

PLACEMENT TESTING AND THE MATH REMEDIATION PROCESS !

by !

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ABSTRACT

This quantitative research study investigated the student pathways to a transferable Math course. This study focused on a preselected sample size of students from an open-door, open-access, comprehensive community college in the Midwest. Incoming students complete an application and, as an open-door institution, all students are accepted to the college. However, student course readiness is assessed before a student can secure enrollment. Course enrollment is aligned to placement scores. Students have two options for Math placement: Submit an acceptable high school grade in Math or an acceptable assessment score; or complete an assessment test on campus.

Students who opt to take an on-campus Math placement test may retake the test if they are not satisfied with their initial scores and may also opt to remediate by using online services provided by ALEKS-PPL or Accuplacer. For this study, the day of week and the specific week of the month determined which placement test a student took during the research period. The researcher collected the initial placement score, the retest placement score, number of hours of remediation, as well as the student's demographic information.

Based on the results, students who completed at least one or more hours of remediation increased their Math placement score on an average of seven points. More females completed remediation hours and the 24 and older age group completed more

remediation hours. Almost half the students who remediated in Accuplacer or ALEKS-PPL placed into a transferable Math course the following semester.

KEY WORDS: Mathematics placement, placement testing, remedial Math

DEDICATION

This dissertation is dedicated to my family and especially to my parents, who have supported me in all of my endeavors. They have always encouraged me to pursue what I have wanted to do and have been there for me. I also acknowledge my husband, Brian, for his unfailing love. My children, Addison and Andrew, have been so inspirational to me. Each of them brings me happiness seeing them grow in the world today and what the future holds for them. As this time in my life comes to a close, I look forward to the future and being able to continue to support my family.

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CHAPTER ONE: INTRODUCTION !

Introduction *

In 2009, President Obama cited the need for an additional five million community college degrees and certificates over the ensuing decade and encouraged every American to commit to at least one year or more of higher education or career training (Cohen, Brawer, & Kisker, 2014, p. 14). In his first address to a joint session of Congress in February 2009, President Barack Obama said that by 2020, America should “...once again have the highest proportion of college graduates in the world” (Fry, 2017). Community colleges will play a significant part in that process.

Placement testing can influence a student’s choice to enroll in or remain at a community college. In the 1980s, placement testing in colleges gained momentum with the requirement for students to take an assessment exam before entering college. For example, Miami Dade Community College required all students to take placement exams. Subsequently, if the student did not succeed in certain courses, they were suspended. The college saw a decrease in enrollment, but a few years later enrollment stabilized, and the policy change was successful. Florida, Tennessee, Georgia, New Jersey, and Texas mandated that all students seeking a degree take placement exams to test basic skills. About 90% of two-year colleges in the 1980s tested first-time students; currently, about 92% of two-year colleges offer placement exams (Cohen, Brawer, & Kisker, 2014, p. 69). Some recommend that students enroll in the suggested

level; other institutions mandate developmental enrollment based on a specified cutoff score (Cohen, Brawer, & Kisker, 2014, p. 69). There are two sides to requiring placement testing. As some students are not accurately assessed and must take developmental courses when they are not necessary. On the other hand, some students are placed into college-level courses and are not successful in the course they enrolled in. Community colleges are open access, so the preparedness of students who enroll varies. Student persistence at community colleges is something that should be tracked and reviewed regularly compared to a student's placement testing scores.

The College Board reported that the goal for the college completion agenda is to "Increase the proportion of 25- to 34-year-olds who hold an associate degree or higher to 55% by the year 2025 in order to make America the leader in education attainment in the world" (Hughes, 2013, p. 2). According to U.S. Census data from 2011, 43.1% of Americans ages 25 to 34 hold a two- or four-year college degree, an increase of two percentage points from the 2009 figure (Hughes, 2013, p. 3). Even though that is a goal, there are other factors that help students be successful, including student motivation and preparation for college. Incoming students select careers that interest them and those in which they feel they can prosper. Another factor a student is faced with is the cost of college and how they afford it, especially if their family does not provide emotional or financial support. Community colleges have given opportunities to students seeking a higher education who are not able or willing to go through the obstacles of a four-year institution. The benefit of community colleges is that they offer open access to all individuals that want an opportunity to further their education and/or improve their overall socio-economic status.

The research for this study was done at a Midwest community college in Illinois. The study examined first-time students wanting to enroll into a Math course. Students took the Math placement test through Accuplacer or ALEKS-Placement, Preparation, and Learning (ALEKS-PPL) depending on the day of the week. If students placed into a developmental Math course, they were given the opportunity to remediate and retest within the same product. This study also sought to determine whether there were differences in Math completion rates for the semester, difference in gender, age, ethnicity, or number of hours remediated.

Effect of Developmental Education

Emerging information reveals that the placement tests have little correlation to students' future success, casting doubt on their use even as the high stakes for students taking remedial courses become increasingly clear (Burdman, 2012, p. 3). More students place into developmental Math courses and future data will need to be reviewed to see if those courses had an impact on a student's success at the community college. Many students enter community college unprepared in many ways, so it is important to ensure that there are processes in place to support student success for all. For example, Bailey, Jaggars, and Jenkins (2015) recommend that students are provided a clear pathway to success that supports a strong advising approach and placement into college-level courses by completing remediation in an accelerated manner (p. 58).

