table 22, adjusted residuals above the z-critical value of 1.96 indicated differences greater or less-than proportions in persistence based on placement method for gateway math courses. Developmental course progression showed significant less than chance proportions of persistence (-3.8<-1.96). Conversely, multiple measures placement showed larger-than-chance proportions of persistence (4.6>1.96). There were no significant differences among placement test and SAT/ACT placement and persistence as all standardized residuals were below 1/-1.

Table 22

Persistence and Placement Method for Gateway Math

Placement Method		Retained in Spring Yes	No	*Total*
DEV	Percent (*N*)	69.7%(347)	30.3%(151)	100.0%(498)
	Adjusted Residual	-3.8	3.8	
MM	Percent (*N*)	82.4%(440)	17.6%(94)	100.0%(534)
	Adjusted Residual	4.6	-4.6	
PT	Percent (*N*)	73.0%(216)	27.0%(80)	100.0%(296)
	Adjusted Residual	-1.2	1.2	
SAT/ACT	Percent (*N*)	77.3%(58)	22.7%(17)	100.0%(75)
	Adjusted Residual	0.4	-0.4	
Total	Percent (*N*)	75.6%(1,061)	24.4%(342)	100.0%(1,403)

Based on the Chi-Square analysis, semester-to-semester persistence and method of placement in gateway mathematics courses based on race/ethnicity was significant $\chi^2(3, N=1403) = 1.925$, $p=.000$. Significance was found among White students $\chi^2(3, N=1047) = 16.936$, $p=.001$ and among Black students $\chi^2(3, N=197) = 8.089$, $p=.044$.

Table 20 provides the percentages and adjusted residuals of persistence and placement method by race/ethnicity. Adjusted standardized residuals above the z-critical value of 1.96 indicated significant differences in the proportions of participants in persistence and placement method based on race/ethnicity for gateway math courses. For developmental course placement, fewer White (-2.6<-1.96) and Black students (-2.5<-1.96) were retained as expected by chance; additionally, fewer White students than expected who were placed by placement test were retained the following semester. Among White students, a larger-than-chance proportion of students retained were placed by multiple measures (3.9>1.96). There were no differences in persistence by method of placement among Hispanic students; all standardized residuals were below 1/-1.

Table 23

Persistence and Placement Method by Race/Ethnicity, Gateway Math

Race/ Ethnicity	Placement Method	Percent(Count)	Retained: Yes	Retained: No	*Total*
White	DEV	Percent (*N*)	72.6%(244)	27.4%(101)	100.0%(345)
		Adjusted Residual	-2.6	2.6	
	MM	Percent (*N*)	82.0%(341)	18.0%(75)	100.0%(416)
		Adjusted Residual	3.9	-3.9	
	PT	Percent (*N*)	70.5%(153)	29.5%(64)	100.0%(217)
		Adjusted Residual	-2.0	2.0	
	SAT/ACT	Percent (*N*)	78.3%(54)	21.7%(15)	100.0%(217)
		Adjusted Residual	0.5	-0.5	
	Total	Percent (*N*)	75.6%(792)	24.4%(255)	100.0%(1047)
Black	DEV	Percent (*N*)	64.1%(59)	35.9%(33)	100.0%(92)
		Adjusted Residual	-2.5	2.5	
	MM	Percent (*N*)	81.0%(47)	19.0%(11)	100.0%(58)
		Adjusted Residual	1.7	-1.7	
	PT	Percent (*N*)	81.4%(35)	18.6%(8)	100.0%(43)
		Adjusted Residual	1.5	-1.5	
	SAT/ACT	Percent (*N*)	50.0%(2)	50.0%(2)	100.0%(4)
		Adjusted Residual	-1.0	1.0	
	Total	Percent (*N*)	72.6%(143)	27.4%(54)	100.0%(197)
Hispanic	DEV	Percent (*N*)	72.1%(44)	27.9%(17)	100.0%(61)
		Adjusted Residual	-1.7	1.7	
	MM	Percent (*N*)	86.7%(52)	13.3%(8)	100.0%(60)
		Adjusted Residual	1.8	-1.8	
	PT	Percent (*N*)	77.8%(28)	22.2%(8)	100.0%(36)
		Adjusted Residual	-0.2	0.2	
	SAT/ACT	Percent (*N*)	100.0%(2)	0.0%(0)	100.0%(2)
		Adjusted Residual	0.7	-0.7	
TOTAL		Percent (*N*)	79.2%(126)	20.8%(33)	100.0%(159)

According to the Chi-Square analysis, semester-to-semester persistence and the method of course placement was not significant based on Pell Grant eligibility for gateway math courses $\chi^2(2, N=1{,}477) = 1.925$, $p=.382$. There were no differences among

persistence and method of placement by Pell Grant Eligibility in gateway math as all standardized residuals were below 1/-1.

