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Preparing New Jersey Community College Students for the Mathematics Placement Tests

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Walden University

College of Education

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Charles Edward Haas

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Walden University
2020

Abstract

Preparing New Jersey Community College Students for the Mathematics Placement Tests

by

Charles Edward Haas

MBA, Western Governors University, 2013

MA, Western Governors University, 2011

BS, Drexel University, 2003

Project Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Walden University

June 2020

Abstract

Although most new college students had to demonstrate algebraic and basic mathematics mastery to earn a high school diploma or the equivalent, the majority of incoming New Jersey community college students are not showing this knowledge on the mathematics placement tests, thus placing into developmental courses, which must be successfully completed before students can attempt any college-level mathematics courses. Guided by Knowles' theory of andragogy and developmental mathematics as a core concept, the purpose of this study was to determine ways to help incoming New Jersey community college students prepare for the ACCUPLACER mathematics tests. The research questions addressed testing and tutoring administrators' perceptions of how to help incoming students achieve higher scores on these assessments. This qualitative exploratory case study consisted primarily of interviews with 10 testing and tutoring administrators representing 6 of the 18 New Jersey community colleges. These colleges have programs to prepare students for the mathematics placement tests, and documents related to these programs were also reviewed. Interview transcripts and documents were coded for relevant themes by following the constant comparative method of Glaser and Strauss. Preparation availability, timing, constraint frustrations, student attendance/usage, and minimal intercollege consistency emerged as themes. A position/white paper with the results and recommendations was written and prepared for sharing with the New Jersey testing and tutoring administrator groups. The knowledge gained from this study will engender social change by helping incoming college students avoid developmental mathematics courses, saving the students time, money, and effort, as well as improving their chances of completing college programs and degrees.

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Dedication

This study is dedicated to my wife, Brooke, and our daughters, Cameron and Jordan.

Acknowledgments

Thank you to the faculty members, colleagues, family members, and friends who have helped me reach this point in my academic career. A special thank you to my chair, James Valadez, for guiding me through the final phase of my doctoral journey. The assistance of my other committee members, Stephen Butler and Tammy Hoffman, was greatly appreciated. The support of my supervisors over the years, particularly Gonzalo Perez, Robert Schreyer, Alexandra Salas, Danielle Zimecki-Fennimore, Diane Veneziale, Rosalyn Pierce, and Harriet Levin Millan, was invaluable. My staff, especially John Kashmer, Le Var Hylton, Amy Collins, Angela Frumin, Katie Gyenge, and Bernard Foyuth, have my eternal gratitude for keeping my departments running smoothly when I took time off to work on this study.

I am indebted to my many New Jersey higher education testing and tutoring colleagues, particularly R. Myung-In Kim and the many active participants in the New Jersey Test Administrators' Special Interest Group and the New Jersey Tutoring Administrator Group. It is also necessary to mention the Hamilton Free Public Library, which provided me with a quiet, distraction-free place to take "vacation days" from work.

Most importantly, my largest debt of appreciation goes to my family members, especially my parents, my wife, and my children. They never doubted I would finish, although my parents probably wish I would have called more often. When I started my initial class, my wife and I were a couple weeks shy of our first wedding anniversary. Seven years and two children later, my doctoral journey has finally reached a successful conclusion. I could not have done this without the love, patience, and understanding of my wife and daughters.

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Section 1: The Problem

The Local Problem

The state of New Jersey awarded $1,000,000 of College Readiness Now III grants to 17 New Jersey community colleges for use during the July 1, 2016 through June 30, 2017 grant cycle year in order to help graduating high school students become college-ready and avoid the burden of developmental classes in mathematics and English (Rogalski & Harrington, 2017). Factoring in the cost of credits at the New Jersey community colleges, a student who takes two developmental mathematics courses (in sequence or through repetition) adds over $1,000 dollars just in tuition and fees to the overall cost of his/her associate degree or certificate program. Developmental mathematics courses are barriers to program and degree completion and cost students extra money, time, and effort (Benken, Ramirez, Li, & Wetendorf, 2015; Hern, 2012; Jenkins & Cho, 2012).

R. Myung-In Kim directs a testing program at a New Jersey community college and runs the New Jersey Test Administrators' Special Interest Group (NJ TASIG), an affinity group of the New Jersey Council of County Colleges (NJCCC). According to Kim, the majority of incoming New Jersey community college students place into developmental mathematics courses due to their low scores on the mathematics placement tests. New Jersey community colleges transitioned from the classic ACCUPLACER tests to the next-generation ACCUPLACER tests in January 2019, and almost all schools replaced the classic ACCUPLACER Elementary Algebra with the next-generation ACCUPLACER Quantitative Reasoning, Algebra, and Statistics (QAS), which is the closest equivalent (NJ TASIG, 2018). The QAS essentially tests students on the same knowledge and skills as the classic Elementary Algebra with the addition of basic statistics (College Board, 2018). According to the NJ TASIG organizer, preliminary results from all New Jersey community colleges that had transitioned to the next-generation tests as of the Fall 2018 semester indicated that students were passing the next-generation QAS at similar or lower rates than the classic Elementary Algebra.

All degree-seeking community college students must pass at least one college-level mathematics course to graduate (Cohen, Brawer, & Kisker, 2014). The essential problem is that the majority of incoming students do not score highly enough on the ACCUPLACER Elementary Algebra or the ACCUPLACER QAS to place into college-level mathematics courses. Research regarding the effectiveness of the QAS is limited due to the recent transition from the classic ACCUPLACER to the next-generation ACCUPLACER during the 2018 to 2019 school year.

According to the College Board (2016), the organization that owns the exams, the ACCUPLACER Elementary Algebra "measures [a student's] ability to perform basic algebra operations and to solve problems using elementary algebra" (Elementary Algebra section, para. 1). The untimed computer-adaptive test consists of 12 multiple-choice questions divided into three types: operations with integers and rational numbers; operations with algebraic expressions; and solution of equations, inequalities, and word problems (College Board, 2016). The QAS is a reworked version of the Elementary Algebra; the QAS is a computer-adaptive test with 20 multiple-choice questions about rational numbers, ratio and proportional relationships, exponents, algebraic expressions, linear equations and applications, probability and sets, descriptive statistics, and geometry concepts (College Board, 2018). Essentially, the main difference is the addition of the statistics component.

According to Hughes and Scott-Clayton (2011), the ACCUPLACER Elementary Algebra "can reasonably be considered valid if the goal is to ensure minimum pass rates in college-level courses" (p. 19). Mattern and Packman (2009) conducted a meta-analysis (of 47 studies) to determine the validity of ACCUPLACER scores for course placement. The researchers found moderate-to-strong relationships between ACCUPLACER scores and subsequent course performance, demonstrating both operational and predictive validity for the tests, with a median accuracy rate of 73% for the ACCUPLACER Elementary Algebra with a C-or-higher criterion (Mattern & Packman, 2009). The ACCUPLACER Elementary Algebra should, therefore, be considered valid for course level placement. The QAS is still new, so research on it is still being conducted; preliminary research, however, indicates the QAS is similar to the Elementary Algebra (Chiantera, 2018).

Poor student performance on the ACCUPLACER Elementary Algebra or QAS is the core problem. When students achieve low scores on the mathematics placement tests, New Jersey community college placement rules stipulate that the students must enroll in developmental mathematics courses, which must be successfully completed before students can attempt any college-level mathematics courses. If a student cannot pass a developmental mathematics course, that student cannot take a college-level mathematics course and cannot graduate. Developmental mathematics courses are, therefore, barriers to retention and degree completion and, by extension, future employment and viability in the job market. Student retention is also important to New Jersey community college administrators because overall New Jersey community college enrollment dropped 21.4% from 2009 to 2018 (Nelson, 2019).

Multiple New Jersey community college administrators want to address this problem and plan to institute or redesign programs to help incoming students prepare for the placement test. In 2015, the New Jersey Center for Student Success released a brief page report to show how "New Jersey's community colleges are doing a number of things to help students brush up and prepare for the Accuplacer [sic] placement exam" (p. 1). The report was based upon in-depth scans of the websites of all 19 (at that time) community colleges. Every single college offered incoming students some type of ACCUPLACER test preparation. A couple years later, in October 2017, NJCCC released a report regarding the use of placement test scores at New Jersey community colleges, and in the report, the New Jersey community college presidents recognized the problem of developmental courses.

Rationale

Evidence of the Problem at the Local Level

The ACCUPLACER Elementary Algebra scaled score range is 20 to 120 (College Board, 2015, p. 17), and the ACCUPLACER QAS scaled score range is 200 to 300 (College Board, 2018, p. 9). Internal community college placement conversion tables detail mathematics course placement for students based on their ACCUPLACER scores. Students scoring below a certain level on the ACCUPLACER Elementary Algebra or

QAS are required to take developmental mathematics courses, with specific developmental level placement determined by the specific scores. Some colleges offer multiple options for developmental mathematics content delivery. At one college, for example, students may select between two course sequences: classroom/lecture (Pre-Algebra followed by Beginning Algebra) or computer lab (Foundations Math I followed by Foundations Math II).

Discussions with several administrators revealed that the high number of incoming students taking developmental mathematics courses is considered a major problem at New Jersey community colleges. According to one typical New Jersey community college's 2015 report to the state, 54.2% of all first-time, full-time students at the school were enrolled in English and/or mathematics developmental courses in the fall of 2014. Of these students, 32.5% took a math computation/pre-algebra course (Pre-Algebra or Foundations Math I), and 18.7% were enrolled in an elementary/introductory algebra course (Beginning Algebra or Foundations Math II). The data from the college's 2015 report to the state thus indicated that 27.8% (slightly more than 1 in 4) of all first-time, full-time students needed to take a developmental mathematics course that semester. Similar numbers can be seen at the other New Jersey community colleges.

Evidence of the Problem From the Professional Literature

Developmental mathematics itself is "a core community college challenge" (Asera, 2011, p. 28), and "the need to improve student success in community colleges has resulted in a growing interest in developmental mathematics" (Zientek, Fong, & Phelps, 2019, p. 183). Nearly 75% of incoming community college students (including both full-time and part-time students) need to take remedial coursework in mathematics and/or English (National Center for Public Policy and Higher Education and the Southern Regional Education Board, 2010). In a study of more than 250,000 incoming students at 57 colleges around the United States, Bailey, Jeong, and Cho (2010) found that almost 60% of these students placed into developmental mathematics courses. According to Okimoto and Heck (2015), more than 70% of incoming community college students are not ready for college-level mathematics. At the Borough of Manhattan Community College, for example, 72% of incoming students place into developmental mathematics classes due to their scores on the mathematics placement test (George & Milman, 2019, p. 29). Kerrigan (2015) recognized that college readiness was a major problem when reporting the results of the 2014 College Access Challenge Grant, which helped 18 (of the then 19) New Jersey community colleges to work with high school districts to improve high school student college readiness in mathematics, reading, and writing.

Community colleges traditionally offer developmental mathematics courses that are algebra-based (Mejia, Rodriguez, & Johnson, 2016). Although incoming New Jersey community college students hold either a high school diploma (or the equivalent), which required demonstration of algebraic and basic mathematics competency (Common Core State Standards Initiative, 2016; New Jersey Department of Education, 2014; Rosenstein, Caldwell, & Crown, 1996), a large portion of incoming community college students fail to demonstrate this competency on the ACCUPLACER Elementary Algebra or QAS, earning low scores that place them into developmental courses. According to Wilson (2011), "73% of the mathematics taught in colleges across the United States is really K-

12 mathematics" (p. 70). A disconnect clearly exists between students being able to demonstrate algebraic mastery to earn a high school diploma (or the equivalent) and later being able to demonstrate this mastery when taking the college placement test. The intent of this study was to determine how New Jersey community college testing and tutoring administrators think the New Jersey community colleges can help incoming students show sufficient mathematics mastery on the ACCUPLACER mathematics tests to place directly into college-level mathematics courses.

Definition of Terms

Community colleges: Open-access institutions that serve high school graduates and adult learners in a local region, typically offering 2-year associate degrees and certificate programs (American Association of Community Colleges, 2016; Lloyd Pfahl, McClenney, O'Banion, Gonzalez Sullivan, & Wilson, 2010).

Developmental mathematics courses: Also referred to as *remedial mathematics courses*, these lower-level mathematics courses are necessary when community college students are not prepared for college-level mathematics courses, with a typical developmental mathematics sequence beginning with arithmetic and continuing through several levels of algebra: pre-algebra, elementary algebra, and intermediate algebra (Stigler, Givvin, & Thompson, 2010).

Dropping out: When a student leaves school and never returns (Ginsberg & Wlodkowski, 2010).

Exit points: Times between courses (such as the potentially three or more in a developmental mathematics course sequence) when students can easily stop or drop out (Hern, 2012).

Stopping out: When a student incrementally works on schooling, taking breaks as necessary to handle issues such as “financial problems, health problems, or family problems” (Ginsberg & Wlodkowski, 2010, p. 28).

Significance of the Study

Institutions of higher learning educate students and help them earn the credentials and skills necessary for employment in the current and future job market. According to Quarles and Davis (2016), “a significant focus of efforts to improve community college success work is remedial (or developmental) education courses, which are nominally designed to give students the skills they need for college-level courses” (p. 34). Developmental mathematics courses cost students extra time, money, and effort (Barry & Dannenberg, 2016; Benken et al., 2015; Bonham & Boylan, 2011; Hern, 2012; Melguizo, Bos, & Prather, 2011; Stigler et al., 2010; Thornton, Case, & Peppers, 2019; Zachry Rutschow & Schneider, 2012; Zientek, Schneider, & Onwuegbuzie, 2014). Although Wheeler and Bray (2017) found that students who successfully completed developmental mathematics classes “did not perform significantly better or worse” in college-level mathematics courses than students who placed directly into the college-level mathematics courses (p. 14), many students are unsuccessful in passing their developmental courses. Developmental courses provide more opportunities for students to stop out or drop out and are stumbling blocks that keep many students from completing their programs of study (Abraham, Slate, Saxon, & Barnes, 2014; Asera, 2011; Benken et al., 2015; Bonham & Boylan, 2011; Bremer et al., 2013; Hern, 2012; Jenkins & Cho, 2012; Melguizo et al., 2011; Stigler et al., 2010; Zachry Rutschow & Schneider, 2012).

By not finishing degree/certificate programs, students can leave school without the necessary credentials to enter their chosen career fields, resulting in students losing income due to decreased job market viability. Students would also have wasted the money they spent on schooling. For institutions of higher learning, this problem translates to decreased retention and lower graduation rates (Abraham et al., 2014; Asera, 2011; Benken et al., 2015; Bonham & Boylan, 2011; Bremer et al., 2013; Hern, 2012; Jenkins & Cho, 2012; Melguizo et al., 2011; Stigler et al., 2010; Zachry Rutschow & Schneider, 2012; Zientek et al., 2014). If New Jersey community college employees can help incoming students show sufficient mathematics mastery on the ACCUPLACER mathematics tests to place directly into college-level mathematics courses, the students and colleges can avoid and/or minimize these developmental mathematics issues. In order to accomplish this goal of helping incoming students demonstrate mathematics mastery on the placement tests, it was necessary to solicit feedback about how to do so from New Jersey community college testing and tutoring administrators.

Research Questions

New Jersey community college administrators want students to achieve their educational goals. The schools' developmental mathematics courses are barriers to retention and degree/certificate completion, just as at community colleges in other states (Benken et al., 2015; Bonham & Boylan, 2011; Hern, 2012; Jenkins & Cho, 2012; Stigler et al., 2010). Most New Jersey community college students place into these courses due to low scores on the ACCUPLACER Elementary Algebra or QAS. Incoming New Jersey community college students hold either a high school diploma (or the equivalent), which requires demonstration of algebraic and basic mathematics competency (Common Core State Standards Initiative, 2016; New Jersey Department of Education, 2014; Rosenstein et al., 1996). Asera (2011) posited that many potential developmental mathematics students simply need a refresher of previously learned material or a boost in skills to bring them up to the college level. Zachry Rutschow and Schneider (2012) found promise in programs that help students avoid developmental mathematics courses.

Although administration of and research on summer bridge programs has been inconsistent, some programs have seen success raising students' abilities to the college level (Cabrera, Miner, & Milem, 2013; Frost & Dreher, 2017). In Summer 2015, a mathematics summer bridge program was launched at one New Jersey community college, offering a 9-hour mathematics course (spread out over 2 weeks) to incoming students who placed into developmental mathematics courses. In Summer 2016, the program was offered again, along with an English summer bridge program for incoming students who placed into developmental English courses. The bridge programs were designed to help students prepare to retake the mathematics and English sections of the ACCUPLACER. Internal reports from the school showed promising results. Other New Jersey community colleges offer similar programs in various formats, including brush-up classes and boot camps.

The purpose of this study was to determine ways to help incoming New Jersey community college students prepare for the ACCUPLACER mathematics tests in order to decrease developmental mathematics enrollment and increase college-level mathematics enrollment. The people best able to identify how to help these students are the staff members providing testing and tutoring services (i.e., those who administer the placement tests and those who provide academic assistance and test preparation, respectively). Because of this, I developed the research questions to focus on these staff members' perceptions of how to help incoming students achieve higher scores on the ACCUPLACER mathematics tests.

1. RQ1: What are testing administrators' perceptions of how to help incoming New Jersey community college students achieve high enough scores on the ACCUPLACER mathematics tests to place into college-level mathematics courses?
2. RQ2: What are tutoring administrators' perceptions of how to help incoming New Jersey community college students achieve high enough scores on the ACCUPLACER mathematics tests to place into college-level mathematics courses?

Review of the Literature

The issues faced by developmental mathematics students form the conceptual framework of this study. A review of the literature revealed that developmental mathematics students face three main issues: competing priorities, limited mathematics foundations, and mathematics anxiety. Developmental mathematics program design was also found to be important, as was the technology available for use with developmental mathematics students. Competing priorities, limited mathematics foundations, mathematics anxiety, program design, and available technology must all be considered when exploring how to help students prepare for the ACCUPLACER Elementary Algebra and QAS.

Conceptual Framework

Developmental mathematics was the core concept grounding this study. While the issues faced by developmental mathematics students specifically made up the conceptual framework, Knowles' theory of andragogy formed the theoretical underpinnings of this study. One of the central tenets of the theory is that adult learners bring their own experiences and prior learning into the classroom (Knowles, Holton, & Swanson, 1998). The keystone of the current study consisted of the understanding that most incoming New Jersey community college students have already demonstrated algebraic and basic mathematics mastery either through a high school program or the equivalent (Common Core State Standards Initiative, 2016; New Jersey Department of Education, 2014; Rosenstein et al., 1996). I conducted this study to determine how New Jersey community college testing and tutoring administrators think their colleges can use incoming students' experiences and knowledge (especially of the algebra and basic mathematics they already learned) to prepare for the ACCUPLACER Elementary Algebra or QAS.

The teaching and learning issues surrounding developmental mathematics students comprised the foundation of the conceptual framework and are discussed in greater detail later in this section. I initially collected relevant studies were initially collected while completing coursework in the current Walden University doctoral program from August 2013 through December 2015. The majority of resources were found via Google Scholar, which allowed for a search of all accessible databases, including those available through Walden University. Initial search terms were *developmental mathematics issues* and similar phrases. As issues were identified, each one was used as a search term, along with any similar variations (such as *developmental* and *remedial*). Some resources were shared with me by colleagues and peers involved in the teaching and/or administration of developmental mathematics programs, as well as colleagues and peers who work in the testing and tutoring departments at higher education institutions in New Jersey and around the country. Physical copies of the 2017, 2018, and 2019 issues of the *Journal of Developmental Education* were received from the National Organization for Student Success (formerly known as the National Association for Developmental Education). These issues were given to attendees of the National College Learning Center Association's 2019 national conference in Louisville, Kentucky.

As I assembled the resources, it became clear that the literature could be divided into three primary issues faced by developmental mathematics students (competing priorities, limited mathematics foundations, and mathematics anxiety), ways developmental mathematics programs could be redesigned beyond these issues, and technology that can be used in developmental mathematics classrooms. These concepts are expanded upon in the following subsections.

Issues Faced by Developmental Mathematics Students

In developmental mathematics courses, student success rates are not as high as program administrators previously thought (Abraham et al., 2014; Waycaster, 2011). Developmental mathematics students deal with multiple teaching and learning issues. A review of the literature for developmental mathematics revealed that these students are especially affected by three particular areas of concern: competing priorities, limited mathematics foundations, and mathematics anxiety. Potential negative effects of these issues range from the loss of important course information (due to lateness or absence), to low exam scores, to discontinuation of the course or program before completion. The literature also showed ways developmental mathematics programs could be redesigned and how technology has impacted developmental mathematics.

Competing priorities. Students taking developmental mathematics courses at community colleges often juggle a variety of responsibilities, such as full-time careers, part-time jobs, community leadership positions, and families (Silver-Pacuilla, Perin, & Miller, 2013). These external demands are competing priorities for a student’s time and attention (Zientek et al., 2014) and are “barriers to success for undergraduate learners” (Heller & Cassady, 2017, p. 4). School is not always a student’s highest priority. Other responsibilities could take precedence, leading to a student not being able to take the time to finish (or even start) homework or devote enough time to studying the concepts and material. This decreased preparation might lead to lower exam grades and result in a student not passing the class.

Competing priorities can also cause learners to have erratic attendance or simply stop showing up to class. This is a common occurrence in developmental mathematics courses. Ginsberg and Wlodkowski (2010) opined that the escalation of diverse enrollment at community colleges has led to students who *stop out*—incrementally work on schooling, taking breaks as necessary to accommodate life problems outside of college (p. 28). These competing priorities might even result in students who *drop out*—never return to continue their educational pursuits. Numerous researchers (Cafarella, 2014; Ginsberg & Wlodkowski, 2010; Guy, Puri, & Cornick, 2016; Tennant, 2014) identified stopping out and dropping out as common occurrences with developmental mathematics students who have competing priorities.

Instead of being viewed as negatives, competing priorities could be turned into positives. Barbatis (2010) referred to them as factors that “influence persistence” (p. 20) and considered them to be part of a student’s external support system. Instructors can help diverse learners turn these competing priorities into part of their support systems (Barbatis, 2010; Cafarella, 2014). For example, instructors can relate concepts to students’ jobs and suggest students use those skills at work. Instructors might also encourage students to talk to their family and friends about school, educational goals, and career plans, as well as find ways friends and family can help support students’ educational endeavors.

Limited foundations. Students can also stop attending developmental mathematics classes because they lack the necessary mathematics background (Bremer et al., 2013; Crisp & Delgado, 2014; Melguizo, Kosiewicz, Prather, & Bos, 2014).

According to Stigler et al. (2010), many students now enter college unprepared for college-level work, and this situation "may be most dire in mathematics" (p. 4). There is a "complete disconnect between elementary school math and college math requirements" (Wilson, 2011, p. 71). This disconnect also exists between high school expectations and college expectations (Burrill, 2017; Latterell & Frauenholtz, 2007). Primary and secondary mathematics classes are not adequately preparing students for college-level mathematics courses (Bremer et al., 2013; Burrill, 2017; Crisp & Delgado, 2014; Kerrigan, 2015).

Mathematics is a progressive discipline; a learner must master the knowledge of one level to understand the concepts in the next level (Huang & Shimizu, 2016; Suh & Seshaiyer, 2015). Developmental mathematics programs usually consist of several courses that cover the material from pre-algebra to intermediate algebra but sometimes start as low as basic arithmetic (Stigler et al., 2010). Asera (2011) posited that students in developmental mathematics courses either previously mastered the material and forgot it or never mastered it the first time they were exposed to it. Because learning mathematics requires a progression of understanding (Suh & Seshaiyer, 2015), a student who still struggles with multiplication will likely have more difficulty learning how to multiply variables than a student who has mastered the multiplication tables. Students with limited math foundations, therefore, will likely need to work harder because they need to master both the previous concepts and the new material.