Developmental education gives students the opportunity to learn or relearn the subject in which they are deficient. This is the term used when students are not college-ready in Math, writing, or reading. The number of high school graduates has increased as well as the number

of students being placed into developmental classes. A sizable amount of basic skill development will continue to be necessary for many years merely to accommodate the backlog of functionally illiterate and nonnative English-speaking people in America (Cohen, Brawer, & Kisker, 2014, p. 457). Recent evidence suggests that nationwide, approximately 60% of all incoming freshmen enroll in at least one developmental course (Beyond the Rhetoric, 2010, p. 2). Community colleges are a great place to provide this essential instruction. Whether developmental education is funded separately, or its cost is aggregated along with other curricular functions, it accounts for one-third of the instructional budget (Cohen, Brawer, & Kisker, 2014, p. 457). The amount fluctuates between institutions because there is a variance in the number of students who are college-ready and the ones who are not. For example, a community college in Florida might have more immigrant students and that population could result in the college providing a larger number of developmental courses. All students need to have academic standards met before enrolling into a college-level course. This could be determined by placement testing scores, American College Test (ACT) score, Scholastic Achievement Test (SAT) score, or other ways depending on the state or community college. Students who are deficient in Math would have to complete additional Math courses before taking college-level Math courses.

The areas of developmental education are subjects that students should have learned in high school, but not all students take advantage of that opportunity. Nearly 60% arrive academically unprepared and enroll in at least one developmental reading, writing, or Math course (Developmental Education, 2013, p. 1). Some face as many as four courses of remedial

Math or English before even attempting a college-level course (Developmental Education, 2013, p. 1).

The need for students to complete a degree or certificate is important at the federal and state levels. Many different committees at the state and national levels have discussed developmental education. Committees wonder what the value is in supporting students who are not college-ready and if community colleges should offer developmental courses in English and Math. Developmental Math builds on the foundation students have and enables them to advance in their educational careers. This could create a barrier for student success for those that are not successful in their developmental courses. Developmental education can many times add an entire year onto a student's college experience, which can lead to frustration and an unwillingness to continue in college (Bailey, 2009, p. 5).

In an effort to minimize the time students must invest in developmental education, colleges have examined various approaches to help students reach particular educational outcomes. By getting students through the developmental sequence in an orderly and timely fashion, colleges can then have students continue in their program of study. This allows students to take courses that result in college credit ("McGraw-Hill Research," 2012, p. 1).

In recent years, the expense associated with developmental education and the low persistence rates have called the effectiveness of developmental education into question. At the Midwest community college where the research was conducted, the reimbursement rate from the State of Illinois in 2014-2015 was \$9.96 for developmental courses and \$22.46 for transferable courses (A. Young, personal communication, August 12, 2017). The number of students at the Midwest community college who matriculated from developmental to college-

level Math has declined nearly 8% since 2011 but has remained relatively flat since 2012 at approximately 80% (*Community Strategic*, 2017). Additionally, others feel that since developmental courses are not college-level courses, funding should be cut or eliminated, and high schools should be held accountable for students to reach particular levels in reading, writing, and Math (Vandal & Wellman, 2011, p. 1).

Completion Rates, Retention, and Attrition

Colleges have long attempted to improve program completion rates, especially in states that correlate institutional state appropriations with student completion rates. Few community colleges have escaped pressure to improve graduation rates, especially among populations that have been traditionally less likely to complete programs of study: part-timers, low-income students, underrepresented minorities, adult students, those who test into developmental education, and those first in their families to attend college (Cohen, Brawer, & Kisker, 2014, p. 50). Some foundations, such as the Lumina Foundation and the Bill & Melinda Gates Foundation, have amplified their efforts to increase the proportion of Americans with high-quality degrees and credentials. The data shows that students completing an associate degree within two years is minimal and the three-year data is slightly higher. For example, just 20% of full-time students seeking a degree from a community college within three years (Dynarski, 2015, p. 1). Depending on the databases and definitions used to search national degree and certificate attainment rates at the community college within six years varies from 14 to 36%. However, most of those percentages are still low compared to other countries (Cohen, Brawer, & Kisker, 2014, p. 401). Overall, college leaders say that “the six-year attainment rates are more

accurate gauges of community college effectiveness” (Cohen, Brawer, & Kisker, 2014, p. 403).

The American Community College also states, “Some leaders even suggest that degrees earned elsewhere should count as a success as long as the student attaining the credential earned a minimum number of credits at their college along the way” (Cohen, Brawer, & Kisker, 2014, p. 403).

Many factors affect retention and completion, especially with minorities and socioeconomic status. Students of lower socioeconomic status and minorities are more likely to come to college underprepared than their peers, which can negatively influence completion (Fike & Fike, 2008, p. 69). Students who are not prepared for college and then do not have resources outside the college are not as likely to succeed. Recent efforts at the Midwest community college where the study is being conducted have been to increase the minority population, especially African Americans. The College received a grant in 2013 that focused on the three high schools with the highest percentage of African American students in the district. The grant supported three individuals to work at the three high schools to recruit students to this Midwest community college. The staff were referred to as “Emerging Leaders” and helped the college increase the number of minorities on campus. These staff members also helped the students when they were at the community college by answering questions or providing other assistance they might need. Enrollment for this population averaged 1,044 students for Fall 2013-2015 and 1,110 students for the Spring 2013-2015 semesters (J. Ballard, personal communication, July 27, 2017). The African American population has remained consistent since receipt of the grant in 2013. The increase in this particular population has had little impact on developmental education enrollment.