Table 24

Persistence and Placement Method by Pell Grant Eligibility, Gateway Math

Pell Eligibility	Placement Method	Percent(Count)	Retention: Yes	Retention: No	*Total*
Did Not Complete FAFSA	DEV	Percent (*N*)	72.9%(94)	27.1%(35)	100.0%(129)
		Adjusted Residual	-1.5	1.5	
	MM	Percent (*N*)	72.9%(76)	27.1%(20)	100.0%(96)
		Adjusted Residual	0.5	-0.5	
	PT	Percent (*N*)	76.3%(58)	23.7%(18)	100.0%(76)
		Adjusted Residual	-0.2	0.2	
	SAT/ACT	Percent (*N*)	93.1%(27)	6.9%(2)	100.0%(29)
		Adjusted Residual	2.1	-2.1	
	Total	Percent (*N*)	77.3%(255)	22.7%(75)	100.0%(299)
(Yes) Pell Eligible	DEV	Percent (*N*)	67.2%(201)	32.8%(98)	100.0%(289)
		Adjusted Residual	-3.3	3.3	
	MM	Percent (*N*)	81.5%(256)	18.5%(58)	100.0%(314)
		Adjusted Residual	3.9	-3.9	
	PT	Percent (*N*)	73.7%(137)	26.3%(49)	100.0%(186)
		Adjusted Residual	-0.1	0.1	
	SAT/ACT	Percent (*N*)	64.3%(18)	35.7%(10)	100.0%(28)
		Adjusted Residual	-1.2	1.2	
	Total	Percent (*N*)	74.0%(612)	26.0%(215)	100.0%(827)
(No) Pell Ineligible	DEV	Percent (*N*)	74.3%(52)	25.7%(18)	100.0%(70)
		Adjusted Residual	-1.1	1.1	
	MM	Percent (*N*)	87.1%(108)	12.9%(16)	100.0%(124)
		Adjusted Residual	3.2	-3.2	
	PT	Percent (*N*)	61.8%(21)	38.2%(13)	100.0%(34)
		Adjusted Residual	-2.6	2.6	
	SAT/ACT	Percent (*N*)	72.2%(13)	27.8%(5)	100.0%(18)
		Adjusted Residual	-0.7	0.7	
	Total	Percent (*N*)	78.9%(194)	21.1%(52)	100.0%(246)
TOTAL		Percent (N)	75.6%(1,061)	24.4%(342)	100.0%(1,403)

Summary

While students' course success and persistence are based upon a variety of internal and external variables, course placement is a variable that colleges can analyze and adjust to ensure students are placed using the most accurate student information. This study examined four different methods of course placement: developmental course progression, placement testing, multiple measures, and SAT/ACT scores. The Chi-Square analyses for this study found dependence between method of course placement and student race/ethnicity, as well as Pell Grant eligibility (Table 25). The study further found dependence between method of course placement and course success, as well as semester-to-semester persistence (Table 26).

Table 25

Summary of Course Success and Persistence by Placement Method and Demographic Variables

Demographic Variables	Course Success: English	Persistence: English	Course Success: Math	Persistence: Math
White	SAT/ACT (+)	DEV (+)	SAT/ACT (+)	DEV (-) MM (+) PT (-)
Black	DEV (-)			DEV (-)
Hispanic	PT (-)	PT (-)	PT (+)	
No FAFSA Information Available			SAT/ACT (+)	SAT/ACT (+)
(Yes) Pell Eligible	DEV (-) SAT/ACT (+)	DEV (-) MM (+)		DEV (-) MM (+)
(No) Pell Ineligible	MM (-) SAT/ACT (+)	DEV (-)		MM (-) PT (-)

This table describes a summary of course success and persistence based on placement method by demographic variables of race/ethnicity and Pell Grant eligibility. The + sign indicated greater than the expected number of students, and the – sign indicated a less than the expected number of students who experienced course success and persistence based on the method of placement into gateway English and math courses.

Table 26

Frequencies of Course Success and Persistence by Placement Method

Placement Method	+ Greater Than Expected Frequency of Success and Persistence	- Less than Expected Frequency of Success and Persistence	*Total*
DEV	1	7	8
MM	3	2	5
PT	1	4	5
SAT/ACT	6	0	6
Total	11	13	24

This table describes the frequencies of course success and persistence based on placement method from Table 25. The + sign indicated greater than expected course success and persistence, and the – sign indicated less than the expected frequencies of course success and persistence based on the method of placement in gateway English and math courses.

Students' course success and persistence differed among the various methods of placement. The findings of this study suggested that course placement by developmental course progression was associated with less course success, especially among Black students and students eligible for Pell Grants (Table 25). Greater course success was related to course placement by SAT/ACT (Table 26), especially among White students and those eligible and ineligible for Pell Grants. Among Hispanic students, however, greater course success was associated with placement by placement testing.