All developmental mathematics students hold either a high school diploma (or the equivalent), meaning they likely passed mathematics courses during their primary and secondary schooling. Stigler et al. (2010) opined that these students were not taught mathematics properly at those levels, stating, “the procedures were never connected with conceptual understanding of fundamental mathematics concepts” (pp. 15–16). Developmental mathematics instructors should teach students thinking and reasoning skills in order to maximize understanding (Hammerman & Goldberg, 2003; Huang & Shimizu, 2016; Stigler et al., 2010). This shift in strategy could give students “something to fall back on when procedures fade” (Stigler et al., 2010, p. 16) and help them retain useful numeracy skills.

Mathematics anxiety. Developmental mathematics students might have trouble understanding previous and current material due to mathematics anxiety. According to Zientek et al. (2014), “math anxiety has been a well-documented deterrent to student achievement” in developmental mathematics courses (p. 69). Yeager (2012) found that 80% of community college students suffer from a moderate or high degree of mathematics anxiety. Math anxiety can cripple a student’s ability to use mathematics at any level of schooling or outside of the learning environment, such as in the workplace (Park, Ramirez, & Beilock, 2014), and has led to a deficit of graduates needed to work in the science, technology, engineering, and mathematics fields in the United States (Beilock & Maloney, 2015). A student with math anxiety might have the capability of understanding the material but is impeded by a feeling that math is simply too difficult. This student could answer all the questions correctly in class and on the homework yet perform poorly on exams due to a high level of math anxiety. Instructors must take math anxiety into consideration when working with developmental mathematics students;

"mathematics anxiety has an important effect in mathematics education that cannot be ignored" (Zakaria & Nordin, 2008, p. 30). At the institutional level, math anxiety could be partially helped by pairing students' first developmental mathematics course with a student success course (Cho & Karp, 2013).

Educators can help reduce mathematics anxiety (Beilock & Willingham, 2014). There are many strategies instructors can use to minimize students' mathematics anxiety, but anxiety levels would need to be determined first. Instructors can assess math anxiety through the administration of either the Fennema-Sherman Math Anxiety Scale, which was used by Zakaria and Nordin (2008), or the Mathematical Anxiety Rating Scale, which was given by Woodard (2004). According to Bonham and Boylan (2011), math anxiety can be reduced by ensuring students have a safe atmosphere to express their thoughts, ideas, and opinions. To help students with math anxiety, Woodard suggested numerous alternate assessment strategies, including oral questioning, observation, projects, and retests. Tutoring interventions can also help decrease math anxiety and boost confidence, helping students pass developmental courses and eventually complete college degrees (Gallard, Albritton, & Morgan, 2010).

Redesigning Programs

Utilizing the aforementioned teaching, learning, and assessment strategies might not be enough. Community college initiatives vary in their effectiveness (Abraham et al., 2014; Bettinger, Boatmann, & Long, 2014; Clotfelter, Ladd, Muschkin, & Vigdor, 2013; Edgecombe, 2011; Fike & Fike, 2011; Gallard et al., 2010; Jenkins & Cho, 2012). In a large-scale multiyear analysis of Texas community colleges studying data from the years

2003 through 2008, Abraham et al. (2014) found that the colleges' initiatives actually resulted in no improvement in college mathematics readiness, so the developmental mathematics programs themselves might need to be redesigned.

Some colleges allow students to hold off on taking their developmental courses until later in their programs of study, after students have completed one or more semesters of college-level courses in other subjects. Fike and Fike (2011) found that delayed enrollment in developmental mathematics courses resulted in lower completion rates for students. Even though there are several challenges associated with accelerating developmental mathematics programs (Edgecombe, 2011), Jenkins and Cho (2012) examined rates of program entry and completion for college students and discovered that students who did not enter a college-level program within a year were far less likely to ever enter a college-level program or earn a credential. Colleges that permit delayed enrollment might want to reexamine this policy and require students to take necessary developmental mathematics courses in the first or second semester of study.

In addition to developmental mathematics courses occurring too late in a student's college career, these courses might also be too long and cover unnecessary material. Developmental mathematics course sequences can include three or more courses, resulting in several exit points where students can easily drop out (Hern, 2012). Hodara and Jaggars (2014) found that a shorter sequence provides students with more access to college-level coursework and leads to long-term success.

Developmental mathematics courses also often require students to master algebra, but statistics, which requires little to no knowledge of algebraic concepts, is often the one college-level mathematics course students are required to take (Hern, 2012). At the City University of New York's six community colleges, for example, liberal arts majors mainly take introductory statistics as their one college-level mathematics course, but the developmental mathematics sequences at all six community colleges are algebra based (Jaggars & Hodara, 2011). Eliminating unnecessary material and concepts covered in a developmental mathematics program can allow colleges to reduce the number of developmental mathematics courses students need to take, possibly even compressing the necessary knowledge into a single course. This would have the added benefit of decreasing the number of exit points. Colleges can increase retention by shortening developmental mathematics programs to reduce breaks between courses (Edgecombe, 2011). Guy, Cornick, Holt, and Russell (2015) saw partial success with a redesigned developmental mathematics program at Queensborough Community College in New York but opined they likely would have had greater success by reducing the number of exit points in the program.

Hern (2012) found that colleges were able to increase completion rates and college mathematics readiness by redesigning their developmental mathematics programs into a single course that eliminated unnecessary concepts and focused on what students needed to be college and career ready. Colleges could require students take this course during the first or second semester of study, eliminating the negative consequences of delayed enrollment (Fike & Fike, 2011; Jenkins & Cho, 2012). These few changes could be beneficial for both colleges and students by leading to higher completion rates and a reduction in resources (from both schools and students) expended on developmental mathematics programs.

Some colleges and universities have found success with summer bridge programs (Strayhorn, 2011; Wachen, Pretlow, & Dixon, 2018). Summer bridge programs help students bridge the academic gap between high school and college. These programs can provide potential developmental mathematics students with an opportunity to bring their mathematics skills up to the college level. Strayhorn (2011) analyzed a 5-week summer bridge program that consisted of daily academic work from 8 a.m. to 3 p.m. on weekdays, plus "weekly math supplemental instruction sessions" (p. 148). Results showed students' mean academic skills were significantly higher at the end of the program than at the beginning. Wachen et al. (2018) analyzed five summer bridge programs operating at the University of North Carolina Chapel Hill in the years 2008 through 2014. The researchers found a positive correlation between summer bridge program attendance and persistence to the second and third years of college attendance.

Technology

Li and Ma (2010) completed a meta-analysis to determine how computer technology affects mathematics learning. They reviewed 76 studies with a combined total of 36,793 participants. These studies showed statistically significant positive effects of computer technology on mathematics learning. Childers and Lu (2017) found no statistically significant differences in grades or completion time between students taking classroom-based developmental mathematics classes and students taking computer-based developmental mathematics classes.

MyMathLab is used in some New Jersey community college classroom-based developmental mathematics classes and some of the college-level mathematics courses. MyMathLab (Pearson Education, 2016) is an online program that instructors can use with their students for mathematics assessments, learning, and homework. All classroom-based developmental math instructors can assign students homework through MyMathLab. Web-based homework leads to higher achievement in developmental algebra courses (Leong & Alexander, 2013).

Adaptive, individualized e-learning environments also yield positive benefits to mathematics students (Özyurt, Özyurt, Baki, & Güven, 2013). Li et al. (2013) found the use of "tailored instruction" using technology to be promising (p. 14). Assessment and Learning in Knowledge Spaces (ALEKS) is an individualized online assessment and learning system that can be used for all levels of mathematics (ALEKS Corporation, 2015). Over the past few years, ALEKS has started to be used in developmental mathematics programs, such as at the University of Texas at El Paso (Lujan & Saxon, 2017). Some New Jersey community college computer lab-based developmental mathematics courses use ALEKS as their foundation. Okimoto and Heck (2015) found that students who complete a developmental mathematics sequence designed around ALEKS are more likely to enroll in college-level mathematics courses than students who attempt a traditional classroom developmental mathematics sequence. In Fall 2016, ALEKS Placement, Preparation, and Learning was going to form the core of a pilot non-algebra-based developmental mathematics course at the University of Maryland (L. Stanwyck, personal communication, April 18, 2016). The program was successful, and

Kowalewski, Stanwyck, and LaCourse (2019) found ALEKS Placement, Preparation, and Learning to be a reliable assessment of math ability for mathematics placement. Woodruff-White et al. (2019) also saw promising results with a pilot of the ALEKS Placement, Preparation, and Learning program as a placement test and ALEKS as a supplement to classroom instruction at Morgan State University.

Games in college math courses yield numerous benefits, including academic efficacy, enjoyment, and involvement (Afari, Aldridge, Fraser, & Khine, 2013). ALEKS engages learners through its game-like approach. The program fills in pie pieces as students master topics. This visual representation of progress allows students to see how much content they understand and how far they have come. Students are also engaged by their ability to pick the next topic they want to learn (from a list of topics ALEKS has determined they are ready to attempt).

Another individualized e-learning environment is Mangahigh (2016), which was founded by game specialists and mathematicians who created a games-based learning website with multiple math games to help students learn the various mathematics concepts. Their games are broken down into separate math topics and were designed for high school students but cover the same algebraic material as the typical community college algebraic developmental mathematics course. In addition, the platform contains built-in assessments, making it easy for instructors to track student progress.

The implementation of new technology could encounter some potential obstacles and resistance. Although there are several possible obstacles, they can all be addressed and resolved with proper planning. According to Roberts (2008), schools should attempt to anticipate these problems and, as part of the design process, make plans to work through them. For any new technological initiative to succeed, the reasons behind it should be clearly communicated (Westberry, McNaughton, Billot, & Gaeta, 2015). In addition, resistance to new technology could be from subjects who do not want to invest the time in learning a new tool or process (Blin & Munro, 2008). Students, faculty members, and staff members should, therefore, be provided with sufficient training and support to help them master new technology.

Conclusion

While the core concept is developmental mathematics, the conceptual framework of this study more specifically consists of the three primary issues faced by developmental mathematics students (competing priorities, limited mathematics foundations, and mathematics anxiety), ways developmental mathematics programs could be redesigned beyond these issues, and technology that can be used in developmental mathematics classrooms. These elements should all be considered when exploring how to help students prepare for the ACCUPLACER mathematics tests.

Implications

Results of data collection and analysis will be shared with relevant New Jersey community college administrators, faculty members, and staff members via a white paper and presentations at local conferences and group meetings, including the meetings of NJ TASIG and NJ TAG. Administrators, faculty members, and staff members could use the results to institute changes in developmental mathematics programs. Results might also be used to design/revise preparation materials and programs to help incoming students place directly into college-level courses by achieving high enough scores on the ACCUPLACER mathematics tests. Specific preparation products might be workshops, study guides, sample tests, and/or books of practice problems.

Summary

Even though almost all incoming New Jersey community college students had to demonstrate algebraic and basic mathematics knowledge to earn a high school diploma or the equivalent, a significant portion of these students cannot show this knowledge on the mathematics tests of the ACCUPLACER. These students' low scores on the ACCUPLACER Elementary Algebra and QAS place them into developmental mathematics courses, which do not count for college credit and cost the students extra time, money, and effort. When deciding how best to prepare students to earn higher scores on the ACCUPLACER mathematics tests, it was important to seek feedback from two New Jersey community college staff groups: testing administrators and tutoring administrators. Perceptions and thoughts from these two groups was invaluable.

Section 2: The Methodology

Introduction

I conducted a qualitative exploratory case study (Walden University IRB #07-16-18-0461321) to obtain feedback from testing and tutoring administrators at New Jersey community colleges to determine how incoming students can be prepared for the mathematics placement tests, primarily ACCUPLACER assessments. One of the colleges did not offer an official mathematics placement test but had instructors administer a pretest the first week of each math class to determine if any students should be placed in another level math class. Interviews were conducted with 10 administrators representing 6 of the 18 New Jersey community colleges[1], and documents from the community colleges (such as those detailing how they prepare students for the mathematics placement tests) were reviewed. All interview transcripts and other documents were coded and themed.

[1] When this research was being conducted in Spring and Summer 2019, there were 19 NJ community colleges. Two merged on July 1, 2019.

Research Design and Approach

The nature of this study was qualitative. A qualitative approach was more useful in this study than a quantitative one because qualitative research explores a problem in depth for greater understanding, compared to quantitative research, which looks for explanations and trends (Creswell, 2012, p. 19). Qualitative research questions "are formulated to investigate topics in all their complexity, in context" (Bogdan & Biklen, 2007, p. 2). An exploratory case study was the most appropriate qualitative design for this study because a case study is used when a researcher wants to examine, in detail, a single subject, setting, or event (see Bogdan & Biklen, 2007; Yin, 2014). A qualitative case study methodology should be selected when contextual conditions are relevant to the studied phenomenon (Baxter & Jack, 2008; Yin, 2014). The exploratory case study is ideal when there is "no clear, single set of outcomes" (Baxter & Jack, 2008, p. 548). Another qualitative strategy, such as an ethnography or life history, would have been less useful because they center on aspects that would not have been appropriate to address the research questions. For example, ethnography focuses on culture, while a life history examines one person's life in detail (Bogdan & Biklen, 2007).

Participants

Participants for this study were from two groups (with some overlap between the two): testing administrators and tutoring administrators. I e-mailed a letter of invitation to participate in this study to administrators in NJ TASIG and NJ TAG. In the letter, I clearly explained that participation was entirely voluntary. A total of 10 administrators at six community colleges volunteered for the study. From my current and recent employment, I have firsthand knowledge of two other New Jersey community colleges. As several interviewees also had recent employment at New Jersey community colleges other than their current employers, over half of the 18 state community colleges were represented.

Access, Bias, and Subjectivity

I currently hold a full-time position at a New Jersey community college running the testing and tutoring departments. Due to potential conflicts of interest and other potential issues, interviews were not conducted with any of the staff at the college I am employed by. Access was not a problem because I have positive, solid working relationships with testing and tutoring administrators across the state. This is partially because I created NJ TAG and attend many of the NJ TASIG meetings.

In this study, I needed to be careful to avoid biases and subjectivity. The most important way to minimize issues was to keep an open mind. This involved accepting any evidence contrary to my beliefs (see Yin, 2014, p. 76), such as participants thinking a brush-up course would not be helpful. For several years, I designed and personally taught an algebra brush-up course. This study was entered with an open mind, and all findings were accepted without bias. According to Yin (2014), one way to reduce bias and "test tolerance for contrary findings" in a case study is to share preliminary findings with a couple critical colleagues to see if they can produce "alternative explanations and suggestions for data collection" (p. 77). Following this suggestion, preliminary findings were shared with two higher education colleagues (not among the interviewees) willing to provide honest and critical feedback.

Informed Consent and Confidentiality

I obtained informed consent through a written consent form that was given to participants prior to the interviews. Each participant was notified of the purpose of the study, the potential risks (i.e., I could identify none), and the option to discontinue participation at any time with no negative consequences. Participation was entirely voluntary, and all potential subjects were informed that they were not required to participate in this study. Before the interview, I asked each participant if he/she had any questions, and written consent was completed through the participant signing and dating the consent form before the interview commenced. Full confidentiality was maintained tin this study through the use of pseudonyms for the participants, not reporting any of their personally identifiable information, and not sharing their names with anyone.

Data Collection

Data collection occurred primarily through interviews with testing and tutoring staff members. Each interviewee had at least 10 years of experience in his/her respective area(s) of responsibility. Interview questions are in Appendix C. As the researcher, I produced the data collection instrument based on discussions with testing and tutoring administrators prior to the current research.

I used pseudonyms both for the community colleges and the interviewees to provide confidentiality of interviewee responses. The names of the colleges were listed in a spreadsheet in alphabetical order, then a random sequence was generated using a random number generator at the website Random.org (see Haahr, 2019) to reorder the names and assign them corresponding letters from A to R. This list was only accessible to me.

Because titles can be personally identifiable, I did not use specific titles in this study, and, when necessary, these staff members were identified by their area (i.e., testing, tutoring, or both) and a pseudonym matching the name of their community college (e.g., Testing Administrator A would be a testing administrator at Community College A). In the cases of duplicate administrators in the same area in the same college, a number was added after the letter based on the order the staff members were interviewed. The 10 administrators were Tutoring Administrator E, Testing Administrator E, Testing and Tutoring Administrator G, Tutoring Administrator L, Testing and Tutoring Administrator L, Testing Administrator M, Tutoring Administrator N, Testing Administrator O, Tutoring Administrator Q1, and Tutoring Administrator Q2.

All participants belonged to NJ TASIG and/or NJ TAG at the time of the study and frequently answer questions from other group members about testing and tutoring, respectively. It can easily be determined what the other community colleges offer students by asking members of these groups. Documents shared and reviewed included course catalogs, program descriptions, reports, and charts of success rates. I examined these documents to determine what placement test preparation was available at other schools and the success rates of the programs. These documents were coded, and all themes were identified.

Saturation

I reached saturation after interviews with 10 testing and tutoring administrators from six community colleges. Saturation was considered reached because no new information was obtained at this point. Data saturation was determined using the constant comparative method of Glaser and Strauss's (1967/2008) grounded theory. According to Glaser and Strauss, a researcher should start coding while still collecting data and attempt to code into as many categories as possible. Once new categories fail to emerge, saturation has been reached.

Data Gathering and Security

I discussed the reasons for selecting a qualitative case study methodology in the preceding section. The research questions were focused on obtaining educated and informed opinions from testing and tutoring administrators. Interviewing was an ideal data collection method for this study because interviewing is open-ended and allows the researcher to ask immediate clarification and follow-up questions (see Yin, 2014). Interviews ranged in duration from 3 minutes 31 seconds to 1 hour 4 minutes 21 seconds. The short interview was with a tutoring administrator who had limited knowledge of ACCUPLACER and was not currently responsible for the college's placement test preparation. The interview period occurred within a 2-month time period from April 23, 2019 through June 24, 2019.

I recorded the interview with a digital recording device and converted the recordings into typed transcripts via the Rev online transcription service. Recording files and transcripts were kept secured on a personal laptop, which was and is password protected. A notebook was also kept with interview and field notes. I took interview notes on what was said to serve as backup to the digital recordings, while the field notes consisted of behavioral observations, context, and emotional states seen during the interviews. This notebook and the recording device were kept locked in an office when at the college or locked in a filing cabinet at my home when not in use.

Data Analysis

Data analysis started after the first interview. Data consisted of interview materials (i.e., transcripts and interview and field notes) and documents obtained from other community colleges in New Jersey. I analyzed all data for codes and themes. Preliminary codes and themes were identified after each interview. Full data analysis commenced at the conclusion of the final interview.

Coding and Themes

The data from the interviews (i.e., recording transcripts and interview and field notes) were coded and examined for themes. Codes and themes provided a framework for organizing and interpreting the data. According to Bogdan and Biklen (2007) and Creswell (2012), there are numerous ways to code qualitative data and coding categories can be mixed. I created full coding categories once data collection was complete, as recommended by Bogdan and Biklen. Themes were also determined based on the coding and the data collected. Coding started during the data collection process by following the constant comparative method of Glaser and Strauss's (1967/2008) grounded theory. This method consisted of four stages: "1) comparing incidents applicable to each category, 2) integrating categories and their properties, 3) delimiting the theory, and 4) writing the theory" (Glaser & Strauss, 1967/2008, p. 105).

I used Saldaña's (2016) coding manual as a guide. Once data started to be collected, initial coding commenced. According to Saldaña, initial coding is "appropriate for virtually all qualitative studies" and involves "break[ing] down qualitative data into discrete parts, closely examin[ing] them, and compar[ing] them for similarities and differences" (p. 295). This was the first stage or cycle of coding the data. Pattern coding was used for the second coding cycle. Pattern coding can provide a category label or "meta code" and helps organize the data into "sets, themes, or constructs and attributes" (p. 296). Each cycle involved going back through the already-coded data to make revisions and updates as new data were coded and reviewed.

Quality, Accuracy, and Credibility

Four procedures helped establish quality, accuracy, and credibility of findings: triangulation, member checking, peer debriefing, and external auditing. I achieved data triangulation through the use of three different data types (i.e., interview recordings and transcripts, interview and field notes, and documents from the community colleges). This combination provided data triangulation, which could be considered one of the qualitative equivalents of ensuring data reliability. Triangulation is an excellent way to confirm evidence in qualitative research (Lodico, Spaulding, & Voegtle, 2010, p. 189). According to Yin (2014), data triangulation can also "strengthen the *construct validity* of [a] case study" (p. 121).

Member checking is another way to ensure validity in qualitative research (Creswell, 2012). Member checking allows subjects to make sure everything that was said is accurate and complete; I provided interviewees with an opportunity to review interview transcripts in order to make any necessary changes and/or add new information. All requested changes were minor word or phrase changes, some of which were typos in the transcription. Examples include changing "classroom type setting *up* program" to "classroom type setting *of* program," "practice" to "PRAXIS," and "and" to "from."

Peer debriefing refers to a disinterested peer reviewing a researcher's work and is another way to check the quality of the findings (Creswell, 2012). At various points of the study process, I shared this work with a colleague who works at a higher education institution in another part of the country. This colleague was also provided with access to the raw data (without associated names) allowing for an external audit. An external audit, when someone uninvolved with a study evaluates the study, is another method of establishing validity in qualitative research (Creswell, 2012).

During coding, discrepant cases (i.e., those that do not fit with the emerging themes) can arise. Discrepant cases are important aspects of the data and should not merely be dismissed because they do not fit the identified themes (Erickson, 2012). No glaring instances of discrepant data arose (only minor differences). Had any occurred, I would have noted and discussed them in the data analysis, as well as investigated them further if necessary.

Data Analysis Results

The bulk of the data came from interviews conducted with 10 testing and tutoring administrators between April 23, 2019 and June 24, 2019. These administrators represented 6 of the 18 New Jersey community colleges. When this research was being conducted, there were 19 community colleges in the state, but two merged a week after research concluded. I treated data from these two schools as coming from two campuses of the same college to mirror the post merger situation. I also reviewed records from all of the 18 colleges and incorporated them into the data analysis.

I used pseudonyms for the names of the community colleges. The names of the colleges were listed in a spreadsheet in alphabetical order, then a random sequence was generated using the random number generator on the website Random.org (see Haahr, 2019) to reorder the names and assign them corresponding letters from A to R. This list was only accessible to me.

Because titles can be personally identifiable, I did not use specific titles in this study, and, when necessary, these staff members were identified by their area (i.e., testing, tutoring, or both) and a pseudonym matching the name of their community college (e.g., Testing Administrator A would be a testing administrator at Community College A). In the cases of duplicate administrators in the same area in the same college, a number was added after the letter based on the order the staff members were interviewed. The 10 administrators were Tutoring Administrator E, Testing Administrator E, Testing and Tutoring Administrator G, Tutoring Administrator L, Testing and Tutoring Administrator L, Testing Administrator M, Tutoring Administrator N, Testing Administrator O, Tutoring Administrator Q1, and Tutoring Administrator Q2.

Of the 10 administrators interviewed, five had recent/current administrative responsibility for just tutoring, three for just testing, and two for both testing and tutoring. Several had previous experience in these areas at other New Jersey community colleges prior to their current roles. All administrators had at least 10 years of experience in their respective areas of responsibility (testing and/or tutoring).