Retention from fall-to-fall is another important topic within higher education that has been studied repeatedly. Numerous interventions have been put into place to positively impact college completion, but no one approach has made significant gains in this area. Efforts on most campuses do not go far enough to promote student retention, especially for first-year students (Tinto, 1999, p. 5). Most studies of orientation and advising have revealed a positive relationship between completing orientation and retention and graduation, as well as between advisor-student contact and increased retention and graduation (Cohen, Brawer, & Kisker, 2014, p. 231). Having the student support systems in place has been proven to increase student retention because the students feel a part of the college and have friends. Those who do not have that sense of belonging will leave the college. Thus, while colleges must focus their effort on all students, they must be especially aware of those who need support throughout their college career, for example, part-time students and those with lower socioeconomic status.

Understanding the Issue

Presently, many community colleges use a Math placement test to place students into courses. The Math placement test could be a variety of products including Accuplacer, ALEKS-PPL, Pearson, College Success, Tailwind, or an exam created by the college itself. Each product varies, but they all aim to assess the level of students' Math proficiency. In Illinois, many students choose not to take a Math course their senior year in high school because the state requires only three years of Math for a diploma. This is one factor that could affect a student's performance on the Math placement exam. Another factor is that there are many students with a fear of Math because they have never done well in their Math courses and now have to face

that fear in college. Colleges need to have tools for students whose Math proficiency is not at a level necessary for college success.

Students are incorrectly assessed and assigned to courses using any of the products mentioned above. Was a student placed into the correct course? Faculty, administrators, students, state agencies, and others ask this question. Burdman (2012) states, “Studies have found that faculty’s biggest complaint about assessments is that they provide no diagnostic information to help instructors understand students’ strengths and weaknesses” (p. 8). This question is hard to answer because students have so much more going on in their lives than just academics. Students who enroll in courses for which they are not academically prepared can cause frustration for the faculty, who find it challenging to teach a wide range of skill levels within the classroom in addition to the challenges for the students. Students would rather not take remediation courses, but colleges want them to be successful in courses.

Other factors could be reviewed before placing students into courses. For example, high school grade point average could be a part of the placement process. Colleges could review ACT scores, GED scores, or SAT scores instead of using a placement test. Colleges could also provide a test of the emotional, physical, or mental well-being of a student, which could be used to place a student into courses.

College advisors admit that many, if not most, students take placement tests without understanding their purpose or high-stakes nature (Safran & Visher, 2010, p. 15). Interview results from community college students found that they were unprepared for the content and format of the tests, that they were still confused about placement policies after taking the tests, and that many never met with a counselor to discuss their results and subsequent course

enrollment options (Hughes & Scott-Clayton, 2010, p. 6). Incoming students need to have the resources to study the material they are going to be tested on and be informed as to why they are taking the placement test. An explanation of scores and how students are placed is necessary. Such explanation should include an example of the developmental education Math sequence, so students can see that if they test into developmental Math, they might have to take an extra semester or two of Math.

Efforts to Address Attrition

Since attrition is unpredictable, we probably will not eliminate it; however, we can recognize and assess those characteristics that have the most significant impact. All transferable courses at the Midwest community college require an English or Math score that places students into college-level courses. At the Midwest community college in this research, college-level courses are numbered 110 and above. The reading, writing, and Math levels must be obtained through standardized tests such as the ACT, SAT, Accuplacer, Advanced Placement, or ALEKS-PPL, or by taking developmental coursework that eventually places the student at the appropriate college level. Students who take a standardized placement exam such as the SAT and achieve appropriate college readiness scores are considered college-ready because they have met the minimum reading, writing, and Mathematical scores needed to take all of the college-level courses.

The Midwest community college has established that the college-level readiness score for English is an ACT of 18 or greater and for Math an ACT score of 22 or greater. Students do have the option of an SAT in English of 480 or greater and a Math SAT of 520 or greater to also

be considered college ready. If students do not achieve the appropriate college readiness score through the ACT or SAT, they must take the Accuplacer exam and achieve the appropriate scores required to be college-ready.

Students are allowed to retest to obtain a higher score in any specific area should they not achieve the minimum score needed; however, they cannot retest more than three times in one year. If students cannot achieve an Accuplacer score required by the college, they must complete some level of developmental education. Depending on their areas of under-preparedness, a student may have one or multiple semesters of required developmental education before enrolling into college-level courses.

Introduction to this Study

Developmental education may adversely affect student retention and college completion because it extends a student's academic career. Analysis was conducted through this dissertation to evaluate two Math remediation products offered to students who were placed into developmental Math courses. Students in this study matched the following conditions:

1. ! Testing resulting in placement into a developmental Math course.
2. ! Receipt of an access code to access an online portal, which was intended to remediate.