In addition to less course success, developmental course progression was also associated with less persistence among White and Black students and students who were both eligible and ineligible for Pell Grants. Greater persistence was associated with

students placed by the SAT/ACT and multiple measures. Placement testing was negatively related to persistence in gateway English courses among Hispanic students.

Chapter V summarizes the study and discusses the findings in greater detail. Conclusions and recommendations for practice are offered, as well as suggestions for future research.

CHAPTER V: DISCUSSION

Introduction

Two-year colleges are unique institutions that enhance communities by providing open-access education that furthers students' careers, professional credentials, and personal development. Open-access ensures college enrollment for all students aged 18 and older despite previous academic performance. Accessibility is only beneficial, however, if students enroll in courses suited to their academic skills and abilities. Course placement, therefore, is among the most important objectives in ensuring students' success and persistence (Belfield & Crosta, 2012). Errors in course placement negatively impact student success and persistence because courses are either too difficult for students to succeed or too easy and cumbersome that students become disinterested or impeded; in either case, students are less likely to persist if they are inaccurately placed (Adams et al., 2009). Researchers vary on the most effective method of placing students in college-level courses, however, which has policy implications that affect students and institutions.

Placement testing is still the most commonly used method of course placement at most community colleges, and many developmental education researchers and instructors support standardized placement testing as an accurate method of determining college readiness (Boylan, 2002). Other researchers, however, contend that a single test score does not provide a sufficient assessment of students' abilities (Armstrong 2000; Scott-

Clayton, 2012). They maintain that study skills, determination, and persistence are factors equally as important as academic ability that are not measured by placement tests. These researchers support the use of other student information, like high school transcripts and high school GPA, to determine if students would benefit from developmental education or if they are college-ready (Sedlacek, 2004).

Open-access to college courses is not always equitable among student demographic groups. Over half of community college students who take placement tests are referred for developmental coursework; many of these students are minority and/or Pell Grant eligible (Long & Calcagno, 2010). State and college leaders believe this number is disproportional to the number of students who are actually in need of developmental education, however (Parsad, et al., 2003). Researchers, like Michaelides (2005), agreed citing that placement tests inaccurately placed up to 33% of students. Inaccurate placement is costly for students and states alike. Unnecessary developmental courses cost students additional time and money because credits do not count toward graduation requirements and may take students up to two-years of additional coursework depending on the level of deficiency. Additionally, state leaders question the need to provide high school-level curricula once in high school and again at the community college. Many states, like North Carolina, have challenged community colleges to expand placement methods to include high school GPA to expedite direct placement into credit bearing courses for more students.

Summary of the Study

This study investigated various course placement methods used to place students into curriculum-level mathematics and English courses at one medium-sized suburban

community college in North Carolina. The course placement options utilized by the College were placement testing, developmental course progression, SAT/ACT, and the most recently adopted placement, multiple measures placement. Multiple measures was an effort on the part of the North Carolina Community College System (NCCCS) to increase direct placement into credit bearing coursework but has only been in place since Fall 2016. Students in the sample identified as White, Black, and Hispanic and were between 18 to 25-years of age at the time they were enrolled in their first attempted gateway English or mathematics course.

The study examined whether the method of course placement for the first attempted English and mathematics courses related to student demographic variables of gender, race/ethnicity, and Pell Grant eligibility. The study also analyzed whether course success and semester-to-semester persistence in the first attempted English and mathematics college-level courses were dependent upon course placement methods for all students in the sample and for demographic groups that indicated interdependence. Findings for this study inform colleges' decisions on course placement policy and practice.

Interpretations and Findings

Placement testing has traditionally been the preferred method of course placement at community colleges due to its efficiency and objective results (Kowski, 2013; Scott-Clayton, 2012); two-year colleges have recently begun incorporating additional inputs to determine college-readiness, however. This study found, that since North Carolina began the implementation of the multiple measures policy in Fall 2013, multiple measures placement was used more frequently to place students who had graduated high school

within five-years of enrolling at the College, especially for gateway English course placement.

Hughes and Scott-Clayton's (2011) study found more than half of students placed by testing were referred for developmental coursework. Although this study observed fewer than half of students entered into college-level courses by way of developmental education, developmental course progression was the second most common method of placement for math and the third most used method for English placement. Eighteen percent of English students and 33% of math students still placed into gateway courses through developmental course progression despite the implementation of multiple measures. This would indicate these students did not come to the College with a high school GPA of 2.6 or higher or that they had not taken the requisite math courses in high school in cases of math placement. Students who did not have the necessary GPA for direct placement were more likely to require developmental course progression in math than in English.

The least utilized method of placement in this study was SAT/ACT scores, which was not surprising because community college students are not required to have SAT/ACT scores for admission. Fewer than 5% submitted SAT/ACT scores in lieu of high school GPA or placement test scores to determine college-level readiness. Though fewer students were directly placed using this method, those who did demonstrated the greatest course success and persistence.