Several themes emerged from the interviews: (a) preparation availability, (b) timing, (c) constraint frustrations, (d) student attendance/usage, and (e) minimal intercollege consistency. The initial and pattern coding in the coding process revealed these five themes tying the interviews together. Aspects of each theme were discussed by most, if not all, of the interviewees in varying levels of detail.

The five themes were discovered through two cycles/stages of coding based upon the guidance of Saldaña's (2016) coding manual. The first cycle—initial coding—began as data started to be collected. In initial coding, the researcher "breaks down qualitative data into discrete parts, closely examines them, and compares them for similarities and differences" (Saldaña, 2016, p. 295). After the initial coding was complete, the second coding cycle consisted of pattern coding. This type of coding can provide a category label or "meta code" and helps organize the data into "sets, themes, or constructs and attributes" (p. 296).

Both cycles involved going back through the already-coded data to make revisions and updates as new data were coded and reviewed. Completing these cycles was like assembling a puzzle where the picture started off fuzzy but became clearer the more times the puzzle was reassembled. Going through this process multiple times allowed the coding and themes to be refined. For example, interviewees discussed preparation being offered at different stages within the testing process (prior to initial testing, after the first test, after the first retest, etc.) and preparation being held at different parts of the year (summer, heavy admission/registration times, spring before fall admission etc.). It was not until almost the end of the coding process that it became apparent these two concepts could be combined into a theme of "timing."

Preparation Availability

Math placement test preparation was available at all 18 New Jersey community colleges in summer 2019. Although College P was the lone school not using an ACCUPLACER math placement test (only ACCUPLACER Next Generation Reading and English as a Second Language assessments), tutoring was available to help students prepare for their math classes and the first week pretest given by instructors in each math course to determine any changes to math level placement for the rest of the semester. The interviewees' colleges all offered and/or were in the process of developing some type of preparation to help students prepare for the math placement tests. Workshops, brush-up courses, boot camps, educational software programs, tutoring, and online resources were all discussed as being offered at interviewees' schools or as being options they heard were available at other New Jersey community colleges. College E offered a free monthly workshop during heavy registration/admission times and listed free self-guided resources on their website. College G held preparation courses through the noncredit area of the school. College L developed a large practice test and website that was used worldwide. In addition, students at College L had access to math tutoring during blocks of time specifically scheduled for ACCUPLACER preparation. Preparation workshops were also available at the school. College N had a college readiness program that worked with the local high schools to help their students prepare for the test.

College O provided students with a set of links to free websites with sample questions and tutorials. Testing Administrator O was considering the implementation of a summer preparation boot camp for incoming Fall 2019 students. College Q received a multiyear grant to use EdReady (a customized online program) to specifically help students prepare for the ACCUPLACER. The grant was scheduled to end in November 2019, and plans were to discontinue use of the program in favor of the free ACCUPLACER preparation phone app offered by the College Board.

The research questions asked about testing and tutoring administrators' perceptions on how to help incoming New Jersey community college students achieve high enough scores on the ACCUPLACER mathematics tests to place into college-level mathematics courses. All of the interviewees recognized the importance and necessity to help incoming students prepare for the mathematics placement tests. Each interviewee expressed the desire to help these students as much as possible and offered students at least one preparation method, but none had confidence that their college's preparation method was optimal. This was encapsulated perfectly by Testing Administrator E: "I haven't found a magic bullet. I don't think anyone has. Again, if we found a magic bullet, we wouldn't be working here . . . I don't know what the answer is."

Program Timing

Colleges varied in the timing of their preparation programs, in terms of timing within the testing process and during the year. There was no consensus on when preparation was offered/marketed during the testing process. Some offered preparation prior to initial testing, some after the first test, some after the first retest, and some at multiple points. Schools provided preparation at various times of the year—in the summer, during heavy admission/registration times, in the spring before fall admission (at local high schools), and throughout the year.

Several administrators discussed students wanting to take the placement tests without preparation, then realizing they need preparation after they see the test or when they receive scores placing them into developmental courses. Testing and Tutoring Administrator L sees this constantly at College L: "'I graduated math in high school. Of course I'll do fine on this test.' It's only after they see the test, is it clear that they don't remember how to do the things." In another part of the interview, the administrator went into further detail:

> The unfortunate part is, the students do not avail themselves of those options nearly as often as they should. We have an intake form that we give to each student, and we encourage there, and in other places, for students to reschedule their appointment if they're not prepared. We have students who walk in off the street who admit to us upfront, "I am not prepared, I haven't done math in 100 years," and so on. One of our people here developed a large practice test that is being used worldwide …, and yet students still insist, "no, no, no, while I'm here I'll just take it." So while we have no prohibition against taking it, therefore, students will not avail themselves of that preparation. It is only after they take it, and come in much lower than they would have thought, do they suddenly realize "maybe I should have taken this seriously."

Students not taking the placements tests seriously were also specifically mentioned as problematic at College G as well:

> … any way that you can prepare students to take a test and to get to them the idea that the test is serious, and it's not just something you can blow off because you could end up in developmentals. And we both know that cycle of developmentals —if you're in the lowest level, it usually takes you six years to get out of an associate degree. (Testing and Tutoring Administrator G)

At College E, proctors try to discourage students from taking the math placement test if the students do not feel ready. Students there read a written warning on the computer, and proctors have them review written instructions:

> After looking at some of these sample questions and reading the instructions to take the test, if you don't think that you're ready, please don't take the test. Tell the proctor, and we'll show you where you can get some study materials. (Testing Administrator E)

Few students are convinced (at most one per day) to leave, practice, and return. According to Testing Administrator E, most students come back a little while later: "But when they leave us for 20 minutes or an hour, exactly what they're doing for that hour we don't know, so I couldn't tell you what they did." Tutoring Administrator E encourages students to practice and tries "to stress to students that even though they want to take the test pretty soon, they maybe [should] take a couple days to refresh themselves, especially if they are looking at math that they haven't done since high school."

At College Q, the busiest time of year for their preparation (EdReady software) "was over the summer because guidance counselors of the local high schools would tell students about it. So they would come in over the summer to prepare for the ACCUPLACER test before they took it" (Tutoring Administrator Q1). College O is the opposite: "… please don't do this over the summer because you're going to have a severe lack of interest. Try over winter break" was the suggestion from Testing Administrator O.

Multiple administrators mentioned not being sure what the "best" preparation timing might be and thought they should be offering preparation at other times during the testing process and the year. The administrators' perceptions seemed to be doubt about when would be good timing for preparation. Clearly the administrators had different experiences regarding timing.

Constraint Frustrations

While there were differing experiences and opinions about test preparation timing, the interviewees universally expressed their frustrations with constraints around placement test preparation program offerings (and potential offerings). The main frustration was the lack of financial support/difficulty finding and/or maintaining funding for preparation initiatives. Many of the administrators took advantage of free resources from sources outside of their individual colleges. Non-free preparation was generally funded by administrators' regular budgets (workshops, tutoring, some courses, etc.) or student fees specifically for a preparation course. College Q received a grant but could not continue with the grant-funded program once the grant funds ran out.

Other constraint frustrations mentioned included doubt of which college department/division should be offering preparation; lack of student knowledge regarding preparation; student apathy about preparation; minimal student attendance/usage; other administrators, staff members, and faculty members not understanding the purpose of a math placement test, how a math placement test works, standard practices for student math placement, or potential benefits of math placement test preparation; and testing and tutoring administrators being blamed for poor student performance on the placement tests. Testing Administrator E experienced this directly:

> One time somebody was trying to point a finger at me and say, "You're responsible for students not doing well on placement tests." And I said, "How am I responsible? If I could make people do something they didn't want to do, I would not be working here. I'd be God. I'd be working for the government. I don't know what I'd be doing." I can lead a horse to water, but come on. Give me a shotgun to make them drink. That's the hard part.

The research questions asked about the testing and tutoring administrators' perceptions, and clearly the administrators were frustrated at the variety of constraints around placement test preparation. These administrators want to help students, but these constraints limit and/or block what the administrators can do. Although these administrators had issues with constraints around the programs, often the students created their own constraints to success through a lack of attendance or usage of mathematics test preparation.

Student Attendance/Usage

Minimal student attendance/usage of any type of math test preparation was one of the biggest concerns shared by all of the interviewees. "The unfortunate part is, the students do not avail themselves of those options as often as they should" (Testing and Tutoring Administrator L). Testing Administrator E conducted an unpublished study several years ago. Students who took the placement test were asked if they prepared for the test. Approximately 50%-75% said no. Of the remainder, many said that their preparation was only an hour or less. When students took the test a second time, they were asked if they prepared this time. Although better than the first time, fewer than half of the students prepared for the second attempt at the test. Students just want to "finish the whole process rather than actually preparing for it" (Tutoring Administrator E).

Testing Administrator O conducted a similar study around the same time as Testing Administrator E. Testing Administrator O found that fewer than 30 total students over 2 years used their online placement test preparation (MyFoundationsLab). This was for both math and English preparation. Testing Administrator O called the program "a major flop" and mentioned that students might have "little or no interest in attending" placement preparation programs, have work and/or family obligations, or simply prefer to be "enjoying summer weather by the beach."

Other interviewees also expressed doubts that students take placement tests seriously. Testing and Tutoring Administrator L stated, "how do you bring a horse to water and force him to drink?" and suggested making preparation mandatory. Tutoring Administrator Q1 did not think students wanted to put in any extra work: "Will they put the time in? We found that a lot of times they'll get the log in, they'll get set up, and then they don't really use the product."

The research questions were about these administrators' perceptions, and they saw difficulties in getting students to complete (or even start) placement test preparation. The administrators saw many students not taking the time to prepare and not taking the tests seriously. The administrators want to help students but recognize that students need to want help and be willing to receive it. Should students be open to receiving help, however, there is a wide variety of what help they might obtain, depending on which community college they choose to attend.

Minimal Intercollege Consistency

Even though all of the New Jersey community colleges offered some type of math test preparation, there was minimal intercollege consistency among programs. No two schools offered the same math placement test preparation programs. Although each interviewee was aware that other colleges offered math placement preparation, no collaboration between the schools was seen, other than links to the same free online resources and a few schools linking to College L's ACCUPLACER preparation website.

Minimal intercollege consistency is closely related to the theme of preparation availability. All of the interviewees knew about workshops, brush-up courses, boot camps, educational software programs, tutoring, and online resources being offered at interviewees' schools or as being options they heard were available at other New Jersey community colleges. Even though all of the interviewees belonged to the statewide testing group and/or the statewide tutoring group, there was no discussion of collaboration between schools. Interviewees shared what preparation was offered at their own schools and what they knew about at other schools, but no one mentioned working together with other institutions. Part of this theme was therefore found in what was not said in the interviews. Sometimes what is not said can be as important as what is.

The research questions focused on testing and tutoring administrators' perceptions of students' math placement test preparation options. While every administrator was aware of options at other colleges, no one seemed to perceive that they were not working together with other schools. With all of the placement test preparation options, a strong case could be made for collaboration between multiple schools, especially at the statewide level from the two groups representing the New Jersey higher education testing and tutoring administrators.

Conclusion

The interviews answered the research questions about the New Jersey community college testing and tutoring administrators perceptions regarding mathematics placement test preparation. Interviewees shared their perceptions and thoughts regarding the current state of mathematics placement test preparation at their own schools and other community colleges in the state, as well as ideas on how this preparation can be improved. The interviews and other data from the New Jersey community colleges show that students definitely need help preparing for the mathematics placement tests. Although the administrators were from six different colleges, they all described somewhat similar experiences and verbalized similar concerns and frustrations about mathematics placement test preparation. They all recognized the need to help students prepare for these tests, and from the spoken words, the vocal tones, and the facial expressions, it was clear that they all had the desire to help students succeed.

The findings from this research can certainly contribute to student success. Although there is no “magic bullet” for test preparation (according to Testing Administrator E), this research revealed ways mathematics placement test preparation offerings can be improved. The position/white paper in Appendix A details some possible options for statewide collaboration and consistency and will be shared with the two New Jersey state groups for testing and tutoring administrators. Improved collaboration and consistency between the colleges would likely improve student performance on these tests.

When students improve their scores on the mathematics placement tests, they can place out of developmental mathematics courses. When students place out of developmental courses, they save time, money, and effort (potential savings of years of extra schooling, thousands of dollars, and numerous hours of coursework and homework). Placing out of developmental courses also means a greater likelihood of a student reaching graduation/program completion. When multiplied by tens or hundreds of students, a college could see substantial increases in retention and graduation/program completion, which are two of the most important metrics of student success. If the recommendations in the policy/white paper are followed by the testing and tutoring administrators at all 18 New Jersey community colleges, student success could increase statewide. Should administrators at higher education institutions in other states choose to implement similar recommendations, student success could increase across the country.

Section 3: The Project

Introduction

The appropriate project for this study was a position paper providing detailed policy recommendations (also known as a white paper). I will share the paper with the New Jersey higher education testing and tutoring administrators through the statewide organizations for the two groups (NJ TASIG and the NJ TAG). Upon approval of this study, the full paper and an accompanying PowerPoint presentation with the paper highlights will be e-mailed to the membership of the two groups. A presentation would be given at the next meeting of each group, but unusual circumstances prevent this. As this study is being written (April and May 2020), New Jersey (like many other states and countries) is in a state of emergency due to COVID-19 (coronavirus disease 2019) and physical gatherings are being substantially restricted around the country through at least June 2020 and likely beyond (see Murphy, 2020). NJ TASIG and NJ TAG have been holding virtual meetings via Zoom instead of in-person meetings.

In the paper, I discuss the findings of the study, which will provide these administrators with knowledge of mathematics placement test preparation offerings at the New Jersey community colleges. The administrators will then be aware of various options they can implement/revise at their individual institutions. According to Boylan in an interview with Levine-Brown and Anthony (2017), "there are a number of methods that research has shown to work well [helping students with mathematics remediation], and using these practices in conjunction with one another can help students be more successful" (p. 19). Sharing the findings of this study in a position paper will also enable discussions on this topic at the group meetings and allow for increased consistency between the New Jersey community colleges.

Rationale

I chose this project genre because the dual purpose of a position/white paper is to inform and make recommendations. The study findings revealed a lack of knowledge among the New Jersey community college testing and tutoring administrators regarding mathematics placement test preparation options and what does and does not work at other institutions. Five themes emerged from the interviews: (a) preparation availability, (b) timing, (c) constraint frustrations, (d) student attendance/usage, and (e) minimal intercollege consistency. With a position/white paper, administrators are provided with information concerning the various options related to the first four themes, and the paper itself will help improve the issue of the fifth theme: minimal intercollege consistency.

Review of the Literature

Position papers are ubiquitous and can be found in many fields. A simple Google Scholar search for the term *position paper* returned over 817,000 results in fields ranging from medicine to politics to education. These works are a form of policy analysis, and assistance can be found for writing policy papers (Herman, 2018). Policy analysis is essentially “the practice of providing policy advice to decision makers” (Radin, 2000, p. 11). Radin (2000) further posited that, although official policy analysis offices becoming a part of the federal government did not occur until the 1960s, policy analysis is “an ancient art” with Machiavellian roots (p. 11). Niccolò Machiavelli (2016; 1469–1527) was a Renaissance writer and political advisor, considered “the father of modern politics” and “the father of modern political thought.” Machiavelli is best known for the political treatise, *The Prince* (1532/2014). This work was a discussion of how princes could rule their princedoms and recommendations for how they could be successful. As such, *The Prince* could be considered a position paper providing policy analysis on leadership. According to Cosans and Reina (2018), *The Prince* has a solid place in the history of leadership philosophy. This would make it a seminal position paper.

Position papers are not new in the field of education. In April 1959, the National Association for Secondary-School Principals arranged for McGrath to author a position paper on foreign language instruction. A few years later, the first position paper on nursing education was written in December 1965 by the American Nurses Association’s Committee on Nursing Education (Donley & Flaherty, 2008). More recently, around the turn of the current millennium, Dyrud (2000) wrote a position paper about the Third Wave’s changes to the field of education with the proliferation of electronic communication and the growing number of virtual universities. Around the same time, Edgerton (2001) was tasked by the Pew Charitable Trusts to write an education white paper on how to create “a new grant program aimed at the improvement of higher education” (p. 1).

More recently, position/white papers have been written about a variety of areas within the field of education. Many higher education administrators receive e-mail newsletters with news and articles about the field. The *UB Daily Newsletter*, published by University Business, calls itself “The Two-Minute Briefing for Higher Ed Leaders” and is read by higher education administrators around the country. On the University Business website, there is a white papers archive, which contains 11 white papers from 2018 and 2019. These papers explore a variety of higher education topics, such as mathematics education technology (Lopez, 2018).

Many recent position papers have been written to explore the use of technology in education and the future of education. Kompen et al. (2019) wrote a position paper about the use of Web 2.0 and personal learning environments in education. In 2019, Heijnen and van der Vaart edited a book comprised of position papers from multiple higher education visionaries about the trends and changes within higher education and what higher education would look like in 2040.

Higher education position papers are continuously being written and shared with higher education administrators and professionals. The Urban Institute's Center on Education Data and Policy has released many data-based higher education research reports (essentially position/white papers). On January 31, 2020, the center published four new research reports, including one about the measurement and use of student-level data (Blom et al., 2020) and another about the measurement of program-level completion rates (Blagg & Rainer, 2020).

In New Jersey, NJCCC and the New Jersey Council for the Humanities partnered to hold "The Essential Skills Summit: Equipping New Jerseyans for a Changing World" on January 31, 2020 at Middlesex County College. State business leaders, K-12 educators, and community college faculty and administrators were invited to discuss how to prepare New Jersey students for the workforce and provide them with the skills that would be necessary for future career success. One basis of the meeting was NJCCC's

Vision 2028: A Framework for the Future of New Jersey's Community Colleges. This position paper was released statewide in October 2019.

As mentioned previously, NJ TASIG is an affinity group of the NJCCC. Although there is no official tutoring administrator affinity group, NJ TAG is the closest equivalent and was designed to be similar to NJ TASIG. In addition to the long history of position paper and policy analysis use, NJCCC's position paper use demonstrates the appropriateness of a position paper (shared with NJ TAG and NJ TASIG) for this project.

Project Description

The position paper is available in Appendix A. I will share it with the testing and tutoring administrators in NJ TASIG and NJ TAG. Both organizations traditionally meet twice per year: NJ TASIG in April and October, and NJ TAG in January and June. As mentioned previously, the pandemic state of emergency in March, April, and May 2020 required cancellation of physical gatherings, and due to an unknown end date, it is unknown when these groups will meet next in person. Sharing at a physical meeting of the groups is currently precluded, but both groups have conducted virtual Spring 2020 meetings via video conferencing platform Zoom (NJ TASIG on April 17, 2020 and NJ TAG on May 1, 2020). I will invite members of both groups via e-mail to attend a Zoom presentation of the findings of this position paper. The paper and accompanying PowerPoint presentation with highlights will be e-mailed to the groups' members after the meeting. Both groups allow any member to e-mail information to all other members and share any relevant information, so there will be no problems obtaining permission to do so. This study should be approved in Summer 2020, so the paper and accompanying presentation will be shared at that time.

If the groups decide to implement the recommendations, I will participate in the joint task force and express the willingness to organize it. These (possibly virtual) meetings can be held during the Summer and Fall 2020 semesters. A white paper from the two groups can be started by the groups in the Fall 2020 semester and released by the end of the Spring 2021 semester.

The only anticipated barriers are time and interest of the group members. Everyone is busy and has a limited amount of time. I can partially alleviate this by being the organizer of the task force. Based on the administrator interviews, many members of the groups are frustrated with current mathematics placement test preparation programs and want to help students succeed, so interest might not be a large barrier. If most group members do not want to participate, even a small number of administrators would be able to address the recommendations suggested in the position paper.

Project Evaluation Plan

This is a goal-based project. The first goal is sharing the position paper information with the testing and tutoring administrators, which will be done via Zoom meeting followed by e-mailing the paper (see Appendix A) and accompanying presentation (see Appendix B) to the NJ TASIG and NJ TAG members in Summer 2020. The New Jersey higher education testing and tutoring administrators, represented by NJ TASIG and NJ TAG, respectively, are the key stakeholders of this project. There is some overlap between the two groups because there are administrators who oversee both the testing and tutoring functions at their institutions.

If the recommendations in the position paper are accepted, a joint task force will be created. The joint task force will create its own white paper with statewide resources and recommendations for mathematics placement test programs that can be implemented at the New Jersey community colleges. The results of the joint task force will be the second goal.

The third goal is for the state testing and tutoring administrators to implement the recommendations from the task force. A follow-up questionnaire can be sent out to these administrators 6 months and 1 year after the release of the paper (the end of the Fall 2021 semester and the end of the Spring 2022 semester, respectively) with questions about if these administrators made any changes to their institutions' mathematics placement test preparation programs based on the task force's recommendations.

Project Implications

Redesigning mathematics placement test preparation can help more students place into college-level mathematics courses. Avoiding developmental courses saves students time, money, and effort. It also reduces the number of exit points for them to stop or drop out, so they would be more likely to complete their degree/certificate programs. This would benefit institutions through increased retention and graduation/completion rates. Although these changes would help students and institutions in New Jersey, the changes could be adapted to other states and schools, allowing for a potential impact across the country.

Section 4: Reflections and Conclusions

Project Strength and Limitations

As discussed in a previous section, the essential problem is that the majority of incoming students do not score highly enough on the ACCUPLACER Elementary Algebra or the ACCUPLACER QAS to place into college-level mathematics courses. A major strength of the project is the focus on the staff members most able to address the problem—the testing and tutoring administrators at the New Jersey community colleges. They provided the problem, the bulk of the data, and can, if they follow the recommendations in the position paper, address the problem. There are three major limitations to the project: the ACCUPLACER change over to the Next Generation tests, the newness of the ACCUPLACER QAS, and the changes to placement testing due to the remote operations required by the state of emergency discussed previously.

During the process of this study, the ACCUPLACER upgraded its exams, and the New Jersey community colleges had to change their mathematics placement tests, usually from the ACCUPLACER Elementary Algebra to the ACCUPLACER QAS. Because the QAS was new, there was not much research about it available. From the e-mails exchanged between NJ TASIG members, all of the New Jersey community colleges are redesigning placement guidelines for the duration of the emergency. Because remote proctoring options are limited and have numerous drawbacks, many colleges are eliminating tests from placement considerations. It is possible that some, many, or even all New Jersey community colleges might not restart placement testing once normal campus operations resume.

Recommendations for Alternate Approaches

Based on the literature, the problem could be perceived in a couple related but different ways. One related problem would be if a mathematics placement test is even necessary. Many senior-level higher education administrators have been discussing the possibility of not using a placement test, and the current state of emergency limiting colleges to remote operations is forcing administrators to reconsider the use and necessity of testing within placement. Another problem apparent from the literature is the disconnect between the algebra-based developmental mathematics courses and the usually-statistics-based college-level mathematics courses. Examining these problems would have resulted in a different study, possibly one in which a quantitative methodology would have been used. The project itself would have likely been more experimental.

Scholarship, Project Development, and Leadership and Change

The coding process in qualitative research was new to me, as was looking for themes from the codes and data. Although my teaching background includes multiple subject areas, mathematics was the subject area I taught most often, usually elementary algebra within the developmental sequence. While many of my doctoral program peers expressed concerns about quantitative research and the preference for qualitative methodology, I both expected and preferred to do quantitative research. The problem and research questions, however, were more appropriately addressed through the qualitative approach. This helped me grow as a scholar practitioner and develop my weaker qualitative skills.