All students who wanted to retest had to wait 48 hours after receiving an access code.

Each subject in the study tested into Developmental Math. Were there any differences between students who completed the remediation and retested versus those who did not remediate and retest? Students who met the conditions of assessing into developmental Math

and retesting into a course at least one level above initial placement were analyzed for course success. In addition, age bands and gender bands were assessed to ascertain if there was a difference in the number of hours remediated compared to an individual's age. Gender was also reviewed to see if that made a difference in the number of hours remediated or the increase in a student's overall placement score.

The two Math placement products used in this study were Accuplacer and ALEKS-PPL. Accuplacer is an integrated system of computer-adaptive assessments designed to evaluate students' skills in reading, writing, and Mathematics ("Why Accuplacer?" n.d.). This tool has assessed student preparedness for introductory credit-bearing college courses for over thirty years ("Why Accuplacer?" n.d.). The program delivers immediate and precise results, offering both placement and Math diagnostic tests, to support intervention and help answer the challenges of accurate placement and remediation ("Why Accuplacer?" n.d.). Over 8.5 million Accuplacer tests are administered each year in more than 2,000 secondary and postsecondary institutions ("Why Accuplacer?" n.d.). Accuplacer connects over 2.5 million students to college and career opportunities ("Why Accuplacer?" n.d.).

ALEKS has helped students succeed in a range of courses for several decades ("Math Placement," n.d.). In 2007, the University of Illinois at Urbana-Champaign ("Math Placement," n.d.) approached ALEKS. School administrators were concerned with non-success rates and students entering into Calculus I lacking prerequisite skills ("Math Placement," n.d.). The Mathematics Department piloted using ALEKS Prep for Calculus for course placement and found a relationship between scores on the ALEKS assessments and course outcomes ("Math Placement," n.d.). For several years, ALEKS collaborated with a variety of institutions to

research and design a program that could assess prerequisite knowledge across a broad spectrum of topics in Math and allow students the opportunity to refresh and prepare for their Math courses ("Math Placement," n.d.). Thanks to those dedicated research partnerships, students all over the country today are able to take advantage of ALEKS Placement, Preparation and Learning (ALEKS-PPL) ("Math Placement," n.d.).

Research Questions

In an effort to examine the two Math placement products and their relationship to student success, the following research questions were developed:

1. ! Does the online Math remediation product (Accuplacer or ALEKS-PPL) increase a student's Math placement score?
2. ! Is there a relationship between the Math remediation product and the type of Math course (transferable or developmental) a student places into?
3. ! Do statistical differences exist in remediation hours among age groups or by gender?
 - a. ! Is there a difference in the number of remediation hours completed between the 18 - 24 and 24 and older age categories?
 - b. ! Is there a difference in the number of remediation hours between males and females?
4. ! Is there a relationship between the Math placement product and a student being successful in their Fall 2016 Math course?

Successful grades in developmental Math courses is defined as a final grade of C or higher for the student to advance to the next level in the Math sequence.

Hypothesis

- There is no relationship between the online Math remediation product and the increase in placement score the student receives.

- There is no statistical difference between the Math placement products ALEKS-PPL and Accuplacer in placing students in a transferable or developmental Math courses after remediation.
- There are no statistical differences among age groups or gender and the remediation hours completed.
- There is no relationship between the online Math remediation product and student success in their Fall 2016 Math course.

Definitions

To ensure understanding of this dissertation the following abbreviations and terms have been defined:

Accuplacer: A suite of tests that quickly, accurately, and efficiently assesses Math, reading, and writing skills ("Why Accuplacer?" n.d.).

ALEKS Placement, Preparation and Learning (ALEKS PPL): Offers colleges & universities a complete solution for Math placement ("Math Placement," n.d.).

Completion: The amount of time necessary for a student to complete all requirements for a degree or certificate according to the institution's catalog. This is typically 2 years (4 semesters or trimesters, or 6 quarters, excluding summer terms) for an associate's degree in a standard term-based institution; and the various scheduled times for certificate programs ("Normal Time," n.d.).

Cut or Cut-Off Scores: The cut score is the point on a score scale that separates one performance standard from another (Horn, Ramos, Blumer, & Madaus, 2000, p. 2).

Developmental Education: Is required for students whose placement test scores suggest that they are underprepared for introductory college courses in writing or Mathematics (Developmental Courses, 2013).

Nontraditional Student: A student being over the age of 24 ("Nontraditional Undergraduates/definitions," n.d.).

Open Admission: generally means that the admission process is unselective and non-competitive; the only criteria for admission is that the student have a high school diploma or GED certificate (Nelson, n.d.).

Persistence: Refers to the act of continuing towards an educational goal (e.g., earning an associate's or bachelor's degree) (*Some Definitions*, n.d., p. 1).

Placement Testing: A test usually given to a student entering an educational institution to determine specific knowledge or proficiency in various subjects for the purpose of assignment to appropriate courses or classes ("Definition of Placement," n.d.)

Retention: A measure of the rate at which students persist in their educational program at an institution, expressed as a percentage. For all other institutions this is the percentage of first-time degree/certificate-seeking students from the previous fall who either re-enrolled or successfully completed their program by the current fall (National Center of Education Statistics, 2017, p. 23).