Demographic categories of gender, race and ethnicity, and socio-economic status are pertinent to study of community college student success and persistence. Bailey et al. (2005) noted that students who identified as female were at higher risk for attrition at

community colleges, but the findings of this study indicated that course placement was not dependent upon gender; course placement was dependent, however, upon the demographic variables of race/ethnicity and Pell grant eligibility. Hoachlander, et al. (2003), as well as Long and Calcagno (2008), also found the demographic variables of race/ethnicity and socio-economic status as factors that place students at a higher risk of non-completion. Results of this study further found that course success and semester-to-semester persistence were dependent upon method of placement. These findings were consistent with other studies that observed relationships between method of placement and course success, as well as persistence (Belfield & Crosta, 2012; Burley et al., 2001; Scott-Clayton, 2012). Developmental course progression has long been associated with lower levels of success and persistence, whereas direct placements, like high school GPA or SAT/ACT, have been correlated with greater course success and persistence (Adams et al., 2009; Ngo & Kwon, 2014).

Course Placement Method and Success

This study found course success, as demonstrated by a final grade of C or higher in the gateway math or English course, was dependent upon method of placement. The dependency identified by the researcher may result from the significant course success of students placed by the SAT/ACT. Though the sample size was too small to generalize the results, students placed by the SAT/ACT experienced greater success in gateway math and English courses than students placed by other methods. This study disagreed with the findings of Hiss and Franks (2014) which found no difference in academic performance between students who submitted SAT/ACT scores and those who did not.

The rate of course success was similar between multiple measures and placement testing in gateway English and math courses. Course success rates between the two placement methods differed only slightly. Other researchers have found similar findings thus suggesting that high school GPA is an accurate representation of students' ability to experience success in college-level English and math courses (Adelman, 1999; Belfield & Crosta, 2012). Course success was similar between students placed by placement testing and multiple measures placement, especially in gateway English courses. These findings support Ngo et al.'s (2013) findings that students placed by multiple measures perform similarly to that of their peers and that placement based upon students' prior math achievements and high school GPA indicated prospective course success (Melguizo et al., 2013).

According to results of the study, students placed by developmental course progression were least successful in gateway math and English courses. Developmental course progression was more common for gateway math placement than for gateway English courses. This is not unlike the findings of other studies, which suggest developmental course placement leads to increased dropout rates and decreased motivation following developmental course progression (Grubb, 2013). Students placed into gateway English and math courses by developmental course progression were less likely to experience success in gateway courses than students placed by other placement methods and were least likely to re-enroll the following semester. The need for and lack of success in developmental courses may be due to subjective assessments and inflated grades in high school resulting in subpar graduation credentials (Adelman, 2006).

The U. S. Department of Education reported disproportionate numbers of minority students in developmental course sequences (NCES, 2009). This study supported those findings citing a relationship between course success and method of placement by race/ethnicity. This study found that students identifying as White and Hispanic were more likely to be placed directly into gateway English courses by multiple measures than students who identified as Black. In gateway math courses, White students were placed into math mostly by multiple measures more often than students who identified as Black. Hispanic students placed into math by developmental course progression but only marginally; otherwise, they were placed into gateway math courses by multiple measures. This study found minority students, especially students who identified as Black, were more likely to place into college-level courses by developmental course progression. This suggests a disparity in direct access to college-level courses based on method of placement by race/ethnicity.

The SAT/ACT was the placement method most associated with course success for all race/ethnic groups, but, again, this placement is uncommon at community colleges. Among Black and White students in gateway English and math courses, placement testing and multiple measures were nearly equivalent in their association with course success outcomes. Although developmental course progression is often perceived as an obstacle (Complete College America, 2012), among Hispanic students in the study, developmental course progression was associated with the greatest percentage of course success. Bettinger and Long (2005) reported similar findings citing positive outcomes from developmental course progression but more so in gateway math courses. For all race/ethnic groups in the study, placement testing was most often associated with course

success, which is consistent with other research findings (Hughes & Scott-Clayton, 2011).

Research has pointed to disparities among minority students and course placement. Bailey et al. (2010) found disproportionality lower course success rates among non-White students and particularly among Black students. Wolfle and Williams (2014) indicated similar findings; their study reported that Black students were 42.6% less likely to persist as a non-Black student and that other non-White ethnicities are 29% more likely to persist than are members of White and Black ethnicities. This inequality is often attributed to the disproportional number of minority students in developmental course sequences and the diminished success and persistence associated with developmental course progression (Complete College America, 2012).