Reflection on the Importance of the Work

This work could potentially be important to many incoming community college students and the college faculty members and administrators who work with them. Students could save money, time, and effort, while colleges could increase retention and graduation/completion rates as a result of the findings of this study. Although I focused this study on community colleges in New Jersey, the findings and recommendations are also relevant and applicable to other types of higher education institutions, both in New Jersey and around the country.

Implications, Applications, and Directions for Future Research

The potential impact for positive social change is at the individual, organizational, and societal/policy levels. At the individual level, a student might be able to avoid developmental mathematics courses, which would save the student potentially thousands of dollars, semesters of time, and numerous hours of effort. At the organizational level, there could be changes at the New Jersey community colleges and how they help incoming students prepare for the mathematics placement tests. At the societal/policy level, NJ TASIG and NJ TAG might make statewide policy recommendations for changes about how community colleges help students prepare for these assessments.

Conclusion

The essence of the study is that New Jersey testing and tutoring administrators can redesign how the state community colleges help students prepare for the mathematics placement tests. Preparing students for these tests can help them earn higher scores and result in fewer developmental mathematics courses for the students. Students who avoid unnecessary developmental mathematics courses could save thousands of dollars in course fees, semesters of time, and numerous hours of effort, which would help community colleges see increased retention and graduation/completion rates. Although these benefits would start at the New Jersey community colleges, these recommendations can be used to help students and higher education institutions around the country.

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Appendix A: Position/White Paper

Executive Summary

Although most new college students had to demonstrate algebraic and basic mathematics mastery to earn a high school diploma or the equivalent, the majority of incoming New Jersey community college students are not showing this knowledge on the mathematics placement tests, thus placing into developmental courses, which must be successfully completed before students can attempt any college-level mathematics courses. A qualitative exploratory case study was conducted to determine New Jersey community college testing and tutoring administrators' perceptions on how to help incoming students achieve higher scores on the mathematics placement tests. Interviews were conducted with 10 testing and tutoring administrators representing six of the 18 New Jersey community colleges. All of these colleges offer some type of program to prepare students for the mathematics placement tests, and documents about these programs were also reviewed.

Interview transcripts, field notes, and related documents were coded for relevant themes by following the constant comparative method of Glaser and Strauss' grounded theory (1967/2008). Preparation availability, timing, constraint frustrations, student attendance/usage, and minimal intercollege consistency emerged as themes. This position/white paper was written and prepared for sharing with the two primary statewide organizations for higher education testing and tutoring administrators: the New Jersey Test Administrators' Special Interest Group (NJ TASIG) and the New Jersey Tutoring Administrator Group (NJ TAG).

Recommendations focus first on addressing awareness and intercollege consistency. Submission of this paper (Appendix A) and accompanying presentation (Appendix B) to NJ TASIG and NJ TAG will provide awareness to the testing and tutoring administrators about the issues surrounding mathematics placement test preparation (primarily based on interviews with members of the two groups). Awareness of an issue or problem is the first step toward addressing it. Once the testing and tutoring administrators are aware of the intercollege inconsistency, they can choose to address it. The two testing and tutoring administrator organizations can work together to create a joint task force and write a position paper with recommendations for mathematics placement test preparation. They would determine how to best address the findings/themes of this study (preparation availability, timing, constraint frustrations, student attendance/usage, and minimal intercollege consistency), as well as the issues faced by potential developmental mathematics students (competing priorities, limited mathematics foundations, and mathematics anxiety).

The knowledge gained from this study can engender social change by helping incoming college students avoid developmental mathematics courses, saving the students time, money, and effort, as well as improving their chances of completing college programs and degrees. This would lead to colleges seeing improved retention and completion rates. Although designed for New Jersey community colleges, the findings and recommendations can be used to help students and higher education institutions around the country.

Introduction and Background

During the July 1, 2016 through June 30, 2017 grant cycle year, the state of New Jersey awarded $1,000,000 of College Readiness Now III grants to 17 New Jersey community colleges to help graduating high school students become college-ready and avoid the burden of developmental classes in mathematics and English (Rogalski & Harrington, 2017). According to Quarles and Davis (2016), “a significant focus of efforts to improve community college success work is remedial (or developmental) education courses, which are nominally designed to give students the skills they need for college-level courses” (p. 34). Developmental mathematics courses are barriers to program and degree completion and cost students extra money, time, and effort (Barry & Dannenberg, 2016; Benken, Ramirez, Li, & Wetendorf, 2015; Hern, 2012; Jenkins & Cho, 2012; Thornton, Case, & Peppers, 2019). Factoring in the cost of credits at the New Jersey community colleges, a student who takes two developmental mathematics courses (in sequence or through repetition) adds over $1,000 dollars just in tuition and fees to the overall cost of his/her associate degree or certificate program. Wheeler and Bray (2017) found that students who successfully completed developmental mathematics classes “did not perform significantly better or worse” in college-level mathematics courses than students who placed directly into the college-level mathematics courses (p. 14), but many students are unsuccessful in passing their developmental courses. Developmental courses also provide more opportunities for students to stop out or drop out.

R. Myung-In Kim directs a testing program at a New Jersey community college and runs the New Jersey Test Administrators’ Special Interest Group (NJ TASIG), an affinity group of the New Jersey Council of County Colleges (NJCCC). According to Kim, the majority of incoming New Jersey community college students place into developmental mathematics courses due to their low scores on the mathematics placement tests. New Jersey community colleges transitioned from the classic ACCUPLACER to the next-generation ACCUPLACER in January 2019 (or earlier), and almost all schools replaced the classic ACCUPLACER Elementary Algebra with the next-generation ACCUPLACER Quantitative Reasoning, Algebra, and Statistics (QAS), which is the closest equivalent (NJ TASIG, 2018). The QAS essentially tests students on the same knowledge and skills as the classic Elementary Algebra with the addition of basic statistics (College Board, 2018). The QAS is still new, so research on it is still being conducted; preliminary research, however, indicates the QAS is similar to the Elementary Algebra (Chiantera, 2018). The essential problem is that the majority of incoming students do not score highly enough on the ACCUPLACER Elementary Algebra or the ACCUPLACER QAS to place into college-level mathematics courses. All degree-seeking community college students must pass at least one college-level mathematics course to graduate (Cohen, Brawer, & Kisker, 2014).

Poor student performance on the ACCUPLACER Elementary Algebra or QAS is the core problem. When students achieve low scores on the mathematics placement tests, New Jersey community college placement rules stipulate that the students must enroll in developmental mathematics courses, which must be successfully completed before students can attempt any college-level mathematics courses. If a student cannot pass a developmental mathematics course, that student cannot take a college-level mathematics course and cannot graduate. Developmental mathematics courses are, therefore, barriers to retention and degree completion and, by extension, future employment and viability in the job market. Student retention is also important to New Jersey community college administrators because overall New Jersey community college enrollment dropped 21.4% from 2009 to 2018 (Nelson, 2019).

Even though almost all incoming New Jersey community college students had to demonstrate algebraic and basic mathematics knowledge to earn a high school diploma or the equivalent, a significant portion of these students cannot show this knowledge on the mathematics tests of the ACCUPLACER. These students' low scores on the ACCUPLACER Elementary Algebra and QAS place them into developmental mathematics courses, which do not count for college credit and cost the students extra time, money, and effort. When deciding how best to prepare students to earn higher scores on the ACCUPLACER mathematics tests, it was important to seek feedback from two New Jersey community college staff groups: testing administrators and tutoring administrators.

Methodology

A qualitative exploratory case study was conducted to obtain feedback from testing and tutoring administrators at New Jersey community colleges to determine how incoming students can be prepared for the mathematics placement tests, primarily ACCUPLACER assessments. One of the colleges did not offer an official mathematics placement test but had instructors administer a pretest the first week of each math class to determine if any students should be placed in another level math class.

I e-mailed a letter of invitation to participate in this study to testing and tutoring administrators in NJ TASIG and NJ TAG in Spring 2019. In the letter, I clearly explained that participation was entirely voluntary. Interviews were conducted with 10 administrators representing 6 of the 18 New Jersey community colleges[2], and documents from the community colleges (such as those detailing how they prepare students for the mathematics placement tests) were examined. Of the 10 administrators interviewed, five had recent/current administrative responsibility for just tutoring, three for just testing, and two for both testing and tutoring. Several had previous experience in these areas at other New Jersey community colleges prior to their current roles. All administrators had at least 10 years of experience in their respective areas of responsibility (testing and/or tutoring). Because several interviewees, as well as the author of this study, had recent employment at New Jersey community colleges other than their current employers, over half of the 18 state community colleges were represented. Interviews were conducted between April 23, 2019 and June 24, 2019.

Literature Review

Developmental mathematics itself is "a core community college challenge" (Asera, 2011, p. 28), and "the need to improve student success in community colleges has resulted in a growing interest in developmental mathematics" (Zientek, Fong, & Phelps, 2019, p. 183). Nearly 75% of incoming community college students (including both full-time and part-time students) need to take remedial coursework in mathematics and/or English (National Center for Public Policy and Higher Education and the Southern

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[2] When this research was being conducted in Spring and Summer 2019, there were 19 NJ community colleges. Two merged on July 1, 2019.

Regional Education Board, 2010). In a study of more than 250,000 incoming students at 57 colleges around the United States, Bailey, Jeong, and Cho (2010) found that almost 60% of these students placed into developmental mathematics courses. According to Okimoto and Heck (2015), more than 70% of incoming community college students are not ready for college-level mathematics. At the Borough of Manhattan Community College, for example, 72% of incoming students place into developmental mathematics classes due to their scores on the mathematics placement test (George & Milman, 2019, p. 29). Kerrigan (2015) recognized that college readiness was a major problem when reporting the results of the 2014 College Access Challenge Grant, which helped 18 (of the then 19) New Jersey community colleges work with high school districts to improve high school student college readiness in mathematics, reading, and writing.

Community colleges traditionally offer developmental mathematics courses that are algebra based (Mejia, Rodriguez, & Johnson, 2016). Although incoming New Jersey community college students hold either a high school diploma (or the equivalent), which required demonstration of algebraic and basic mathematics competency (Common Core State Standards Initiative, 2016; New Jersey Department of Education, 2014; Rosenstein, Caldwell, & Crown, 1996), a large portion of incoming community college students fail to demonstrate this competency on the algebra-based ACCUPLACER Elementary Algebra or QAS, thereby earning low scores that place them into developmental courses.

According to Wilson (2011), “73% of the mathematics taught in colleges across the United States is really K-12 mathematics” (p. 70). A disconnect clearly exists between students being able to demonstrate algebraic mastery to earn a high school diploma (or the equivalent) and later being able to demonstrate this mastery when taking the college placement test. Students taking developmental mathematics courses might have either previously mastered the material and forgot it or never mastered it the first time they were exposed to it (Asera, 2011), but mathematics placement test preparation programs can help (Zachry Rutschow & Schneider, 2012).

When a student places into developmental mathematics courses, that student becomes a developmental mathematics student. A review of the literature revealed that developmental mathematics students face three main issues: competing priorities, limited mathematics foundations, and mathematics anxiety. A variety of mathematics placement test preparation options were also found to be in use at institutions around the country. Technology, particularly adaptive mathematics software programs, was also found to be important. Competing priorities, limited mathematics foundations, mathematics anxiety, placement preparation test options, and technology must all be considered when exploring how to help students prepare for the ACCUPLACER Elementary Algebra and QAS.

Issues Faced by Developmental Mathematics Students

Developmental mathematics students deal with multiple teaching and learning issues. A review of the literature for developmental mathematics found that these students are especially affected by three particular areas of concern: competing priorities, limited mathematics foundations, and mathematics anxiety. Potential negative effects of these issues range from the loss of important course information (due to lateness or absence), to low exam scores, to discontinuation of the course or program before completion.

Competing priorities. Students taking developmental mathematics courses at community colleges often juggle a variety of responsibilities, such as full-time careers, part-time jobs, community leadership positions, and families (Silver-Pacuilla, Perin, & Miller, 2013). These external demands are competing priorities for a student's time and attention (Zientek et al., 2014) and are "barriers to success for undergraduate learners" (Heller & Cassady, 2017, p. 4). School is not always a student's highest priority. Other responsibilities could take precedence, leading to a student not being able to take the time to finish (or even start) homework or devote enough time to studying the concepts and material. This decreased preparation might lead to lower exam grades and result in a student not passing the class.

Competing priorities can also cause learners to have erratic attendance or simply stop showing up to class. This is a common occurrence in developmental mathematics courses. Ginsberg and Wlodkowski (2010) opined that the escalation of diverse enrollment at community colleges has led to students who *stop out*—incrementally work on schooling, taking breaks as necessary to accommodate life problems outside of college (p. 28). These competing priorities might even result in students who *drop out*—never return to continue their educational pursuits. Numerous researchers (Cafarella, 2014; Ginsberg & Wlodkowski, 2010; Guy, Puri, & Cornick, 2016; Tennant, 2014) identified stopping out and dropping out as common occurrences with developmental mathematics students who have competing priorities.

Instead of being viewed as negatives, competing priorities could be turned into positives. Barbatis (2010) referred to them as factors that "influence persistence" (p. 20) and considered them to be part of a student's external support system. Instructors can help diverse learners turn these competing priorities into part of their support systems (Barbatis, 2010; Cafarella, 2014). For example, instructors can relate concepts to students' jobs and suggest students use those skills at work. Instructors might also encourage students to talk to their family and friends about school, educational goals, and career plans, as well as find ways friends and family can help support students' educational endeavors.

Limited foundations. Students can also stop attending developmental mathematics classes because they lack the necessary mathematics background (Bremer et al., 2013; Crisp & Delgado, 2014; Melguizo, Kosiewicz, Prather, & Bos, 2014). According to Stigler et al. (2010), many students now enter college unprepared for college-level work, and this situation "may be most dire in mathematics" (p. 4). There is a "complete disconnect between elementary school math and college math requirements" (Wilson, 2011, p. 71). This disconnect also exists between high school expectations and college expectations (Burrill, 2017; Latterell & Frauenholtz, 2007). Primary and secondary mathematics classes are not adequately preparing students for college-level mathematics courses (Bremer et al., 2013; Burrill, 2017; Crisp & Delgado, 2014; Kerrigan, 2015).

Mathematics is a progressive discipline; a learner must master the knowledge of one level to understand the concepts in the next level (Huang & Shimizu, 2016; Suh & Seshaiyer, 2015). Developmental mathematics programs usually consist of several courses that cover the material from pre-algebra to intermediate algebra but sometimes start as low as basic arithmetic (Stigler et al., 2010). Asera (2011) posited that students in developmental mathematics courses either previously mastered the material and forgot it or never mastered it the first time they were exposed to it. Because learning mathematics requires a progression of understanding (Suh & Seshaiyer, 2015), a student who still struggles with multiplication will likely have more difficulty learning how to multiply variables than a student who has mastered the multiplication tables. Students with limited math foundations, therefore, will likely need to work harder because they need to master both the previous concepts and the new material.

All developmental mathematics students hold either a high school diploma (or the equivalent), meaning they likely passed mathematics courses during their primary and secondary schooling. Stigler et al. (2010) opined that these students were not taught mathematics properly at those levels, stating, “the procedures were never connected with conceptual understanding of fundamental mathematics concepts” (pp. 15–16).

Developmental mathematics instructors should teach students thinking and reasoning skills in order to maximize understanding (Hammerman & Goldberg, 2003; Huang & Shimizu, 2016; Stigler et al., 2010). This shift in strategy could give students “something to fall back on when procedures fade” (Stigler et al., 2010, p. 16) and help them retain useful numeracy skills.

Mathematics anxiety. Developmental mathematics students might have trouble understanding previous and current material due to mathematics anxiety. According to Zientek et al. (2014), “math anxiety has been a well-documented deterrent to student achievement” in developmental mathematics courses (p. 69). Yeager (2012) found that

80% of community college students suffer from a moderate or high degree of mathematics anxiety. Math anxiety can cripple a student's ability to use mathematics at any level of schooling or outside of the learning environment, such as in the workplace (Park, Ramirez, & Beilock, 2014), and has led to a deficit of graduates needed to work in the science, technology, engineering, and mathematics fields in the United States (Beilock & Maloney, 2015). A student with math anxiety might have the capability of understanding the material but is impeded by a feeling that math is simply too difficult. This student could answer all the questions correctly in class and on the homework yet perform poorly on exams due to a high level of math anxiety. Instructors must take math anxiety into consideration when working with developmental mathematics students; "mathematics anxiety has an important effect in mathematics education that cannot be ignored" (Zakaria & Nordin, 2008, p. 30). At the institutional level, math anxiety could be partially helped by pairing students' first developmental mathematics course with a student success course (Cho & Karp, 2013).

Educators can help reduce mathematics anxiety (Beilock & Willingham, 2014). There are many strategies instructors can use to minimize students' mathematics anxiety, but anxiety levels would need to be determined first. Instructors can assess math anxiety through the administration of either the Fennema-Sherman Math Anxiety Scale, which was used by Zakaria and Nordin (2008), or the Mathematical Anxiety Rating Scale, which was given by Woodard (2004). According to Bonham and Boylan (2011), math anxiety can be reduced by ensuring students have a safe atmosphere to express their thoughts, ideas, and opinions. To help students with math anxiety, Woodard suggested numerous alternate assessment strategies, including oral questioning, observation, projects, and retests. Tutoring interventions can also help decrease math anxiety and boost confidence, helping students pass developmental courses and eventually complete college degrees (Gallard, Albritton, & Morgan, 2010).

Mathematics Placement Test Preparation Options

According to the New Jersey Center for Student Success, in 2015 all New Jersey community colleges offered some type of mathematics placement test preparation, including bridge programs, brush-up courses, webpages, and sample tests. Colleges and universities across the country offer similar programs to help students prepare for the mathematics placement test. Couturier and Cullinane (2015) evaluated math placement policies across the country and recommended incoming college students take math placement assessments as early as 10th grade in high school and be given a chance "to understand their scores, brush up on skills, and re-test" (p. 9). They also recommended summer bridge programs and STEM Starter Academies.

Some colleges and universities found success with summer bridge programs (Strayhorn, 2011; Wachen, Pretlow, & Dixon, 2018). Summer bridge programs help students bridge the academic gap between high school and college. These programs can provide potential developmental mathematics students with an opportunity to bring their mathematics skills up to the college level. Strayhorn (2011) analyzed a 5-week summer bridge program that consisted of daily academic work from 8 a.m. to 3 p.m. on weekdays, plus "weekly math supplemental instruction sessions" (p. 148). Results showed students' mean academic skills were significantly higher at the end of the program than at the beginning. Wachen et al. (2018) analyzed five summer bridge programs operating at the University of North Carolina Chapel Hill in the years 2008 through 2014. The researchers found a positive correlation between summer bridge program attendance and persistence to the second and third years of college attendance.

Technology

Li and Ma (2010) completed a meta-analysis to determine how computer technology affects mathematics learning. They reviewed 76 studies with a combined total of 36,793 participants. These studies showed statistically significant positive effects of computer technology on mathematics learning. Childers and Lu (2017) found no statistically significant differences in grades or completion time between students taking classroom-based developmental mathematics classes and students taking computer-based developmental mathematics classes.

MyMathLab is used in some New Jersey community college classroom-based developmental mathematics classes and some of the college-level mathematics courses. MyMathLab is a part of MyFoundationsLab (Pearson Education, 2016) is an online program that instructors can use with their students for mathematics assessments, learning, and homework. Chingos, Griffiths, and Mulhern (2017) tested MyFoundationsLab use at three Maryland universities and saw small increases in student scores on placement retesting with limited student engagement on the platform.

Adaptive, individualized e-learning environments also yield positive benefits to mathematics students (Özyurt, Özyurt, Baki, & Güven, 2013). Li et al. (2013) found the use of “tailored instruction” using technology to be promising (p. 14). Assessment and

Learning in Knowledge Spaces (ALEKS) is an individualized online assessment and learning system that can be used for all levels of mathematics (ALEKS Corporation, 2015). Over the past few years, ALEKS has started to be used in developmental mathematics programs, such as at the University of Texas at El Paso (Lujan & Saxon, 2017). Woodruff-White et al. (2019) saw promising results with a pilot of the ALEKS Placement, Preparation, and Learning program as a placement test and ALEKS as a supplement to classroom instruction at Morgan State University. ALEKS Placement, Preparation, and Learning program was also used in a successful pilot program in Fall 2016 at the University of Maryland and found to be a reliable assessment of math ability for mathematics placement (Kowalewski, Stanwyck, & LaCourse, 2019). Some New Jersey community college computer lab-based developmental mathematics courses use ALEKS as their foundation. Okimoto and Heck (2015) found that students who complete a developmental mathematics sequence designed around ALEKS are more likely to enroll in college-level mathematics courses than students who attempt a traditional classroom developmental mathematics sequence.

Analysis of Findings

The bulk of the data came from interviews conducted with 10 testing and tutoring administrators between April 23, 2019 and June 24, 2019. These administrators represented six of the 18 New Jersey community colleges. When this research was being conducted, there were 19 community colleges in the state, but two merged a week after research concluded. Data from these two schools were treated as coming from two campuses of the same college to mirror the post merger situation. I reviewed records from all of the 18 colleges and incorporated them in the data analysis.

I used pseudonyms for the names of the community colleges. The names of the colleges were listed in a spreadsheet in alphabetical order, then a random sequence was generated using the random number generator on the website Random.org (see Haahr, 2019) to reorder the names and assign them corresponding letters from A to R. This list was only accessible to me.

Because titles can personally identifiable, no specific titles were used in this paper, and, when necessary, these staff members were identified by their area (i.e., testing, tutoring, or both) and a pseudonym matching the name of their community college (e.g., Testing Administrator A would be a testing administrator at Community College A). In the cases of duplicate administrators in the same area in the same college, a number was added after the letter based on the order the staff members were interviewed. The 10 administrators were Tutoring Administrator E, Testing Administrator E, Testing and Tutoring Administrator G, Tutoring Administrator L, Testing and Tutoring Administrator L, Testing Administrator M, Tutoring Administrator N, Testing Administrator O, Tutoring Administrator Q1, and Tutoring Administrator Q2.

Of the 10 administrators interviewed, five had recent/current administrative responsibility for just tutoring, three for just testing, and two for both testing and tutoring. Several had previous experience in these areas at other New Jersey community colleges prior to their current roles. All administrators had at least 10 years of experience in their respective areas of responsibility (testing and/or tutoring).

Several themes emerged from the interviews: (a) preparation availability, (b) timing, (c) constraint frustrations, (d) student attendance/usage, and (e) minimal intercollege consistency. The initial and pattern coding in the coding process revealed these five themes tying the interviews together. Aspects of each theme were discussed by most, if not all, of the interviewees in varying levels of detail.

Preparation Availability

Math placement test preparation was available at all 18 New Jersey community colleges in summer 2019. Although College P was the lone school not using an ACCUPLACER math placement test (only ACCUPLACER Next Generation Reading and English as a Second Language assessments), tutoring was available to help students prepare for their math classes and the first week pretest given by instructors in each math course to determine any changes to math level placement for the rest of the semester. The interviewees' colleges all offered and/or were in the process of developing some type of preparation to help students prepare for the math placement tests. Workshops, brush-up courses, boot camps, educational software programs, tutoring, and online resources were all discussed as being offered at interviewees' schools or as being options they heard were available at other New Jersey community colleges. College E offered a free monthly workshop during heavy registration/admission times and listed free self-guided resources on their website. College G held preparation courses through the noncredit area of the school. College L developed a large practice test and website that was used worldwide. In addition, students at College L had access to math tutoring during blocks of time specifically scheduled for ACCUPLACER preparation. Preparation workshops were also available at the school. College N had a college readiness program that worked with the local high schools to help their students prepare for the test.