Stop out: A student who left the institution and returned at a later date (National Center of Education Statistics, 2017, p. 26).

Student Attrition: The number of individuals who leave a program of study before they have finished ("Student Attrition," n.d.).

Student Success: Defined as a favorable or desirable student outcome (Cuseo, n.d., p. 1).

These words will be used throughout the research and are important to community colleges throughout the country. Community colleges are open admission colleges that usually have a higher median age range in their student body. Colleges are working on retaining their current students and tracking how students persist after they earn a degree/certificate from the college. Developmental education has increased over the past 10-15 years, and one reason is that student deficiencies in Math are identified through the placement test. The two products used in this research are Accuplacer and ALEKS-PPL, which are used to place students into a Math course.

Conclusion

Placement testing has a significant impact on students planning to attend community college. These assessments can affect a student's time to earn a degree or certificate, because they may have to take one or two semesters of developmental courses, which may delay a

student's intended transfer or graduation timeline. Student success is important to colleges and one reason is performance-based funding, which happens in many states; and all states may use this model in the future. Also, part of student success is placing students into courses in which they can persist, so the college will retain them. Developmental education is a barrier for students, and those who are placed into developmental classes have a very low likelihood of ever completing college (Burdman, 2012, p. 6). In addition, a college might lose students who place into those lower level Math courses, which in part could lower the retention rate and college revenue. Evaluation of the placement testing remediation products had an impact on which Math course a student enrolled in for Fall 2016 and their level of success in that course may provide insight into the placement product recommendations. Both Accuplacer and ALEKS-PPL assess Math proficiency and can provide instruction to increase Math proficiency. If students use the placement product to remediate instead of taking a 16-week course, the retention rate could increase at the college.

This research study focused on Accuplacer and ALEKS-PPL, which are two Math placement products that students complete to assess Math readiness. This study compared students who were placed into developmental education based on their Accuplacer or ALEKS score. Students received an activation code, which they could use to access the product and perform the remediation activities suggested based on their deficiencies. Students had the option to remediate in as many hours as they wanted, which ranged from 0 to 35 hours. Additionally, racial, age, and gender differences of the study population were evaluated to determine if there were any patterns correlating to any of these groups.

The review of literature in the following chapter provides information about the placement testing and the two products used in the study. In Chapter Three, the research design and methodology are discussed. Chapter Four presents the data and analysis of the placement products. Conclusions, implications and recommendations are presented and discussed in Chapter Five.

CHAPTER TWO: LITERATURE REVIEW !

Introduction *

Junior colleges were created in the 20th century and the name changed to community colleges in the 1970s. They remain open access to anyone who wants to invest in an education. Such open-door policies generally allow admission to anyone who can pay tuition, regardless of educational background (Nelson, n.d.). Community college is defined in The American Community College book (2014, p. 5) as any not-for-profit institution regionally accredited to award the associate in arts or the associate in science as its highest degree. All community colleges that are public, private, or technical are included in this definition. Being an open-door institution and being able to assess student skillsets in reading and Math are important in enrolling students in courses aligned to their skill level.

Placement testing, or skill level testing, has been in existence since the 1600s with Harvard University being the first to use a form of testing for course placement. In the 1960s when students were on academic probation, academic dismissal, or suspension, failing courses, not attending courses, or not passing at midterm, colleges would intervene and not let them advance to the next level of coursework. In the 1970s, students disfavored these mandates and they wanted to enroll without barriers. The 1970s was a time of conversation about whether or not community colleges should mandate placement testing. Proponents of the "student's right to fail" philosophy argued that community college students were adults who should have the

freedom to make their own educational decisions, and that this freedom promoted responsibility (Hughes & Scott-Clayton, 2010, p. 5). However, by the end of the decade, placement testing practices were reintroduced as a result of prodding by both legislators and educators concerned with the costs of high failure and dropout rates (Hughes & Scott-Clayton, 2010, p. 5). They realized the benefit in aligning the placement recommendations to course enrollment. Students knew courses that began around their skillsets might result in course completion instead of dropping the course during the semester.

During the 1980s, community colleges scrambled for a middle ground between linear, forced-choice, sequential curricula and the lateral, laissez-faire approach of allowing open/non-skill matching course enrollment (Cohen, Brawer, & Kisker, 2014, p. 68). Five states (Florida, Georgia, New Jersey, Tennessee, and Texas) required all entering students or students seeking degrees or transfer to take tests in the basic skills (Cohen, Brawer, & Kisker, 2014, p. 68). Even in some states that did not mandate placement tests, individual colleges made the decision to start requiring placement testing before course enrollment. Colleges stated the benefit in offering placement testing was that students would be properly placed into courses. A national survey from the same time period found that the majority of two-year colleges accepted all persons over the age of 18 who had earned a high school diploma. However, almost 90% of community colleges used placement tests to place first-time students (Woods, 1985, p. 1). Community colleges wanted to place students into remedial courses if placement results identified skill deficiencies.