Research has indicated that students who spend additional time in developmental courses were more likely to experience decreased course success due to the additional time spent in the non-credit courses (Perkins, 2004). This study found Black and Hispanic students were more likely than White students to be placed into college-level courses by developmental course progression; these placement findings by race/ethnicity are similar to those reported by Long and Calcagno (2010). Among White students multiple measures was the placement most associated with persistence

One of the key goals of multiple measures placement was to place a greater number of students, especially from populations identified as at-risk for non-completion, directly into college-level courses (Multiple Measures Assessment Project Research Team, 2014). Because multiple measures placement is reflective of high school grades and academic performance, a greater awareness and focus on GPA among high school

students might improve more students' GPAs and increase direct placement through multiple measures diminishing the need for developmental courses for students coming to the community college from high school.

This study included three categories for Pell Grant eligibility: Pell Grant eligible, Pell Grant ineligible, and Did Not Complete FAFSA. For purposes of this study, Pell Grant eligibility was a proxy for socio-economic status. The category "did not complete FAFSA" indicated the student did not complete a FAFSA application for the Pell Grant, so no financial information was known about the student. The study identified a relationship between course success and Pell Grant eligibility among students who were both eligible and ineligible to receive the Pell Grant for gateway English courses. In gateway math courses, a relationship was found between course success and SAT/ACT placement among students who did not complete the FAFSA application.

The findings of this study were similar to the findings of Long and Calcagno (2010) in that Pell Grant recipients experienced less frequent course success and persistence than students who were ineligible for Pell and for students who did not complete the FAFSA. Ross et al. (2012) reported that students from the lowest financial quartile were less likely to earn a degree than their peers. Students who did not receive the Pell Grant were more likely to be successful in gateway English and mathematics. Students who did not complete the FAFSA were slightly more successful than students who received Pell, but since the FAFSA was not completed, students' socio-economic status is unknown. McKinney and Novak (2015) described characteristics of students who elect not to complete the FAFSA application; they are most often male and have no dependents other than a spouse. They are typically over 24-years of age, employed part-

time while attending community college, and earn more than $10,000 per year. They may, however, be hesitant to provide personal identifying information or did not think they would qualify due to earned income or residency status.

Students who were ineligible for Pell Grants experienced greater course success and persistence, but this may be attributed to greater access to resources and academic readiness (Ross et al., 2012). Pell ineligible students were more likely to re-enroll the following semester than students who received the Pell Grant and more likely to re-enroll than students who did not submit a FAFSA application. Students eligible for the Pell Grant were less likely to experience course success in gateway math and English courses. Hoachlander et al. (2003) had similar findings attributing low or stagnant completion rates to students who experienced financial challenges while in college.

Course Placement Method and Persistence

Persistence is a national focus of community colleges because graduation rates at community colleges are especially low (U.S. Department of Education, 2009). This study found persistence, as demonstrated by enrollment in the spring semester following the gateway math or English course, was dependent upon method of course placement in gateway math and English courses. Findings indicated that placement by multiple measures resulted in the greatest persistence as evidenced by enrollment in the spring semester. This finding is consistent with other studies that maintain that GPA is strongly predictive of academic proficiency, as well as motivation and perseverance (Bowen et al., 2009; Scott-Clayton, 2012).

This study found developmental course progression to have the lowest persistence among the College's placement methods. Persistence is often low among community

college students in general, but academic and social challenges places students at even greater risk for attrition (Calcagno & Long, 2008). The findings for this study were reflective of other studies that examined course placement and student persistence (Complete College America, 2012; Grubb, 2013). A study by Smith (2014) found just one of every three students who completed developmental course progression was continuously enrolled in courses the second year. The findings of higher attrition among students placed by developmental course progression has been recognized by other researchers, as well; Adams et al. (2009) found course success and completion were at risk when students were encumbered by excessive coursework.

A key concern surrounding the implementation of multiple measures was placement accuracy. However, students placed by multiple measures experienced comparable levels of course success when compared with placement testing and were retained more often than students placed by placement testing and developmental course progression. Though some critics of multiple measures placement insist that high school standards are often misaligned with college expectations (Venezia et al., 2003), this study reinforced studies whose findings suggested that high school GPA was strongly associated with college success and re-enrollment (Belfield & Crosta, 2012; Fralick, 1993; Scott-Clayton, 2012). Course success among students placed by multiple measures and placement testing was similar in gateway math and English courses. Multiple measures students, however, were retained at a higher rate than students placed by placement testing and more likely than developmental students to be retained the following spring.

In addition to reduced course success, graduation rates and continuous enrollment, or persistence, are often lower among community college students, especially among minority students who are prescribed developmental course sequences (Kastinas & Tollefson, 2009; NCES 2009). This study found semester-to-semester persistence was lower among Black students than White and Hispanic students, especially following gateway English courses. A greater number of Black students were placed by developmental course progression into gateway courses, however, which may contribute to the reduction in retention. Bailey et al. (2010) and Perkins (2004) found many developmental students never attempted the college-level course after completing a series of developmental courses and for students who took the gateway course, over half failed to complete a two-year degree within six years.