College O provided students with a set of links to free websites with sample questions and tutorials. Testing Administrator O was considering the implementation of a summer preparation boot camp for incoming fall 2019 students. College Q received a multiyear grant to use EdReady (a customized online program) to specifically help students prepare for the ACCUPLACER. The grant was scheduled to end in November 2019, and plans were to discontinue use of the program in favor of the free ACCUPLACER preparation phone app offered by the College Board.

The research questions asked about testing and tutoring administrators' perceptions on how to help incoming New Jersey community college students achieve high enough scores on the ACCUPLACER mathematics tests to place into college-level mathematics courses. All of the interviewees recognized the importance and necessity to help incoming students prepare for the mathematics placement tests. Each interviewee expressed the desire to help these students as much as possible and offered students at least one preparation method, but none had confidence that their college's preparation method was optimal. This was encapsulated perfectly by Testing Administrator E: "I haven't found a magic bullet. I don't think anyone has. Again, if we found a magic bullet, we wouldn't be working here . . . I don't know what the answer is."

Program Timing

Colleges varied in the timing of their preparation programs, in terms of timing within the testing process and during the year. There was no consensus on when preparation was offered/marketed during the testing process. Some offered preparation prior to initial testing, some after the first test, some after the first retest, and some at multiple points. Schools provided preparation at various times of the year—in the summer, during heavy admission/registration times, in the spring before fall admission (at local high schools), and throughout the year.

Several administrators discussed students wanting to take the placement tests without preparation, then realizing they need preparation after they see the test or when they receive scores placing them into developmental courses. Testing and Tutoring Administrator L sees this constantly at College L: "'I graduated math in high school. Of course I'll do fine on this test.' It's only after they see the test, is it clear that they don't remember how to do the things." In another part of the interview, the administrator went into further detail:

> The unfortunate part is, the students do not avail themselves of those options nearly as often as they should. We have an intake form that we give to each student, and we encourage there, and in other places, for students to reschedule their appointment if they're not prepared. We have students who walk in off the street who admit to us upfront, "I am not prepared, I haven't done math in 100 years," and so on. One of our people here developed a large practice test that is being used worldwide …, and yet students still insist, "no, no, no, while I'm here I'll just take it." So while we have no prohibition against taking it, therefore, students will not avail themselves of that preparation. It is only after they take it,

> and come in much lower than they would have thought, do they suddenly realize "maybe I should have taken this seriously."

Students not taking the placements tests seriously was also specifically mentioned as being a problem at College G as well:

> … any way that you can prepare students to take a test and to get to them the idea that the test is serious, and it's not just something you can blow off because you could end up in developmentals. And we both know that cycle of developmentals —if you're in the lowest level, it usually takes you six years to get out of an associate degree. (Testing and Tutoring Administrator G)

At College E, proctors try to discourage students from taking the math placement test if the students do not feel ready. Students there read a written warning on the computer, and proctors have them review written instructions:

> After looking at some of these sample questions and reading the instructions to take the test, if you don't think that you're ready, please don't take the test. Tell the proctor, and we'll show you where you can get some study materials. (Testing Administrator E)

Few students are convinced (at most one per day) to leave, practice, and return. According to Testing Administrator E, most students come back a little while later: "But when they leave us for 20 minutes or an hour, exactly what they're doing for that hour we don't know, so I couldn't tell you what they did." Tutoring Administrator E encourages students to practice and tries "to stress to students that even though they want to take the test pretty soon, they maybe [should] take a couple days to refresh themselves, especially if they are looking at math that they haven't done since high school."

At College Q, the busiest time of year for their preparation (EdReady software) "was over the summer because guidance counselors of the local high schools would tell students about it. So they would come in over the summer to prepare for the ACCUPLACER test before they took it" (Tutoring Administrator Q1). College O is the opposite: "… please don't do this over the summer because you're going to have a severe lack of interest. Try over winter break" was the suggestion from Testing Administrator O.

Multiple administrators mentioned not being sure what the "best" preparation timing might be and thought they should be offering preparation at other times during the testing process and the year. The administrators' perceptions seemed to be doubt about when would be good timing for preparation. Clearly the administrators had different experiences regarding timing.

Constraint Frustrations

While there were differing experiences and opinions about test preparation timing, the interviewees universally expressed their frustrations with constraints around placement test preparation program offerings (and potential offerings). The main frustration was the lack of financial support/difficulty finding and/or maintaining funding for preparation initiatives. Many of the administrators took advantage of free resources from sources outside of their individual colleges. Non-free preparation was generally funded by administrators' regular budgets (workshops, tutoring, some courses, etc.) or student fees specifically for a preparation course. College Q received a grant but could not continue with the grant-funded program once the grant funds ran out.

Other constraint frustrations mentioned included doubt of which college department/division should be offering preparation; lack of student knowledge regarding preparation; student apathy about preparation; minimal student attendance/usage; other administrators, staff, and faculty not understanding the purpose of a math placement test, how a math placement test works, standard practices for student math placement, or potential benefits of math placement test preparation; and testing and tutoring administrators being blamed for poor student performance on the placement tests. Testing Administrator E experienced this directly:

> One time somebody was trying to point a finger at me and say, “You’re responsible for students not doing well on placement tests.” And I said, “How am I responsible? If I could make people do something they didn’t want to do, I would not be working here. I’d be God. I’d be working for the government. I don’t know what I’d be doing.” I can lead a horse to water, but come on. Give me a shotgun to make them drink. That’s the hard part.

The research questions asked about the testing and tutoring administrators’ perceptions, and clearly the administrators were frustrated at the variety of constraints around placement test preparation. These administrators want to help students, but these constraints limit and/or block what the administrators can do. Although these administrators had issues with constraints around the programs, often the students created their own constraints to success through a lack of attendance or usage of mathematics test preparation.

Student Attendance/Usage

Minimal student attendance/usage of any type of math test preparation was one of the biggest concerns shared by all of the interviewees. "The unfortunate part is, the students do not avail themselves of those options as often as they should" (Testing and Tutoring Administrator L). Testing Administrator E conducted an unpublished study several years ago. Students who took the placement test were asked if they prepared for the test. Approximately 50%-75% said no. Of the remainder, many said that their preparation was only an hour or less. When students took the test a second time, they were asked if they prepared this time. Although better than the first time, fewer than half of the students prepared for the second attempt at the test. Students just want to "finish the whole process rather than actually preparing for it" (Tutoring Administrator E).

Testing Administrator O conducted a similar study around the same time as Testing Administrator E. Testing Administrator O found that fewer than 30 total students over 2 years used their online placement test preparation (MyFoundationsLab). This was for both math and English preparation. Testing Administrator O called the program "a major flop" and mentioned that students might have "little or no interest in attending" placement preparation programs, have work and/or family obligations, or simply prefer to be "enjoying summer weather by the beach."

Other interviewees also expressed doubts that students take placement tests seriously. Testing and Tutoring Administrator L stated, "How do you bring a horse to water and force him to drink?" and suggested making preparation mandatory. Tutoring Administrator Q1 did not think students wanted to put in any extra work: "Will they put the time in? We found that a lot of times they'll get the log in, they'll get set up, and then they don't really use the product."

The research questions were about these administrators' perceptions, and they saw difficulties in getting students to complete (or even start) placement test preparation. The administrators saw many students not taking the time to prepare and not taking the tests seriously. The administrators want to help students but recognize that students need to want help and be willing to receive it. Should students be open to receiving help, however, there is a wide variety of what help they might obtain, depending on which community college they choose to attend.

Minimal Intercollege Consistency

Even though all of the New Jersey community colleges offered some type of math test preparation, there was minimal intercollege consistency among programs. No two schools offered the same math placement test preparation programs. Although each interviewee was aware that other colleges offered math placement preparation, no collaboration between the schools was seen, other than links to the same free online resources and a few schools linking to College L's ACCUPLACER preparation website.

Minimal intercollege consistency is closely related to the theme of preparation availability. All of the interviewees knew about workshops, brush-up courses, boot camps, educational software programs, tutoring, and online resources being offered at interviewees' schools or as being options they heard were available at other New Jersey community colleges. Even though all of the interviewees belonged to the statewide testing group and/or the statewide tutoring group, there was no discussion of collaboration between schools. Interviewees shared what preparation was offered at their own schools and what they knew about at other schools, but no one mentioned working together with other institutions. Part of this theme was therefore found in what was not said in the interviews. Sometimes what is not said can be as important as what is.

The research questions focused on testing and tutoring administrators' perceptions of students' math placement test preparation options. While every administrator was aware of options at other colleges, no one seemed to perceive that they were not working together with other schools. With all of the placement test preparation options, a strong case could be made for collaboration between multiple schools, especially at the statewide level from the two groups representing the New Jersey higher education testing and tutoring administrators.

Recommendations and Next Steps

One of the purposes of NJ TASIG is to ensure the New Jersey higher education testing administrators know what is going on with higher education testing around the state. NJ TAG was modeled after NJ TASIG and has the same purpose for New Jersey tutoring administrators. Submission of this paper (Appendix A) and accompanying presentation (Appendix B) to both groups provides awareness to the testing and tutoring administrators about the issues surrounding mathematics placement test preparation (primarily based on interviews with members of the two groups). Awareness of an issue or problem is the first step toward addressing it.

The intercollegiate inconsistency is the simplest of the findings to address. Once the testing and tutoring administrators are aware of the inconsistency, they can choose to address it. The two testing and tutoring administrator organizations can work together to create a position paper with recommendations for mathematics placement test preparation. This could be similar to the October 2017 New Jersey community college presidents' report regarding the use of placement test scores at New Jersey community colleges (NJCCC, 2017).

The organizers of the two groups can schedule a series of three to five monthly meetings for administrators to discuss the findings and share data about their mathematics test preparation resources. This can be a joint task force of the two groups. Administrators can compare information on programs and resources and determine how to best address the findings/themes of this study (preparation availability, timing, constraint frustrations, student attendance/usage, and minimal intercollege consistency), as well as the issues faced by potential developmental mathematics students (competing priorities, limited mathematics foundations, and mathematics anxiety).

Conclusion

The goal of this paper and its recommendations is the same as the goal of most education initiatives—student success. Educators want students to be successful. Following the recommendations of this paper will help students better prepare for the mathematics placement tests. Helping students better prepare for the mathematics placement tests will increase the number of students placing directly into college-level mathematics courses. By avoiding developmental mathematics courses, these students will benefit in a myriad of ways: potential financial savings of thousands of dollars per student, faster degree/certificate program completion, and a higher likelihood of degree/certificate program completion due to fewer opportunities to stop or drop out. These student benefits will translate into college benefits, most notably increased retention and graduation/completion rates. Although these benefits would start at the New Jersey community colleges, these recommendations could be used to help students and higher education institutions around the country.

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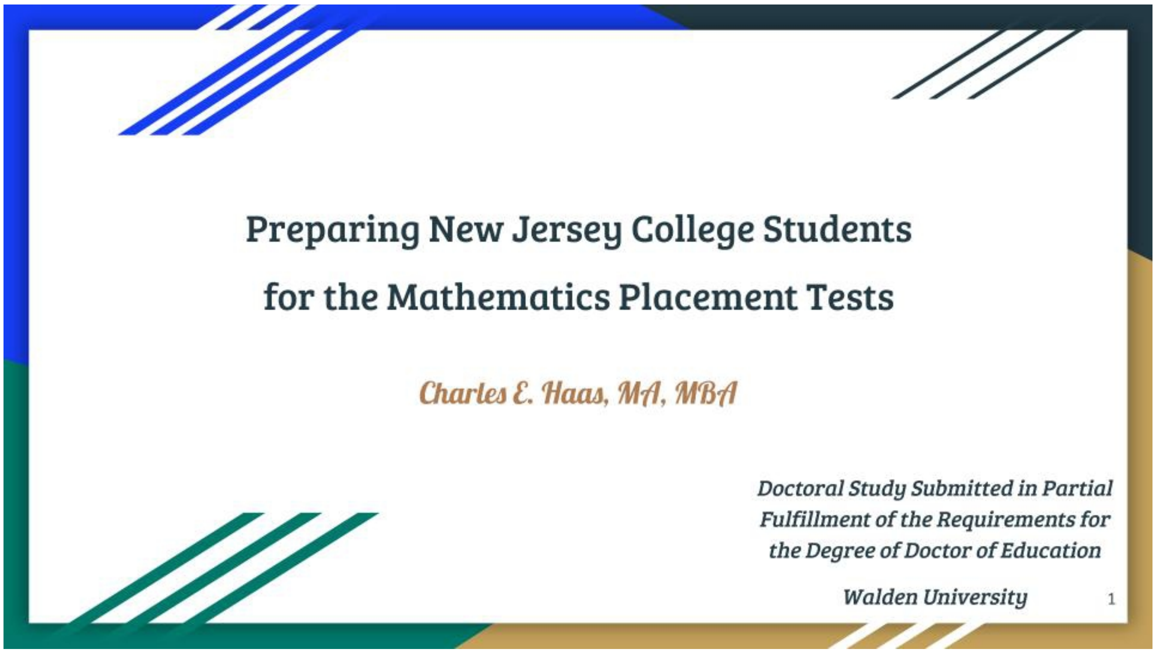
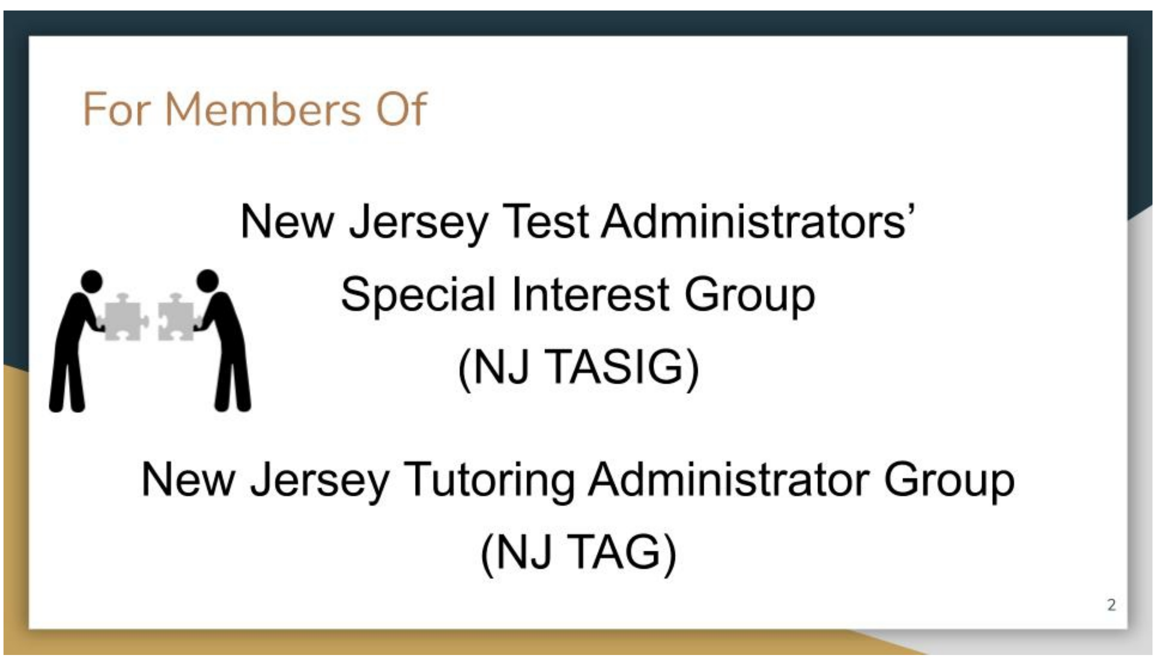
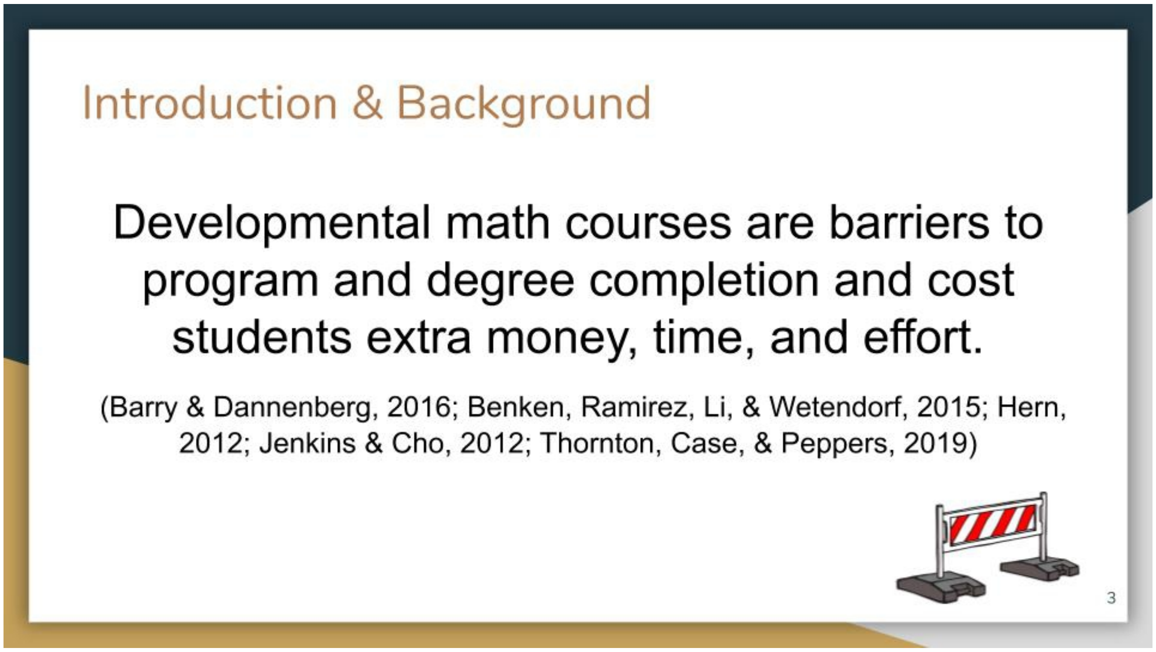
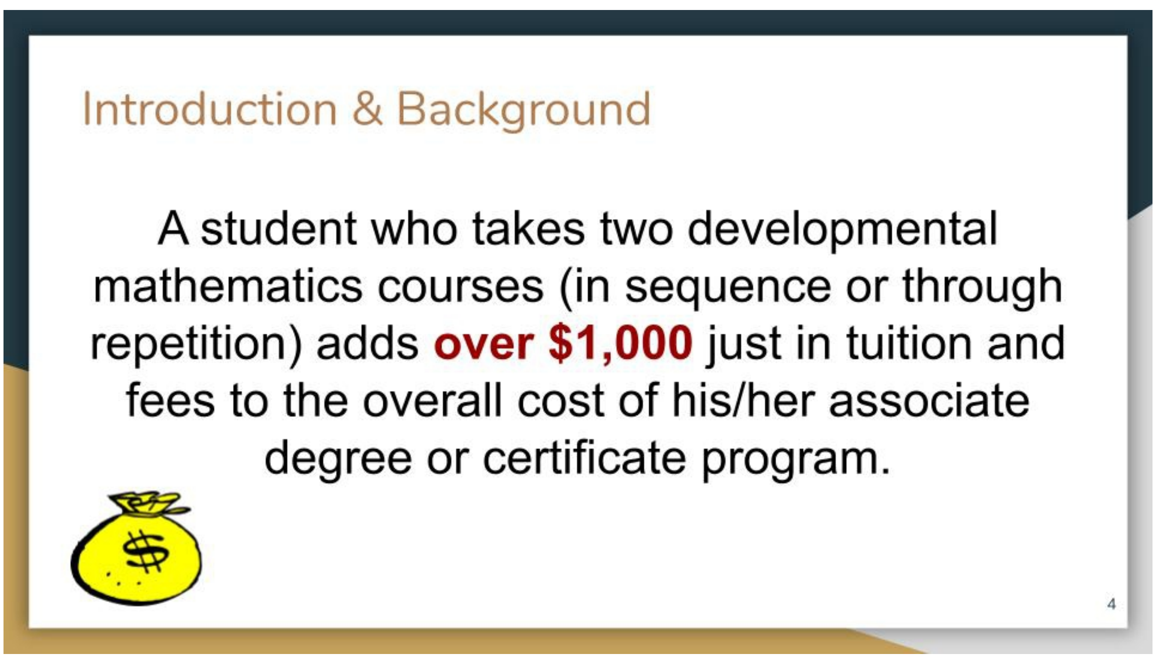
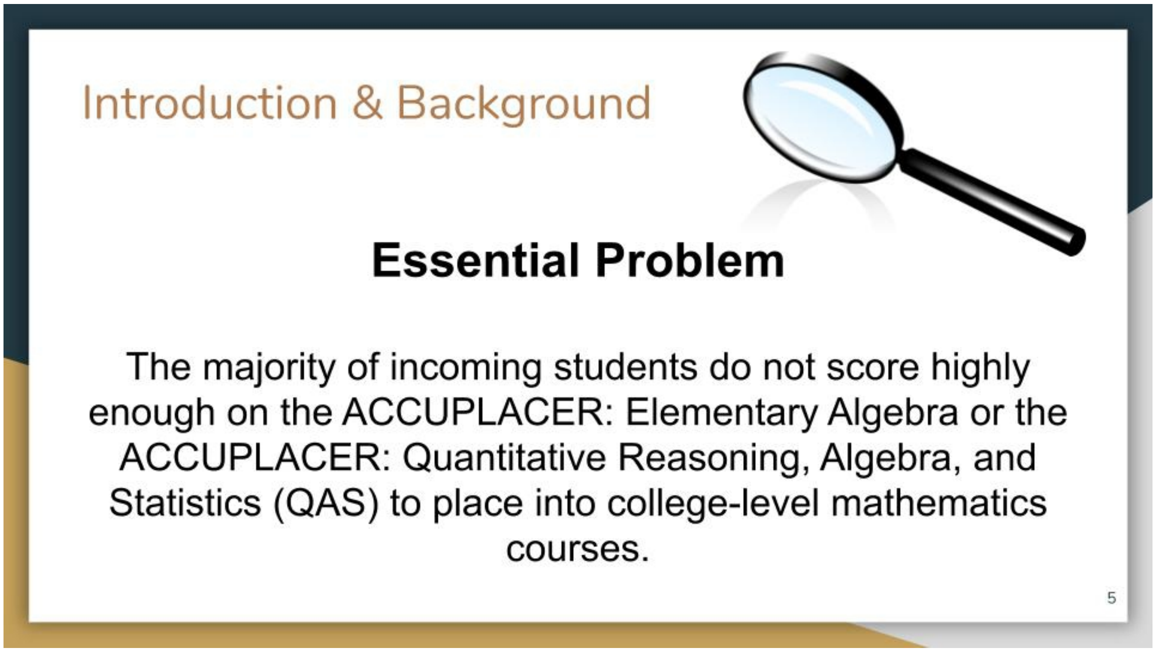
Appendix B: Presentation to Accompany Position/White Paper