In recent years the controversy centered on the validity of tests designed to determine incoming student placement into developmental or college-level courses (Cohen, Brawer, &

Kisker, 2014, p. 69). While the vast majority (92%) of two-year colleges offer such exams, some only recommend that students enroll in the suggested level; other institutions mandate developmental enrollment based on a specified cutoff score (Cohen, Brawer, & Kisker, 2014, p. 69). Colleges have the choice to mandate that students enroll in developmental courses based upon scores set by the institution. For example, a score above a 90 in algebra places a student into college algebra. A score between 70-89 would place a student into intermediate algebra, which is a developmental course. To complicate student placement, institutions may choose not to align placement scores to what courses a student should enroll in. Why are students taking the placement test in this instance? Students enrolling in courses for which they are not academically prepared can cause frustration for the faculty. In addition to resulting in challenges for the students, instructors may find it challenging to teach a wide range of skill levels within the same classroom.

The students' perspective is that they would prefer not to be in remediation (Hughes & Scott-Clayton, 2010, p. 6). If testing and placement are to be imposed on students, some observers have emphasized the importance of also providing support services (Hughes & Scott-Clayton, 2010, p. 6). College advisors admit that many, if not most; students take placement tests without understanding their purpose or high-stakes nature (Hughes & Scott-Clayton, 2010, p. 6). Interview results from community college students found that students were unprepared for the content and format of the tests, that they were still confused about placement policies after taking the tests, and that they never met with a counselor to discuss their results and subsequent course-taking options (Hughes & Scott-Clayton, 2010, p. 6).

Role of Placement Testing

There has been research on the benefits of placement testing and why students should be tested before entering college. The National Center for Public Policy and Higher Education (2010) conducted research on a uniform set of testing and placement standards. These results show that testing: (1) prepares students for college-level courses, (2) improves placement accuracy, (3) helps institutions establish a common benchmark to measure college readiness, (4) facilitates student transfer between two- and four-year institutions, and (5) helps states develop performance measures to assess the effectiveness of developmental education sequences across institutions (Melguizo, Kosiewicz, Prather, & Bos, 2014, p. 695). In contrast to the standards, opponents of placement assessments contend that uniformity will prevent institutions from meeting the needs of their students, increase the cost burden associated with testing, and ultimately, enroll more students typically of color in developmental education (Melguizo, Kosiewicz, Prather, & Bos, 2014, p. 695).

Some states, like Florida and Virginia, implemented customized placement tests that were developed with faculty input and associated with each state's curriculum. Colleges in the state of California considered creating a common statewide community college placement tool that would have the ability to diagnose the academic needs of students (Burdman, 2012, p. 4). Community colleges in Texas sought to adopt a single readiness standard for college-level work (Burdman, 2012, p. 4). In a study examining the standardization of testing and placement across three Achieving the Dream states, Virginia, North Carolina, and Connecticut developed common cut score policies as a means to improve student success (Melguizo, Kosiewicz, Prather, & Bos, 2014, p. 696). When developing standards like common cut scores, there has to be an

agreement between faculty and administration on the definition of what it means to be college-ready before the scores can be developed.

According to a study by Perin (2006), community college officials found ways to reduce the number of students placed into developmental education by overriding statewide testing requirements (Melguizo, Kosiewicz, Prather, & Bos, 2014, p. 696). This policy could help or hinder the process depending on whether the policymakers and policy implementers agree on the goals, targets, and tools of the policies themselves (Melguizo, Kosiewicz, Prather, & Bos, 2014, p. 696).

Role of the States

Colleges vary in terms of how they validate their placement exams, and it appears that only some states or systems have requirements regarding validation (Burdman, 2012, p. 21 & Fulton, 2012, p.3). Florida has developed common cut score policies as a means to improve student success, but there are still some researchers that argue that the ways in which students are deemed college-ready should be revamped because they do not place students fairly (Fulton, 2012, p. 10). Students are tested while they are still in high school or after they have graduated high school, which could be months or years prior to college enrollment. Could the timing of taking a placement test increase or decrease a student's placement score? One would think the longer an individual has not had Math courses the lower their placement score would be. However, is that assertion true or not? The data in Chapter Four will help answer these questions.

Some institutions review the cut scores used for placement on a regular basis but do not evaluate the instrument being used with such regularity. Cut scores are scores that place students into developmental or transferable courses at each institution. Colleges usually do not review the placement score unless the placement test or scoring criteria has changed. When the test changes, it forces an institution to review the scores and product being used. For example, when ACT announced it was no longer going to offer a placement exam (Compass), this forced colleges to find a new product and develop new scores. Most companies have suggested cut scores, which may help colleges set their scores for students. Students need to be aware of the placement scores and how scores on each portion place them into Math courses.