According to this study's findings, persistence related to the method of placement according to race/ethnicity. Following gateway English courses, White students showed greater persistence when placed by multiple measures placement and SAT/ACT. Black students had greater persistence rate when placed by multiple measures or placement testing. Hispanic students placed by SAT/ACT and placement testing demonstrated the greatest persistence. Following enrollment in gateway math courses, multiple measures placement was most associated with persistence for all race/ethnic groups.

Pell Grant eligibility, or socio-economic status, was associated with persistence according to the results of this study. Pell Grant eligibility was significant among students who did not receive the Pell Grant and among students who did receive the Pell Grant for gateway English courses. Students who did not receive the Pell Grant were more likely to remain continuously enrolled in the following semester than students who received the

Pell Grant and more likely to persist than students who did not submit a FAFSA application. Students ineligible for FAFSA demonstrated the greatest persistence, but around 18% of gateway English and math students did not complete the FAFSA, so no information exists about the socio-economic status of these students to correlate with their persistence in the spring. Similar to Long and Calcagno's (2010) findings, students who did not receive the Pell Grant were more likely to persist into the following semester. Because income is often associated with activities that promote college-readiness like access to quality schools and supplemental tutoring, the association between Pell Grant eligibility and persistence was somewhat anticipated.

Conclusions and Recommendations for Practice

The focus of this research was to examine the relationship between course success and persistence based on method of placement. There are many policy implications that can be considered based upon the finding of the study. The results showed that course success and persistence were similar among students placed by multiple measures and placement testing in both English and math gateway courses, though slightly more so in English gateway courses. According to the results of this study, multiple measures placement was positively associated with course success and persistence and was a comparable alternative to placement testing. Despite the multiple measures placement option, significant numbers of students are still referred for developmental course progression resulting in drop out rates, especially among demographic groups considered at-risk for attrition. According to this study, developmental course progression was strongly associated with less course success and persistence, especially among minority students and Pell Grant eligible students. Although these students seemingly have access

to college-level courses, the path of developmental course progression places them at higher risk for course failure and lack of persistence. While the concept of open-access appears democratic and unrestricted, the placement process challenges the field to consider whether access in this case results in viable opportunities for success.

The policy implications from these findings suggest that developmental course progression is not an optimal means of placement for gateway English or math courses; we must call into question the equity of placing more marginalized groups into a sequence that has less likelihood of moving toward completion/persistence. Creating awareness about the importance of high school GPA in relationship to college-level readiness is needed in high schools so that more students understand the importance of GPA and college placement prior to enrolling in college so fewer students are recommended for remediation. This awareness can be extended through partnerships and collaborations with local high schools to teach students how to monitor and improve their GPAs, thus preparing greater numbers of students for college-level courses upon enrollment at the community college.

Though community colleges cannot necessarily effect students' high school GPA prior to enrolling at the college, 2-year institutions can expand dual-enrollment programs on high school campuses to reach more students, especially those who are at-risk for developmental course progression. Currently, most 2-year schools offer only general education and vocational-based courses on high school campuses; students must go to community college campuses for remediation needs. If, however, colleges shifted the practice of remediation instruction access to high school campuses, students who demonstrated the need for developmental courses could complete developmental course

sequences while in high school and begin college-level coursework upon enrolment at the community college, thus increasing their likelihood for course success and persistence in college.

The purpose and policy surrounding the implementation of multiple measures placement was positive according to the findings of the study. Multiple measures course success outcomes aligned similarly to those of placement testing in gateway English and math courses and exceed persistence outcomes, but does not provide the equity that was intended to place more at-risk students directly into gateway courses. Minority and Pell Grant eligible students are still referred for remediation in greater numbers, which perpetuates the cycle of decreased course success and persistence. Future prospects for multiple measures placement are promising but must be expanded to include more minority and financially disadvantaged students through increased collaboration with high school faculty and students. This expansion might include the use of non-cognitive measures that are predictive of success, like adjustment, motivation, and perception, especially among minority and Pell Grant eligible students who are more likely to place into gateway courses through developmental course progression (Sedlacek, 2004).

In addition to the use of non-cognitive measures, institutions may explore pre-testing remediation to review students' basic skills prior to taking the placement test. Often students know more than they demonstrate on placement tests because they have not utilized the skills being assessed since high school (Bambrick-Santoyo, 2014). Reviewing the material prepares students in advance for the level of rigor expected on the placement test so that students can refresh their skills and improve deficiencies prior to taking the placement test. Many colleges have policies limiting the number of times

students are allowed to re-take placement tests each semester. Modifying this policy to allow students to test more frequently may alleviate some of the high-stakes anxiety associated with testing and increase students' capacity to exempt developmental course progression.