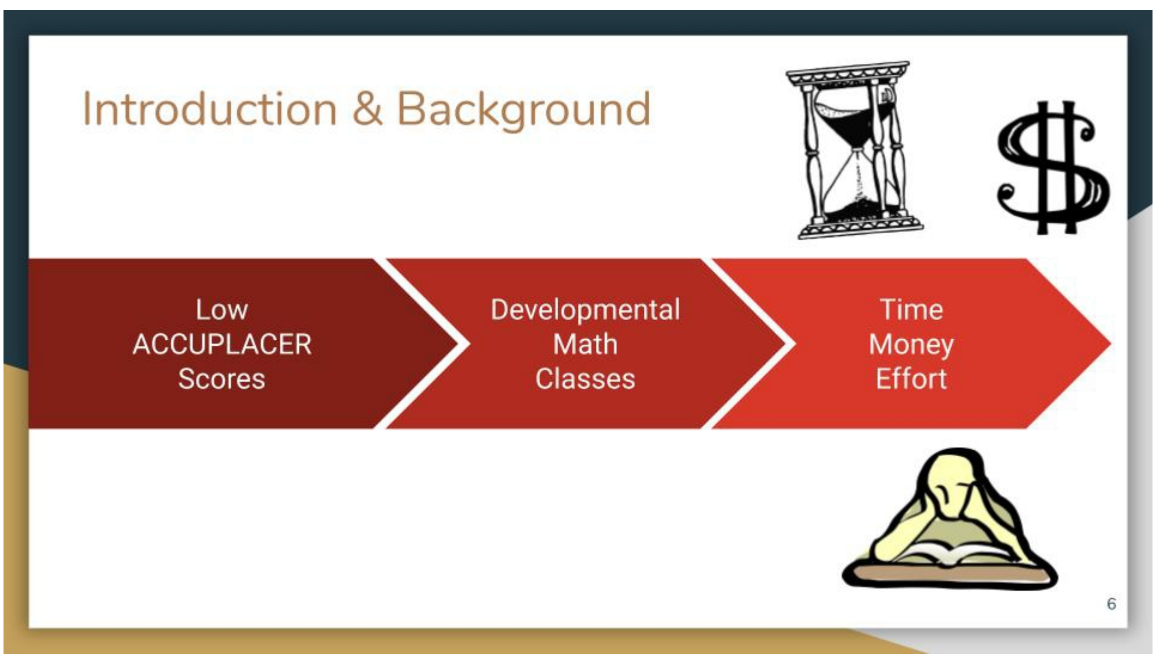


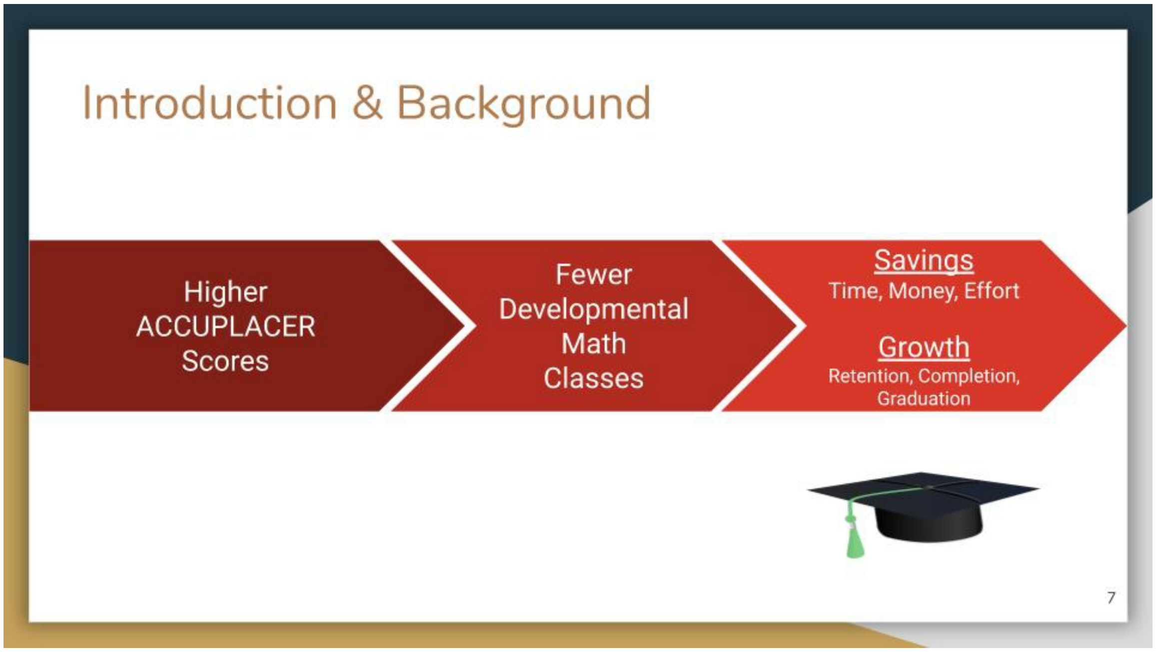


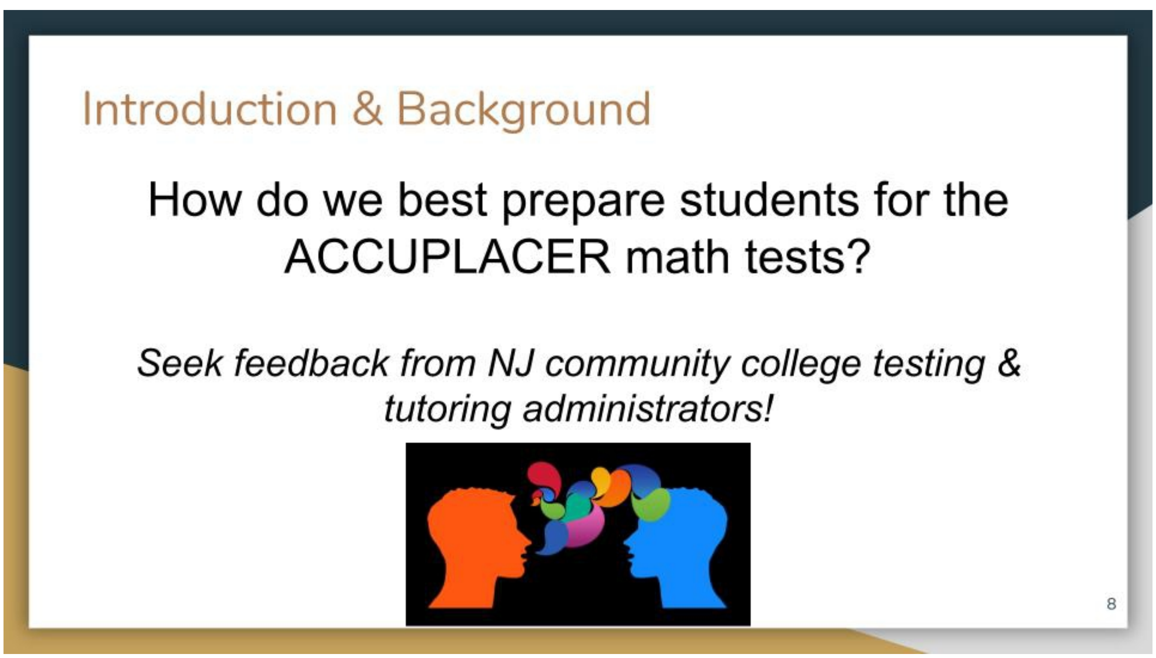

Introduction & Background
Developmental math courses are barriers to program and degree completion and cost students extra money, time, and effort.
(Barry & Dannenberg, 2016; Benken, Ramirez, Li, & Wetendorf, 2015; Hern, 2012; Jenkins & Cho, 2012; Thornton, Case, & Peppers, 2019)
3


Introduction & Background
A student who takes two developmental mathematics courses (in sequence or through repetition) adds over $1,000 just in tuition and fees to the overall cost of his/her associate degree or certificate program.
4


Introduction & Background
Essential Problem
The majority of incoming students do not score highly enough on the ACCUPLACER: Elementary Algebra or the ACCUPLACER: Quantitative Reasoning, Algebra, and Statistics (QAS) to place into college-level mathematics courses.
5


Introduction & Background
Low ACCUPLACER Scores
Developmental Math Classes
Time Money Effort
6


Introduction & Background
Higher ACCUPLACER Scores
Fewer Developmental Math Classes
Savings
Time, Money, Effort
Growth
Retention, Completion, Graduation
7


Introduction & Background
How do we best prepare students for the ACCUPLACER math tests?
Seek feedback from NJ community college testing & tutoring administrators!
8

Methodology

Qualitative Exploratory Case Study

Obtain Feedback from NJ Community College Testing & Tutoring Administrators

Determine How Incoming Students

Can Be Prepared for the Math Placement Tests

9

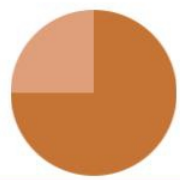
Literature Review: Introduction

Developmental mathematics itself is “a core community college challenge” (Asera, 2011, p. 28), and “the need to improve student success in community college has resulted in a growing interest in developmental mathematics” (Zientek, Fong, & Phelps, 2019, p. 183).

10

Literature Review: Introduction

Nearly **75%** of incoming community college students (including both full-time and part-time students) need to take remedial coursework in mathematics and/or English (National Center for Public Policy and Higher Education and the Southern Regional Board, 2010).



11

Literature Review: Introduction

Developmental math courses are typically **algebra**-based (Mejia, Rodriguez, & Johnson, 2016).

Incoming students hold a high school diploma (or the equivalent), which **required** demonstration of **algebraic and basic math competency** (Common Core State Standards Initiative, 2016; New Jersey Department of Education, 2014; Rosenstein, Caldwell, & Crown, 1996).

A study of 250,000 incoming students at 57 US college found that almost **60%** of these students placed into developmental math courses (Bailey, Jeong, & Cho, 2010).

12

Literature Review: Introduction

Disconnect

Between

Students Being Able to Demonstrate Algebraic & Basic Math Mastery to Earn a HS Diploma (or the Equivalent)

AND

Later Being Able to Demonstrate This Master on the Math Placement Tests

13

Literature Review: Introduction

Students taking developmental math courses might have either previously mastered the material and forgot it or never master it the first time they were exposed to it (Asera, 2011), but math placement test preparation programs can help (Zachry Rutschow & Schneider, 2012).

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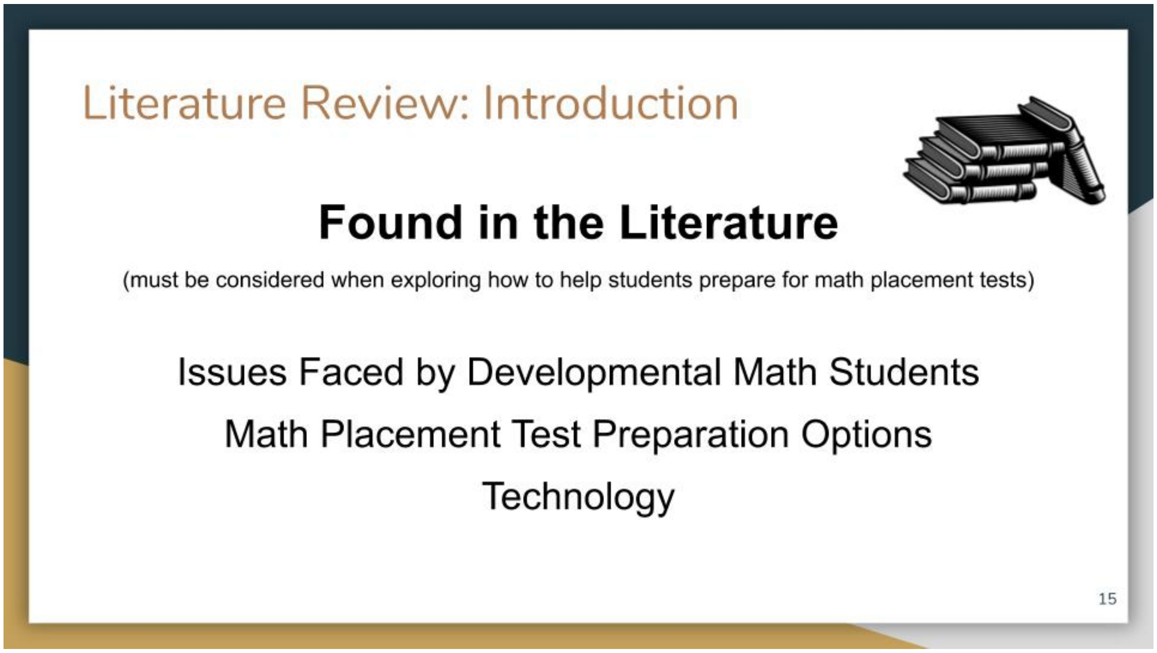
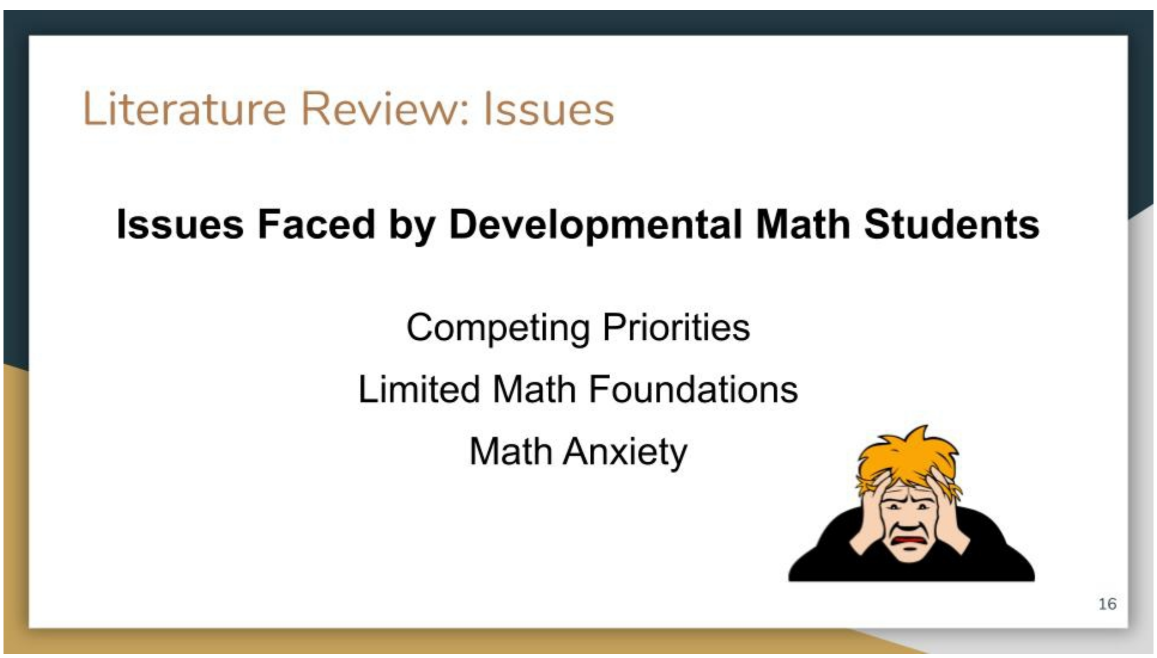

Literature Review: Introduction
Found in the Literature
(must be considered when exploring how to help students prepare for math placement tests)
Issues Faced by Developmental Math Students
Math Placement Test Preparation Options
Technology
15


Literature Review: Issues
Issues Faced by Developmental Math Students
Competing Priorities
Limited Math Foundations
Math Anxiety
16

Literature Review: Issues

Competing Priorities

Full-Time Careers
Part-Time Jobs
Community Leadership Positions
Families

17

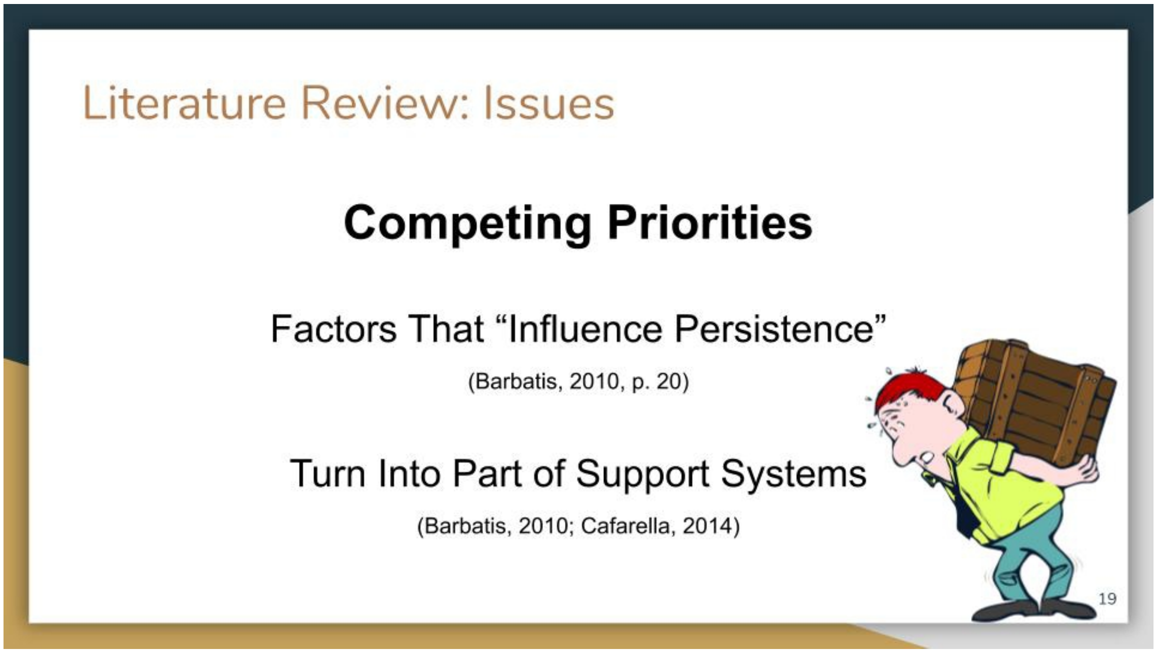
Literature Review: Issues

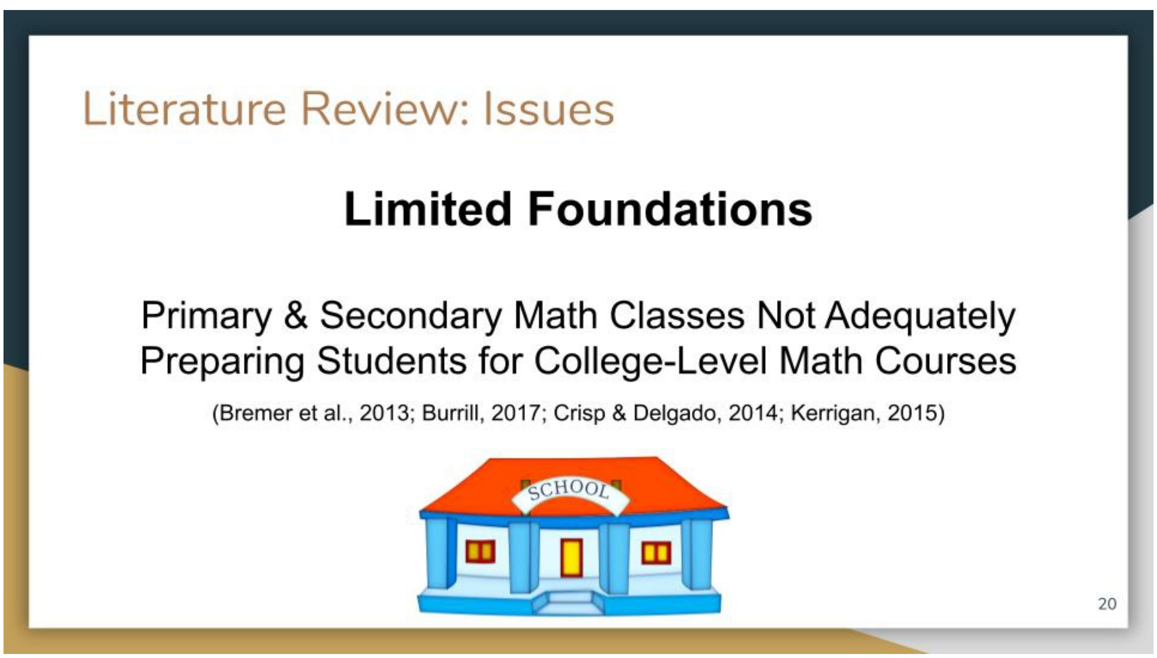
Competing Priorities

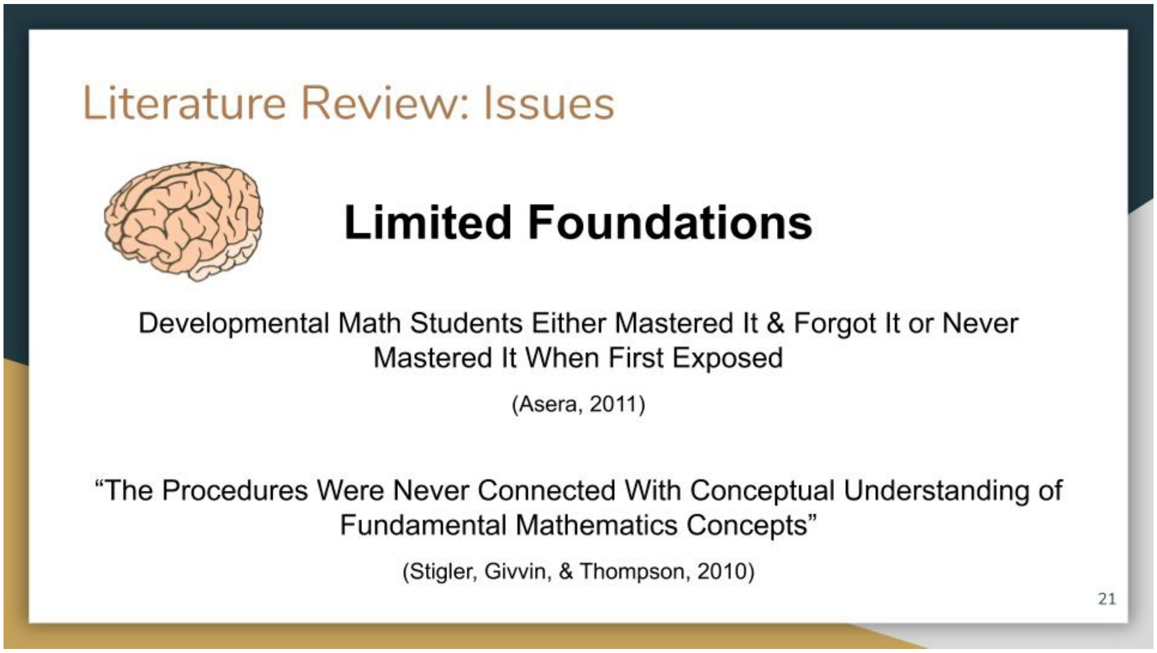
"Barriers to Success for Undergraduate Learners"
(Heller & Cassady, 2017, p. 4)