Both the ACT and College Board (SAT) suggest that validation of the instrument should happen every 5 - 7 years or more frequently if there are changes in course content, examination content, or the characteristics of incoming students (Morgan & Michaelides, 2005, p. 11). A few colleges call for regular review of cut scores, but not of the instruments themselves (Cohen, Brawer, & Kisker, 2014, p. 249). The most common approach often fails to distinguish between students who would benefit from remediation and those who could succeed in college-level courses with additional support (Cohen, Brawer, & Kisker, 2014, p. 249). Burdman (2012) states, "Some in the field argue that placement exams are intended to measure readiness, not predict student success, noting that factors other than readiness can affect success (p.12)." Other approaches to validity and reliability include:

1. Content validity: Is the content consistent with the related courses?

2. ! Consequential validity: Do faculty and students think students were placed appropriately? Interestingly, surveys at California colleges routinely find satisfaction levels of 75% and higher.
3. ! Reliability: Does the test produce consistent results for students who appear to have similar skills? (Burdman, 2012, p. 21)

Both the ACT and College Board have shown that their placement tests have content validity, but neither test has proven predictive validity. Tests gain validity if they are matched with course requirements. Short refresher courses offered prior to testing are also helpful; however, these test prep courses are available at less than half of the community colleges (Cohen, Brawer, & Kisker, 2014, p. 250). Brown and Niemi's (2007) research discovered poor alignment between content taught in the classroom and the material tested on the placement exams (p. 9). Secondly, this suggests that factors such as student motivation and ability to dedicate time to school may be more powerful predictors of student outcomes (Burdman, 2012, p. 6).

Placement testing and developmental coursework are included in some state's college admissions requirements. For example, the Illinois Community College Board program approval manual (p. 192) states that colleges should determine whether students have met admission requirements by one of the three requirements:

1. ! A review of high school transcripts, or
2. ! Placement tests, or
3. ! Remedial or college coursework taken prior to the time a student applies for admission to a transfer program.

Placement tests may be necessary for students who graduated prior to 1993, who earned a GED, or who did not take an appropriate course, either because the course was not

offered at the school they attended or because the student chose to take other coursework. If placement tests indicate that there are deficiencies, successful completion of related college coursework can enable students to be admitted to a transfer program.

A challenge that community colleges face is tracking the success of students who place into remedial courses. Remediation varies between states, but those that use placement testing should offer a remediation option like ALEKS-PPL or Accuplacer that students can do on their own instead of enrolling in the suggested developmental course. On the other hand, states like Florida, Missouri, New York, South Carolina, and Arizona have implemented policies that public universities do not offer remedial instruction (Cohen, Brawer, & Kisker, 2014, p. 248). Other states have placed limits on how many developmental courses a university can offer, so universities work with community colleges on arranging remedial instruction for students. One of the reasons the number of developmental course offerings has risen in the past ten years at community colleges is because of laws that regulate how many courses public universities can offer. Illinois law stipulates that “the primary emphasis on postsecondary remedial programs [is] at Public Community Colleges” (Ignash, 1997, p. 7). In every state in which developmental education figures prominently in the community college policy agenda, a group of institutional leaders has consistently advocated for the state to provide resources and support for developmental education (Prince, 2005, p. 5). Community colleges need to receive more support and financial funding for offering developmental education, so the college can serve those students with deficiencies. Some states give different reimbursements to colleges based upon the nature of the course, developmental or college level.

There are states like New Mexico that do not have a statute on developmental courses, and the state government still gives funding to colleges for those courses. In Maryland, where local control is relatively strong, community colleges agreed to use the same test and statewide cutoff scores as a way to raise quality standards (Prince, 2005, p. 6). Minnesota, which has a centralized state governing board, has established a level that leaves individual institutions the option of raising the bar for its students (Prince, 2005, p. 6). Students in Minnesota who score below the minimum standards must complete the appropriate developmental education curricula, either through courses or through other means, before enrolling in selected general education courses (Prince, 2005, p. 8). This gives students a variety of options to remediate through, which could include a course or through the testing product itself. Students would have to remediate through a course or testing product and show they have the skills to enroll in college-level courses.

Studies have been conducted that consider students who have more than one developmental course to take before college-level readiness and the unsuccessful path that these students tend to take. For example, Florida has removed developmental courses from community colleges, which has negatively affected the success of students who are not ready for college level courses. The study from Achieving the Dream found that less than half of developmental education students actually complete entire course sequences (Melguizo, Kosiewicz, Prather, & Bos, 2014, p. 696). They also learned that about three out of ten developmental education students never enrolled, and that less than two-thirds enrolled in the course to which they were assigned (Melguizo, Kosiewicz, Prather, & Bos, 2014, p. 696). The article "When College Students Start Behind" states that, "In one sample, among students who

are referred to three remedial Math courses, only 11% successfully complete college-level Math within three years” (Bailey & Jaggars, 2016, p. 5). Prince (2005) suggests, “Developmental education policies are more likely to succeed if they are part of a coherent package of policies designed to ensure that students entering developmental education are supported and guided long enough to succeed in such courses and to move quickly to desired college programs” (p. 8). Many students have other responsibilities outside of school, so if the road to credit courses is long, they are more likely to drop out. States should be careful when mandating cutoff scores as they lead colleges to set up a rigid, long, sequential ladder from developmental into college courses (Prince, 2005, p. 9).

Students are more likely to be “under-placed” in remedial coursework (they are assigned to these courses when they could be successful in the relevant college-level course), rather than “over-placed” in college-level coursework (they are directly assigned to college-level courses but fail those courses). (See Figure 1).