Around 22% of students in this study did not complete the FAFSA applicaton to receive the Pell Grant. Though students who were Pell Grant eligible were not as successful in gateway courses as their peers, Pell Grants can provide students with resources to help them reach their academic and career goals. Given the number of students who did not complete the FAFSA application, it could be implied that Pell Grant information should be provided in greater depth to high school students and community college students. Too often, students are told to complete the form online with little technical assistance. Financial aid workshops at community colleges and high schools can offer students accurate information about financial aid and assist students through the application process. Though the FAFSA process is shorter and more simplified, many students still require support to complete the process successfully. This study, along with others, found too many students did not take advantage of Pell Grant opportunities, which may increase their success and persistence through financial resources and support (McKinney & Novak, 2015).

Suggestions for Future Research

Placement is an issue of policy and practice at community colleges. Institutions want to implement placement policies that offer course access to the greatest number of students without requiring unnecessary coursework. Nevertheless, they want students to be successful in the courses they take and re-enroll in subsequent semesters. Colleges

understand that students experience success or failure for a variety of reasons, and the method of course placement alone does not uniquely explain course success and persistence outcomes (Bostian, 2012; Scott-Clayton, 2012); however, accurate placement does provide students an appropriate academic foundation from which to begin (Boylan, 2002). Because developmental courses are associated with less course success and persistence, ancillary methods may decrease the number of students requiring developmental course sequences.

In an effort to decrease the number of developmental course progression placements, colleges could look at combining existing placement methods for a more holistic and personalized approach to course placement. Some research shows that even non-cognitive measures are useful in determining college readiness, especially for low-income and minority students, who are most likely to progress into gateway courses through developmental course progression (Sedlacek 2004). Due to the number of students who experience gateway course failure and lack of persistence following developmental course progression, research points to identifying alternative or supplementary placement methods for students who do not meet pre-requisites under multiple measures, placement test, or SAT/ACT may grant increased access to gateway courses, especially among minority and Pell Grant eligible students.

This study found that course success and persistence varied based on placement by race/ethnicity and Pell Grant eligibility. An additional prospect for future research might further examine the heterogeneous effects of various placement methods on demographic groups. Safran and Visher (2010) noted that a system of placement that works effectively for one population may not be as accurate for other student populations.

By identifying groups of students for whom placement methods are helping or delaying course progression and persistence, college leaders and policymakers can modify and continue to expand placement methods that expedite students' academic progression. Based on the literature review and findings of this study, developmental course progression is associated with less course success; this is believed to be due to the increased time required by students before they ever reach the gateway course (Long & Calcagno, 2010).

Research findings in the study suggested that developmental course progression was negatively associated with course success and persistence. For students required to take developmental coursework, however, future research may experiment with variations of course placement supplemental alternatives in which an indirect placement in developmental education is augmented with the corresponding curriculum-level course. Often students who do not achieve the cut-off score but are close may especially benefit from direct placement in the college-level course if a lab or supplemental learning experience was included (Bailey, 2009). With the goal of decreasing the number of students needing developmental course sequences, further research focusing on marginal developmental placements may offer swifter pathways to curriculum courses for students who placed near the cut-off score.

Though multiple measures placement has increased direct access to gateway courses, not all demographic groups have benefited from the implementation. Multiple measures has exempted many students from taking the placement test, yet the placement test and multiple measures were comparable in course success and persistence. Placement

strategies to increase access among the least prepared students should be further examined to increase the success and persistence of underprepared students.

Summary

The mission of the North Carolina Community College System (NCCCS) (2015) is to "open the door to high-quality, accessible educational opportunities that minimize barriers to post-secondary education, maximize student success…and improve the lives and well-being of individuals." Access does not equal equity of access, however, and open-access that is not equitable does not truly offer all students the same opportunity to be successful. Though placement strategies have expanded to increase gateway course access, success and persistence continue to remain low among the students who are least prepared. Students who come to gateway courses through developmental course progression remain more likely to fail the gateway course and not persist the following semester.

Course placement is imperative to the mission of the NCCCS because it establishes students' first experiences with the college and affects their pathway to course success and degree completion. Determining the optimal course placement for students is essential to ensuring that students take the classes they need and for which they are prepared and avoiding barriers to success, like unnecessary coursework. Developing placement options that minimize the need for developmental coursework may offer students a greater chance to succeed in gateway math and English courses and re-enroll the following semester.

Institutions of higher education are continuing to experiment with placement methods to expedite students' direct placement into credit bearing course while ensuring

students who need developmental coursework receive the foundational help they need to be successful in college-level courses. Because a greater number of placement options are available to colleges, it is increasingly important that leaders and staff continue to examine the efficacy of various placement methods not just in specific subjects, like mathematics or English, but in how placement methods predict the success of specific student populations.

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Appendices

Appendix A: Sample ACCUPLACER Questions for Writing, Reading, and Mathematics

The following placement test questions represent a sampling of questions in the areas of writing, reading, and mathematics from the College Board's (2016) ACCUPLACER Sample Questions for Students.

Writing Sample Questions

Select the best version of the underlined part of the sentence. The first choice is the same as the original sentence. If you think the original sentence is best, choose the first answer.