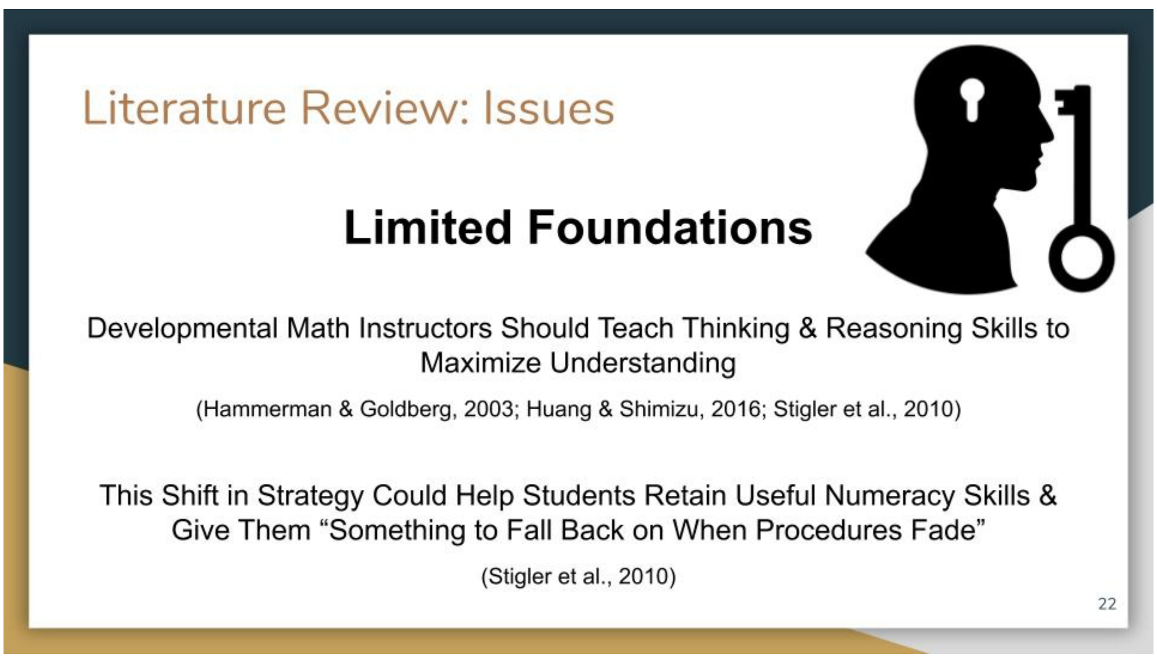
Can Result in Students Who *Stop Out* or *Drop Out*
(Cafarella, 2014; Ginsberg & Wlodkowski, 2010; Guy, Puri, & Cornick, 2016; Tennant, 2014)

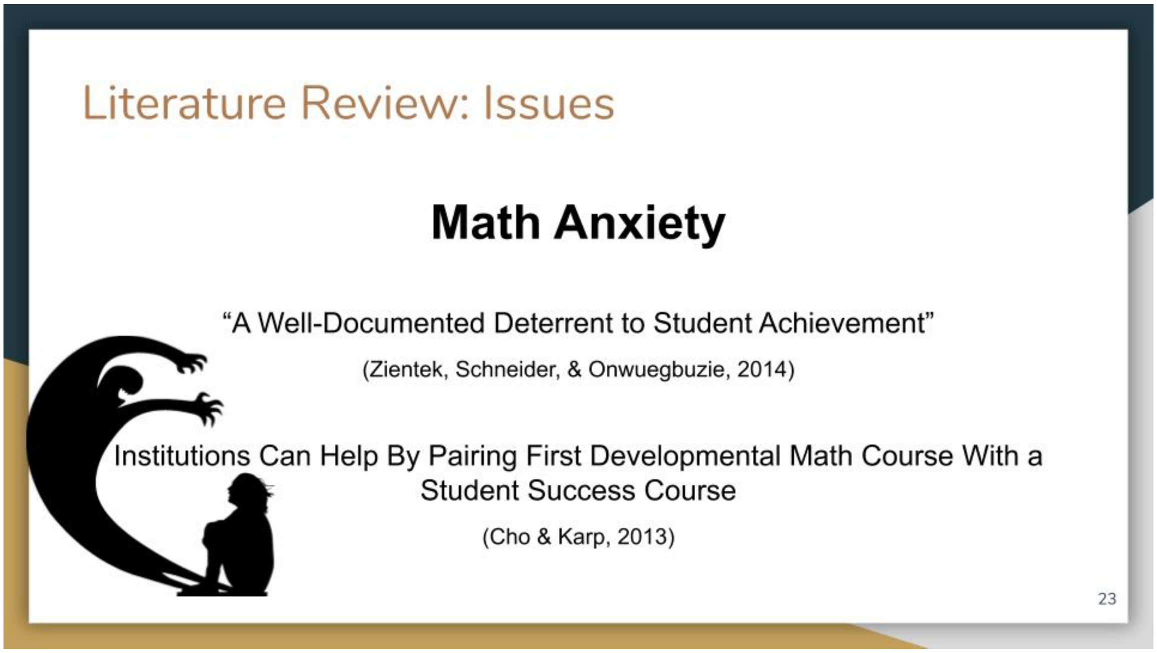
18

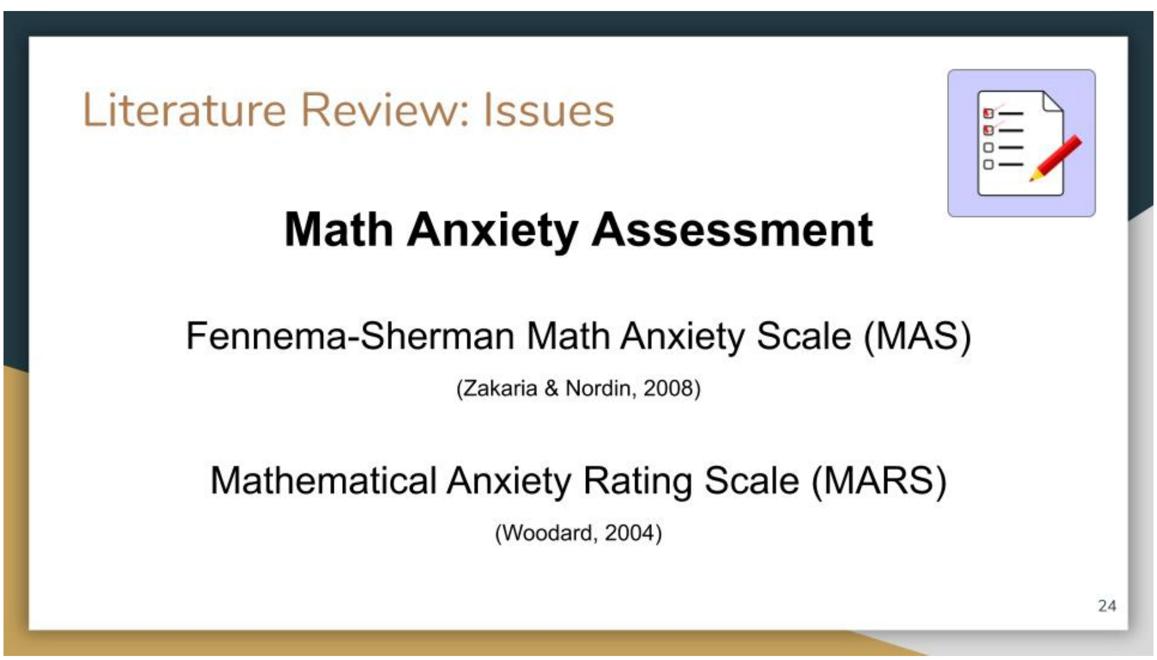

Literature Review: Issues
Competing Priorities
Factors That "Influence Persistence"
(Barbatis, 2010, p. 20)
Turn Into Part of Support Systems
(Barbatis, 2010; Cafarella, 2014)
19


Literature Review: Issues
Limited Foundations
Primary & Secondary Math Classes Not Adequately
Preparing Students for College-Level Math Courses
(Bremer et al., 2013; Burrill, 2017; Crisp & Delgado, 2014; Kerrigan, 2015)
SCHOOL
20


Literature Review: Issues
Limited Foundations
Developmental Math Students Either Mastered It & Forgot It or Never Mastered It When First Exposed
(Asera, 2011)
"The Procedures Were Never Connected With Conceptual Understanding of Fundamental Mathematics Concepts"
(Stigler, Givvin, & Thompson, 2010)
21


Literature Review: Issues
Limited Foundations
Developmental Math Instructors Should Teach Thinking & Reasoning Skills to Maximize Understanding
(Hammerman & Goldberg, 2003; Huang & Shimizu, 2016; Stigler et al., 2010)
This Shift in Strategy Could Help Students Retain Useful Numeracy Skills & Give Them "Something to Fall Back on When Procedures Fade"
(Stigler et al., 2010)
22


Literature Review: Issues
Math Anxiety
“A Well-Documented Deterrent to Student Achievement”
(Zientek, Schneider, & Onwuegbuzie, 2014)
Institutions Can Help By Pairing First Developmental Math Course With a Student Success Course
(Cho & Karp, 2013)
23


Literature Review: Issues
Math Anxiety Assessment
Fennema-Sherman Math Anxiety Scale (MAS)
(Zakaria & Nordin, 2008)
Mathematical Anxiety Rating Scale (MARS)
(Woodard, 2004)
24

Literature Review: Issues

Math Anxiety Reduction

A Safe Atmosphere for Students to Express Thoughts, Ideas, & Opinions

(Bonham & Boylan, 2011)

Alternate Assessment Strategies, Including Oral Questioning, Observation, Projects, & Retests

(Woodard, 2004)

Tutoring Interventions

(Gallard, Albritton, & Morgan, 2010)

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Literature Review

Math Placement Test Preparation Options

In 2015, All NJ Community Colleges Offered Some Type of Mathematics Placement Test Preparation:

Bridge Programs, Brush-Up Courses, Webpages, Sample Tests, Etc.

(New Jersey Center for Student Success, 2015)

Summer Bridge Programs Help

(Couturier & Cullinane, 2015; Strayhorn, 2011; Wachen, Pretlow, & Dixon, 2016)

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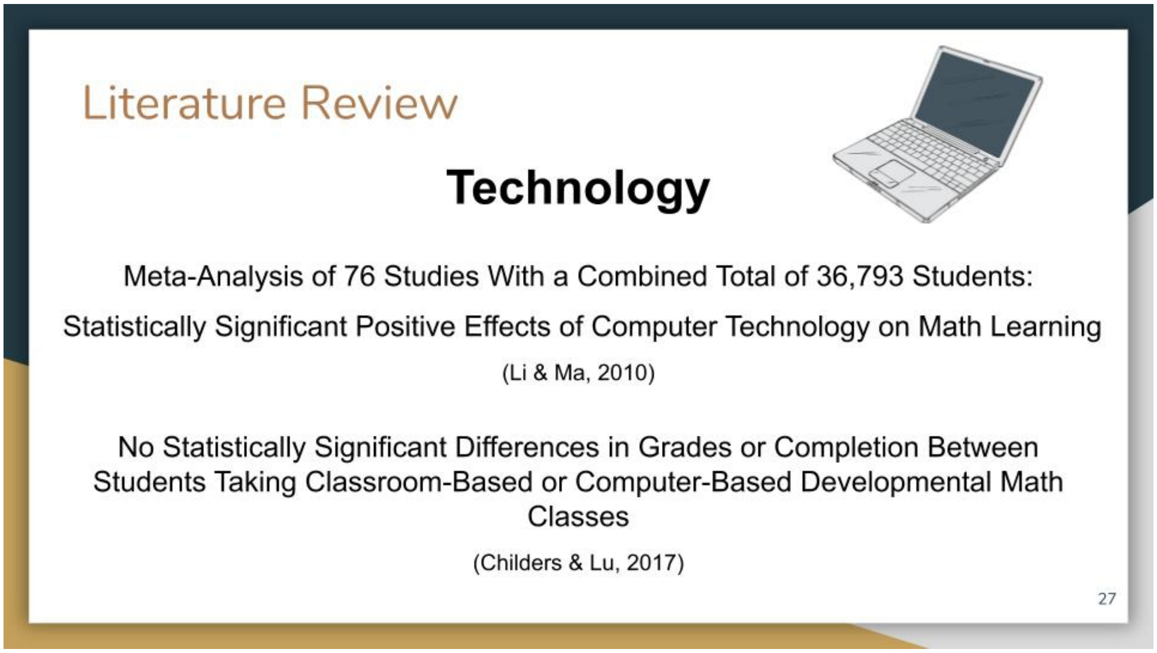
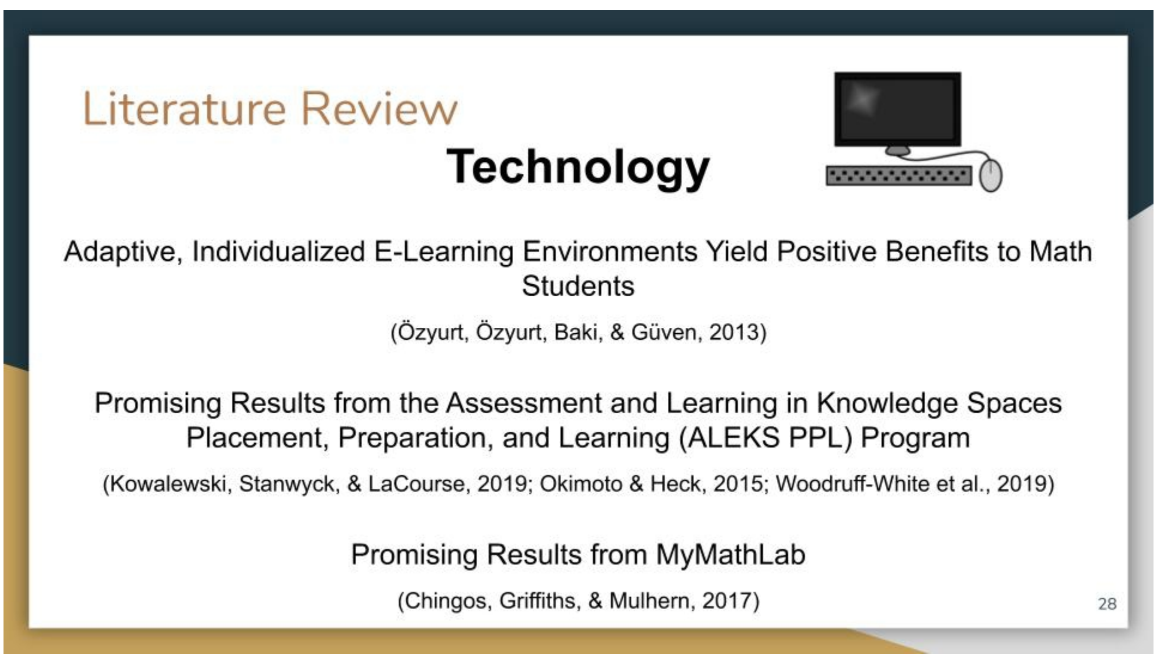
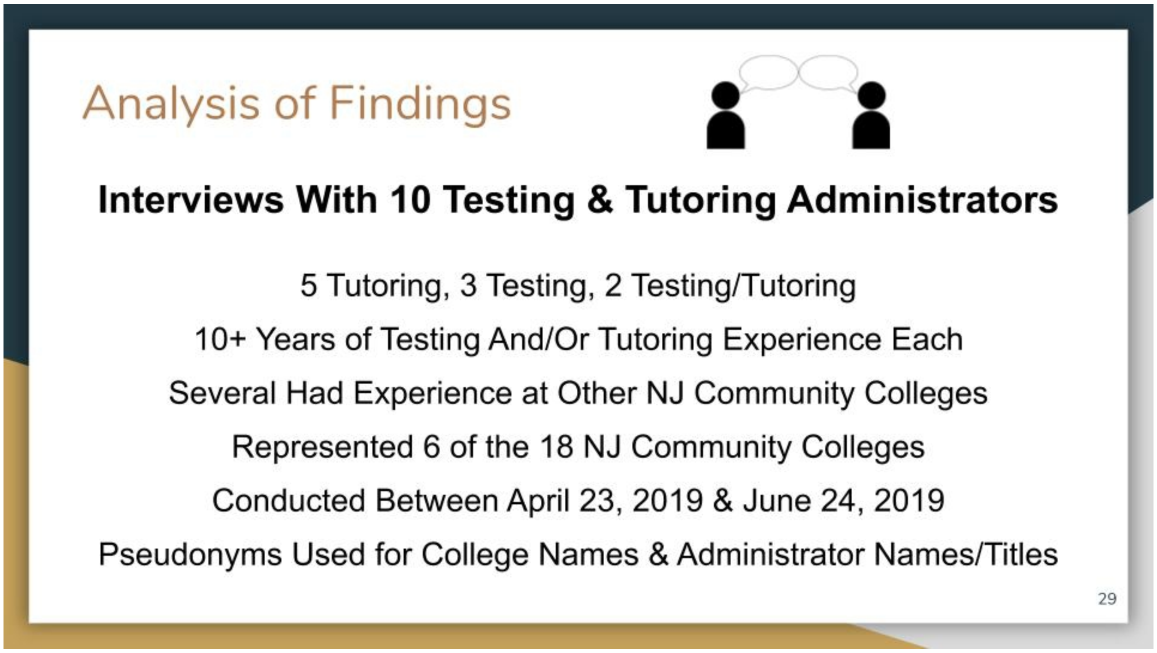
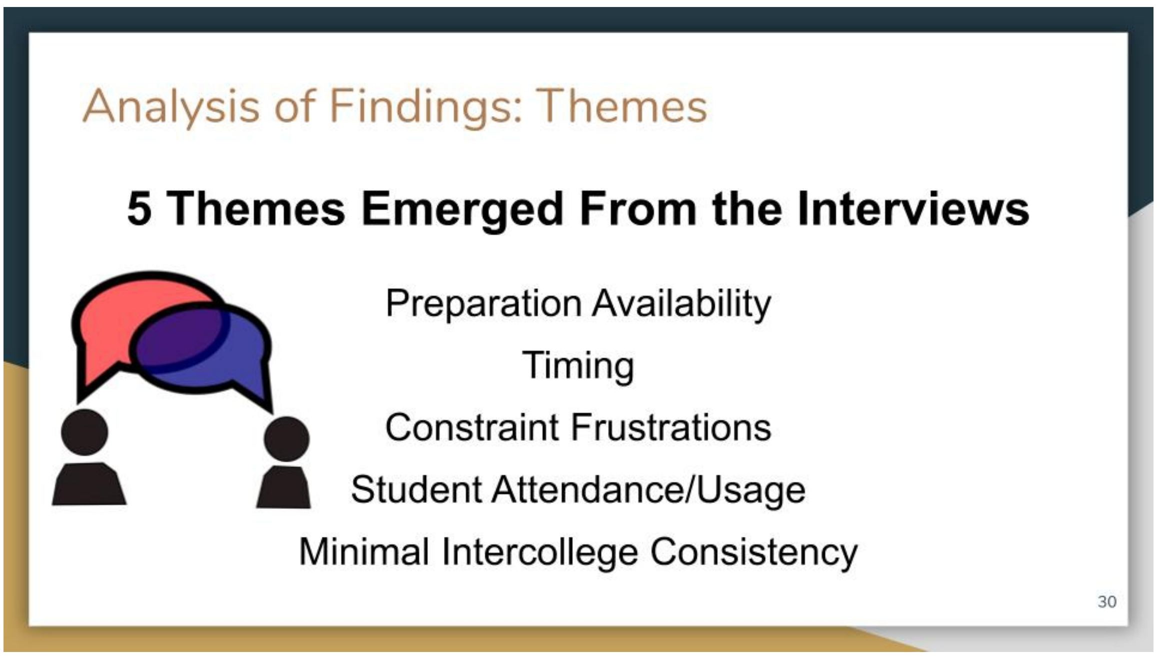

Literature Review
Technology
Meta-Analysis of 76 Studies With a Combined Total of 36,793 Students:
Statistically Significant Positive Effects of Computer Technology on Math Learning
(Li & Ma, 2010)
No Statistically Significant Differences in Grades or Completion Between Students Taking Classroom-Based or Computer-Based Developmental Math Classes
(Childers & Lu, 2017)
27


Literature Review
Technology
Adaptive, Individualized E-Learning Environments Yield Positive Benefits to Math Students
(Özyurt, Özyurt, Baki, & Güven, 2013)
Promising Results from the Assessment and Learning in Knowledge Spaces Placement, Preparation, and Learning (ALEKS PPL) Program
(Kowalewski, Stanwyck, & LaCourse, 2019; Okimoto & Heck, 2015; Woodruff-White et al., 2019)
Promising Results from MyMathLab
(Chingos, Griffiths, & Mulhern, 2017)
28


Analysis of Findings
Interviews With 10 Testing & Tutoring Administrators
5 Tutoring, 3 Testing, 2 Testing/Tutoring
10+ Years of Testing And/Or Tutoring Experience Each
Several Had Experience at Other NJ Community Colleges
Represented 6 of the 18 NJ Community Colleges
Conducted Between April 23, 2019 & June 24, 2019
Pseudonyms Used for College Names & Administrator Names/Titles
29


Analysis of Findings: Themes
5 Themes Emerged From the Interviews
Preparation Availability
Timing
Constraint Frustrations
Student Attendance/Usage
Minimal Intercollege Consistency
30

Analysis of Findings: Themes

Preparation Availability

Math Placement Test Preparation Available at All 18 NJ Community Colleges in Summer 2019

Workshops, Brush-Up Courses, Boot Camps, Educational Software Programs, Tutoring, & Online Resources

31

Analysis of Findings: Themes

Preparation Availability

None of the Interviewees Were Confident Their College's Preparation Method Was Optimal

"I haven't found a magic bullet. I don't think anyone has. Again, if we found a magic bullet, we wouldn't be working here . . . I don't know what the answer is."

(Testing Administrator E)

32

Analysis of Findings: Themes

Program Timing

Various Points Within the Testing Process

Prior to Initial Testing

After the First Test

After the First Retest

Multiple Points

33

Analysis of Findings: Themes

Program Timing

Students Want to Test Without Preparation, Then Realize They Need It After Receiving Their Scores

"'I graduated math in high school. Of course I'll do fine on this test.' It's only after they see the test, is it clear that they don't remember how to do the things."

(Testing and Tutoring Administrator L)

34

Analysis of Findings: Themes

Program Timing

Various Times of Year

In the Summer

During Heavy Admission/Registration Times

In the Spring

Throughout the Year

35

Analysis of Findings: Themes

Program Timing

Various Times of Year

At College Q, the busiest time of year for their preparation (EdReady software) "was over the summer because guidance counselors of the local high schools would tell students about it. So they would come in over the summer to prepare for the ACCUPLACER test before they took it" (Tutoring Administrator Q1). College O is the opposite: "… please don't do this over the summer because you're going to have a severe lack of interest. Try over winter break" was the suggestion from Testing Administrator O.

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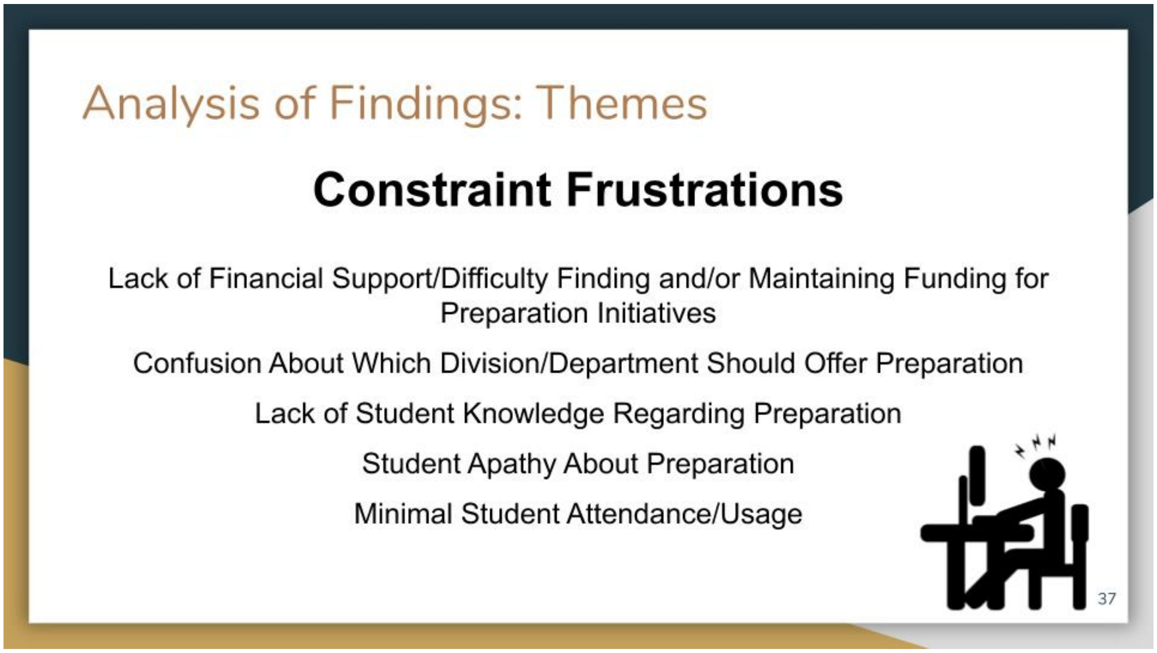
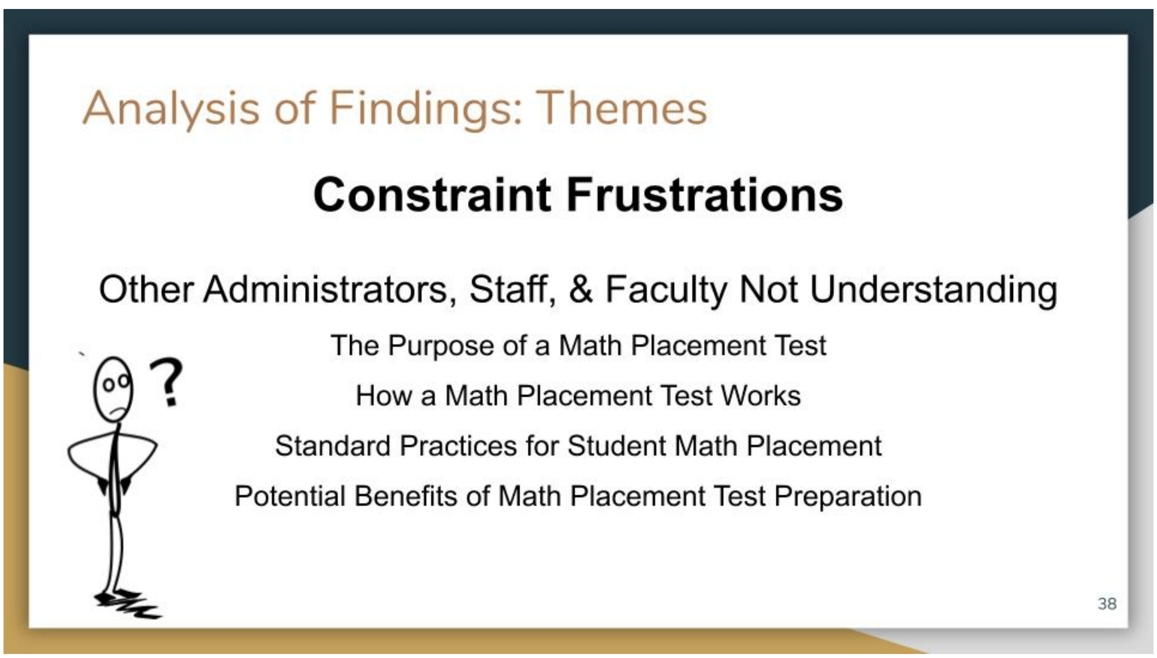

Analysis of Findings: Themes
Constraint Frustrations
Lack of Financial Support/Difficulty Finding and/or Maintaining Funding for Preparation Initiatives
Confusion About Which Division/Department Should Offer Preparation
Lack of Student Knowledge Regarding Preparation
Student Apathy About Preparation
Minimal Student Attendance/Usage
37


Analysis of Findings: Themes
Constraint Frustrations
Other Administrators, Staff, & Faculty Not Understanding
The Purpose of a Math Placement Test
How a Math Placement Test Works
Standard Practices for Student Math Placement
Potential Benefits of Math Placement Test Preparation
38

Analysis of Findings: Themes

Constraint Frustrations

Testing & Tutoring Administrators Being Blamed for Poor Student Performance on the Placement Tests

One time somebody was trying to point a finger at me and say, “You’re responsible for students not doing well on placement tests.” And I said, “How am I responsible? If I could make people do something they didn’t want to do, I would not be working here. I’d be God. I’d be working for the government. I don’t know what I’d be doing.” I can lead a horse to water, but come on. Give me a shotgun to make them drink. That’s the hard part.

(Testing Administrator E)

39

Analysis of Findings: Themes

Student Attendance/Usage

Minimal Student Attendance/Usage of Math Test Preparation

Students just want to “finish the whole process rather than actually preparing for it.”

(Tutoring Administrator E)

“Will they put the time in? We found that a lot of times they’ll get the log in, they’ll get set up, and then they don’t really use the product.”

(Tutoring Administrator Q1)

40

Analysis of Findings: Themes

Student Attendance/Usage

Unpublished Study by Testing Administrator E

Students who took the placement test were asked if they prepared for the test. Approximately **50-75% said no**. Of the remainder, many said that their preparation was only an hour or less. When students took the test a second time, they were asked if they prepared this time. Although better than the first time, fewer than half of the students prepared for the second attempt at the test.

41

Analysis of Findings: Themes

Student Attendance/Usage

Unpublished Study by Testing Administrator O

Fewer than 30 total students over two years used College O's online placement test preparation (MyFoundationsLab). This was for both math and English preparation. Testing Administrator O called the program "a **major flop**" and mentioned that students might have "little or no interest in attending" placement preparation programs, have work and/or family obligations, or simply prefer to be "enjoying summer weather by the beach."

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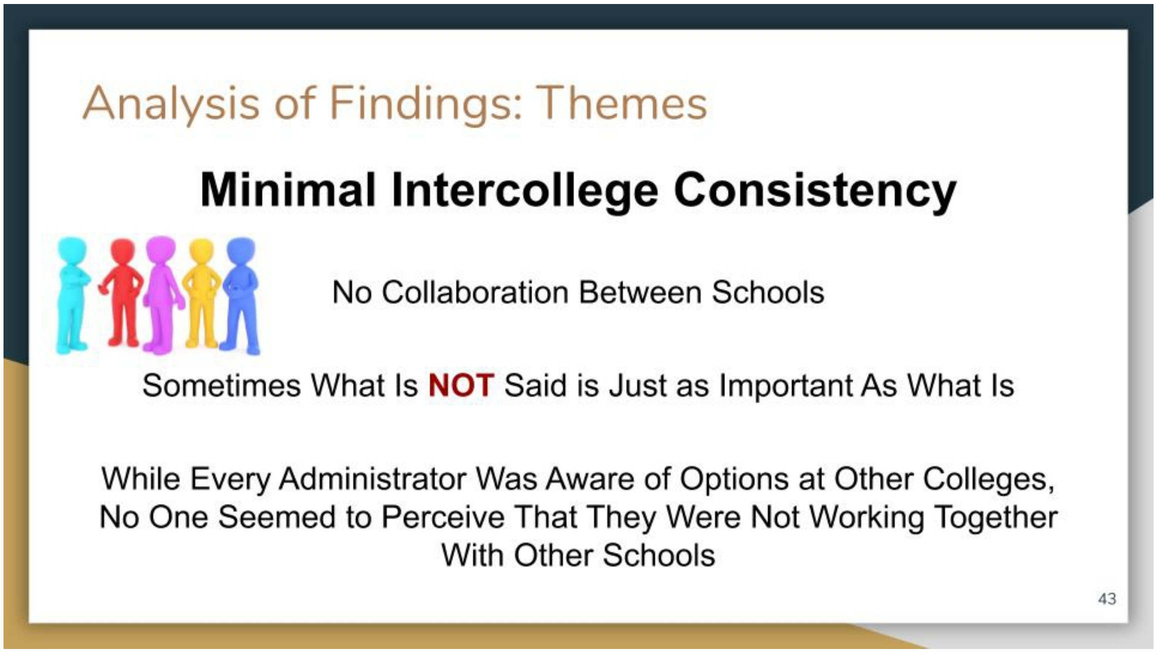
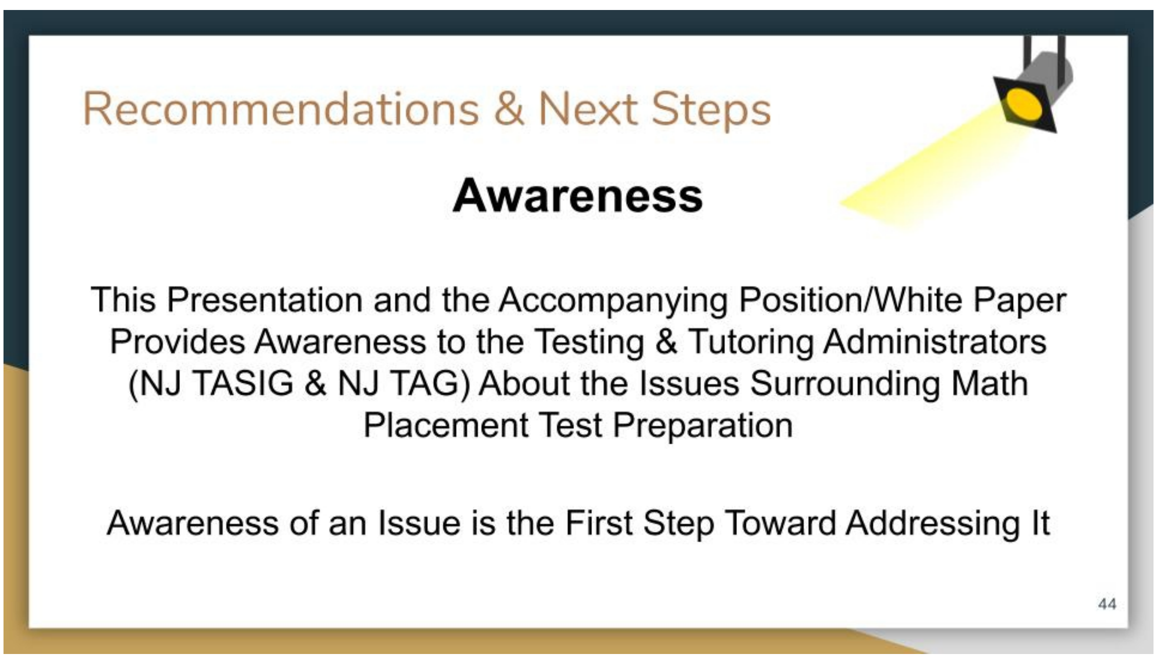
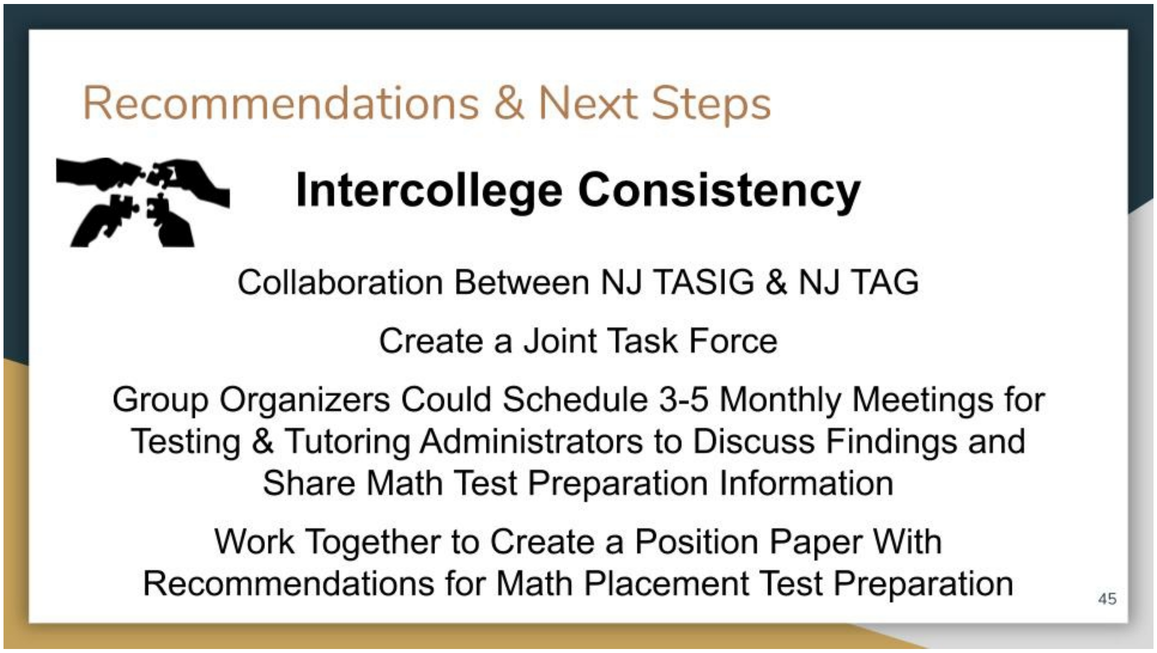
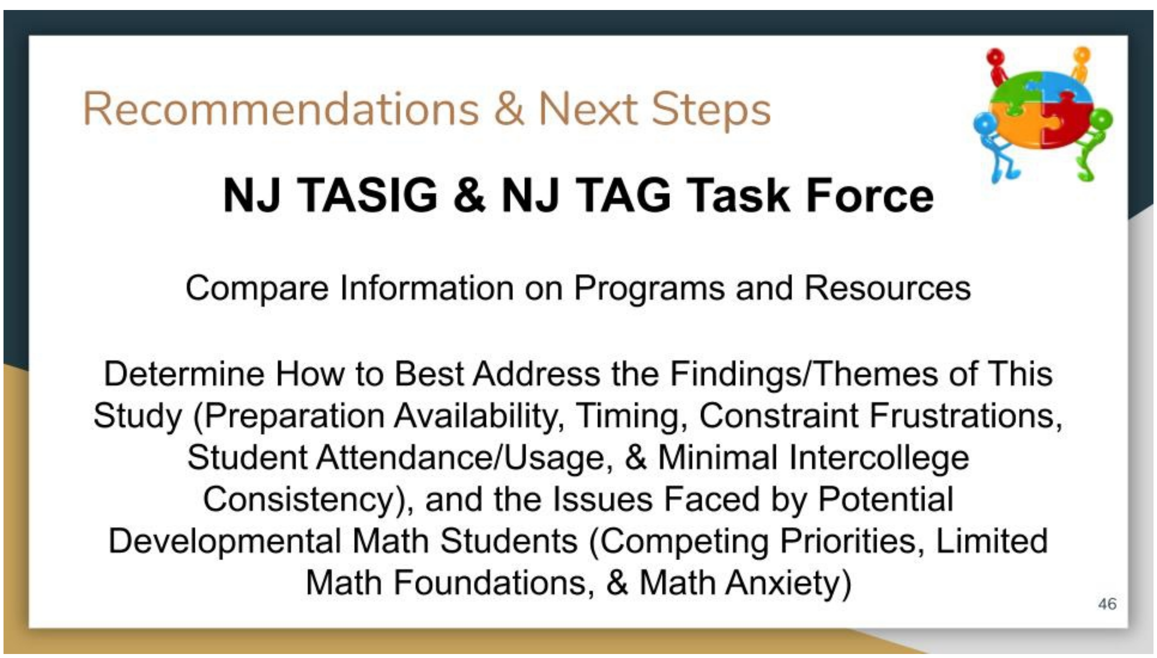
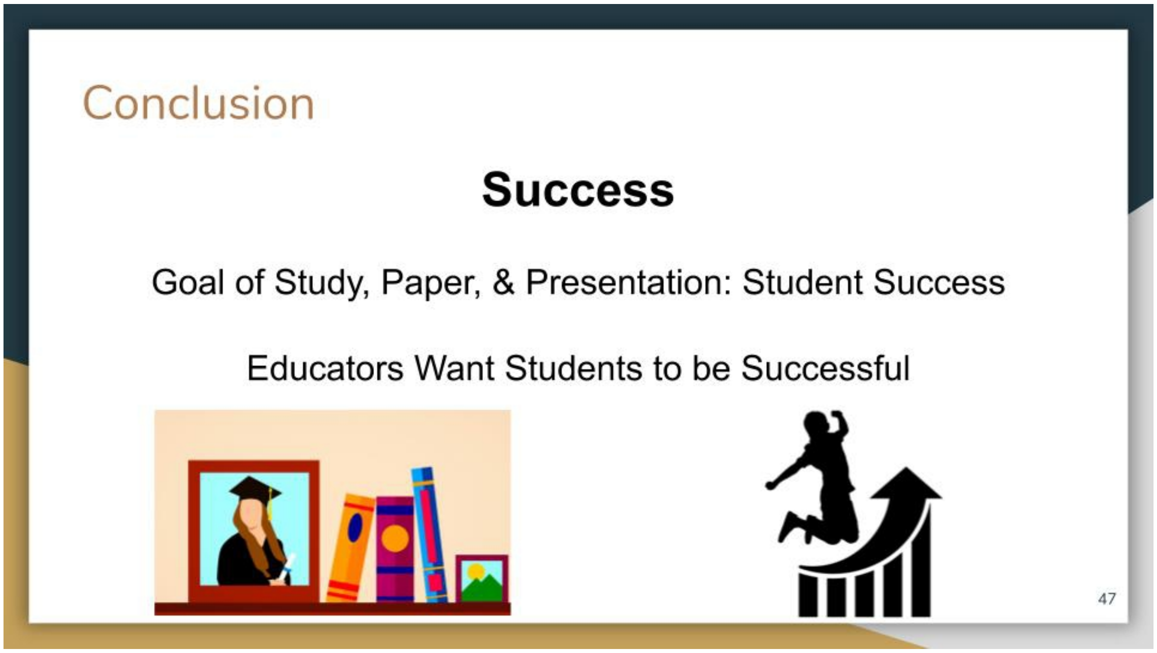
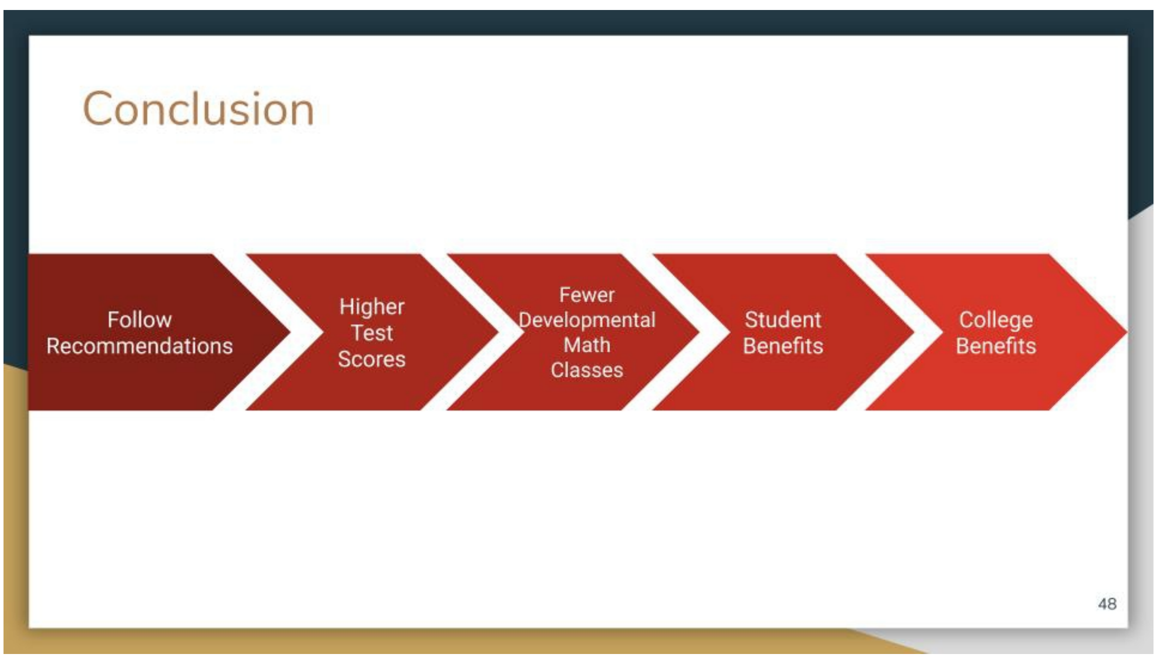

Analysis of Findings: Themes
Minimal Intercollege Consistency
No Collaboration Between Schools
Sometimes What Is NOT Said is Just as Important As What Is
While Every Administrator Was Aware of Options at Other Colleges, No One Seemed to Perceive That They Were Not Working Together With Other Schools
43


Recommendations & Next Steps
Awareness
This Presentation and the Accompanying Position/White Paper Provides Awareness to the Testing & Tutoring Administrators (NJ TASIG & NJ TAG) About the Issues Surrounding Math Placement Test Preparation
Awareness of an Issue is the First Step Toward Addressing It
44


Recommendations & Next Steps
Intercollege Consistency
Collaboration Between NJ TASIG & NJ TAG
Create a Joint Task Force
Group Organizers Could Schedule 3-5 Monthly Meetings for Testing & Tutoring Administrators to Discuss Findings and Share Math Test Preparation Information
Work Together to Create a Position Paper With Recommendations for Math Placement Test Preparation
45


Recommendations & Next Steps
NJ TASIG & NJ TAG Task Force
Compare Information on Programs and Resources
Determine How to Best Address the Findings/Themes of This Study (Preparation Availability, Timing, Constraint Frustrations, Student Attendance/Usage, & Minimal Intercollege Consistency), and the Issues Faced by Potential Developmental Math Students (Competing Priorities, Limited Math Foundations, & Math Anxiety)
46


Conclusion
Success
Goal of Study, Paper, & Presentation: Student Success
Educators Want Students to be Successful
47


Conclusion
Follow Recommendations
Higher Test Scores
Fewer Developmental Math Classes
Student Benefits
College Benefits
48

Conclusion

Student Benefits

Potential Financial Savings of Thousands of Dollars Per Student, Faster Degree/Certificate Program Completion, & a Higher Likelihood of Degree/Certificate Program Completion Due to Fewer Opportunities to Stop or Drop Out

College Benefits

Most Notably Increased Retention & Graduation/Completion Rates

49

Conclusion

Benefits

Although These Benefits Would Start at NJ Community Colleges, These Recommendations Could be Used to Help Students & Higher Education Institutions Across the Country

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Questions?

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Appendix C: Interview Questions

1. What is your role at your community college?

2. How does your role relate to the ACCUPLACER mathematics tests?

3. Are you aware of incoming students' options at your college for help preparing for the ACCUPLACER mathematics tests?

    3a. If so, what do you think of these options?

    3b. How can they be improved?

4. Are you aware of programs at other NJ community colleges for helping students prepare for the ACCUPLACER mathematics tests?

    4a. If so, what do you think of these programs?

    4b. How can these programs be improved?

5. What options should incoming community college students be offered to help them prepare for the ACCUPLACER mathematics tests?

6. What are the issues with the new versions of the ACCUPLACER mathematics tests?

7. What are your concerns with the new versions of the ACCUPLACER mathematics tests?