1. Stamp collecting being a hobby that is sometimes used in the schools to teach economics and social studies.
A. being a hobby that is
B. is a hobby because it is
C. which is a hobby
D. is a hobby

2. Knocked sideways, the statue looked as if it would fall.
A. Knocked sideways, the statue looked
B. The statue was knocked sideways, looked
C. The statue looked knocked sideways
D. The statue, looking knocked sideways,

3. To walk, biking, and driving are Pat's favorite ways of getting around.
A. To walk, biking, and driving
B. Walking, biking, and driving
C. To walk, biking, and to drive
D. To walk, to bike, and also driving

4. When you cross the street in the middle of the block, this is an example of jaywalking.
A. When you cross the street in the middle of the block, this
B. You cross the street in the middle of the block, this
C. Crossing the street in the middle of the block
D. The fact that you cross the street in the middle of the block

5. Walking by the corner the other day, a child, I noticed, was watching for the light to change.

A. a child, I noticed, was watching
B. I noticed a child watching
C. a child was watching, I noticed,
D. there was, I noticed, a child watching

Reading Sample Questions

Read the statement or passage and then choose the best answer to the question. Answer the question based on what is stated or implied in the statement or passage.

1. In the words of Thomas De Quincey, "It is notorious that the memory strengthens as you lay burdens upon it." If ,like most people, you have trouble recalling the names of those you have just met, try this: The next time you are introduced, plan to remember the names. Say to yourself, "I'll listen carefully; I'll repeat each person's name to be sure I've got it, and I will remember." You'll discover how effective this technique is and probably recall those names for the rest of your life.

The quotation from De Quincey indicates that the memory

A. always operates at peak efficiency
B. breaks down under great strain
C. improves if it is used often
D. becomes unreliable if it tires

2. Unemployment was the overriding fact of life when Franklin D. Roosevelt became president of the United States on March 4, 1933. At the time, the government did not systematically collect statistics of joblessness; actually it did not start doing so until 1940. The Bureau of Labor Statistics later estimated that 12,830,000 persons were out of work in 1933, about one-fourth of a civilian labor force of more than 51 million. Roosevelt signed the Federal Emergency Relief Act on May 12, 1933. The president selected Harry L. Hopkins, who headed the New York relief program, to run FERA. A gifted administrator, Hopkins quickly put the program into high gear. He gathered a small staff in Washington and brought the state relief organizations into the FERA system. While the agency tried to provide all the necessities, food came first. City dwellers usually got an allowance for fuel, and rent for one month was provided in case of eviction.

This passage is primarily about

A. methods of estimating unemployment rates in the1930s
B. the effect of unemployment on United States families
C. President Franklin D. Roosevelt's presidency
D. the creation of President Roosevelt's FERA program

Mathematics Sample Questions: Arithmetic

For each of the questions below, choose the best answer from the four choices given. You may use the paper you received as scratch paper.

1. $2.75 + 0.003 + 0.158 =$

A. 0.436
B. 2.911
C. 2.938
D. 4.36

2. $7.86 \times 4.6 =$

A. 36.156
B. 36.216
C. 351.56
D. 361.56

3. 7/20=

A. 0.035
B. 0.35
C. 0.858
D. 3.5

4. Which of the following is the least?

A. 0.105
B. 0.501
C. 0.015
D. 0.15

Mathematics Sample Questions: Elementary Algebra

For each of the questions below, choose the best answer from the four choices given. You may use the paper you received as scratch paper.

1. If A represents the number of apples purchased at 15 cents each, and B represents the number of bananas purchased at 10 cents each, which of the following represents the total value of the purchases in cents?

A. A + B
B. 25(A + B)
C. 10A + 15B
D. 15A + 10B

2. $\sqrt{2} \times \sqrt{15} = ?$

A. $\sqrt{17}$
B. $\sqrt{30}$
C. 17
D. 30

3. What is the value of the expression 2x2 + 3xy – 4y2 when x = 2 and y = –4?

A. –80
B. –32
C. 32
D. 80

Mathematics Sample Questions: College-Level Mathematics

For each of the questions below, choose the best answer from the five choices given. You may use the paper you received as scratch paper.

1. The graph of which of the following equations is a straight line parallel to the graph of y = 2x ?
A. 4x – y = 4
B. 2x – 2y = 2
C. 2x – y = 4
D. 2x + y = 2
E. x – 2y = 4

2 . An equation of the line that contains the origin and the point (1, 2) is

A. y = 2x
B. 2y = x
C. y = x – 1
D. y = 2x + 1
E. y/2 = x – 1

3. An apartment building contains 12 units consisting of one- and two-bedroom apartments that rent for $360 and $450 per month, respectively. When all units are rented, the total monthly rental is $4,950. What is the number of two-bedroom apartments?

A. 3
B. 4
C. 5
D. 6
E. 7