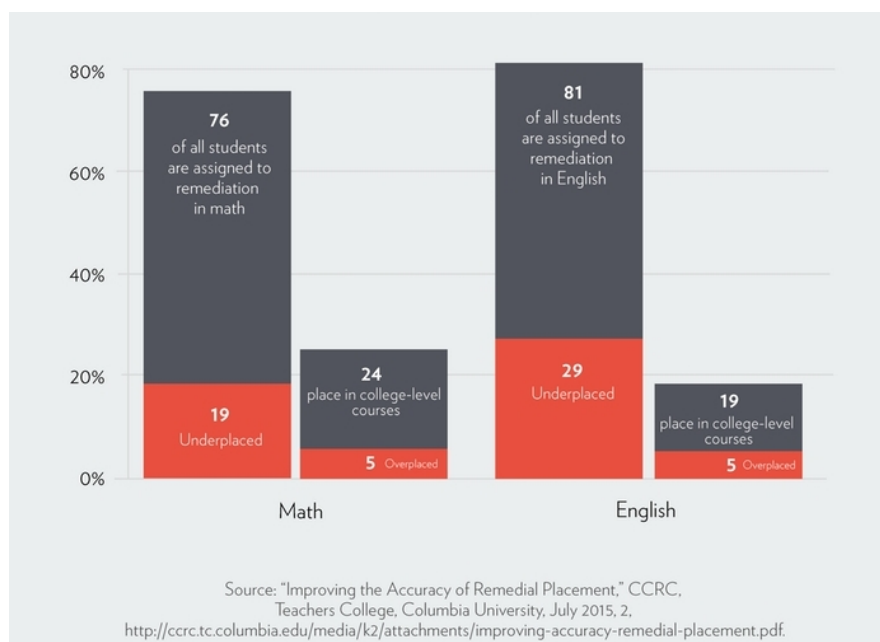


Figure 1: Tested Students Severely Under-placed and Over-placed (

This suggests that exam cutoff scores for college-level coursework tend to be too high. Given the prevalence of under-placement, some colleges using traditional placement tests have also recently lowered their cutoff scores (Bailey & Jaggars, 2016, p. 7). Bailey and Jaggars (2016) go on to state “While tentative, research suggests that lowering too-high cutoffs will allow many more students to enroll in introductory college-level Math courses, and only slightly decrease those courses’ pass rates” (p. 8). Giving students the option to remediate in the areas they are deficient in might be an option instead of taking a semester course. Most students are only deficient in certain areas, not all the areas the course covers. Remediation would be an option for students to do on their own time and at the completion of the remediation, they could retest.

Preliminary research suggests that lowering too-high cutoffs will allow many more students to enroll in introductory college-level Math and English courses and only slightly decrease those courses’ pass rates—with the net effect of allowing substantially more students to complete college-level Math and English (see Figure 2). Lowering the cutoff scores is an option, but collecting the data to make sure students still pass the college-level course is also critical. Students who have lower test scores compared to students who have higher test scores need to then be compared for success in the Math course. Another option might be to have supplemental instruction as an option in Math courses that have a high number of lower test scores. Providing the resources for student success is important for every college to consider. Further, student success is important and something that needs to be reviewed consistently.

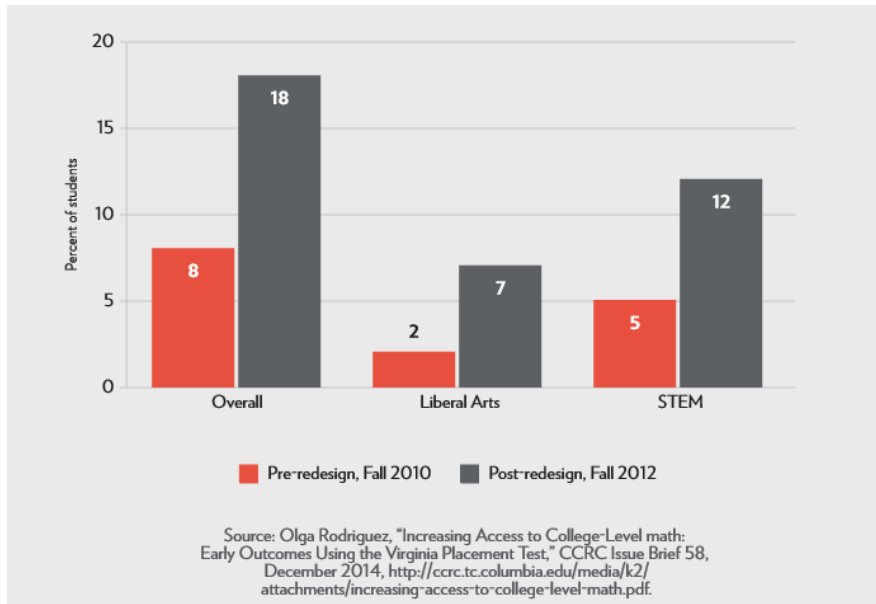


Figure 2: Percentage of Students in the Virginia Community College System Who Placed into and Successfully Completed College Math

The whole education system is complex, and when the K-12 schools have to work with the postsecondary schools, it becomes more complex. Community colleges have numerous high schools in districts they serve. This is challenging, yet critical to college readiness standards. These components include the standards themselves and the application of the standards through teacher preparation and training, high school testing and curriculum, college placement, and state accountability systems that reward readiness in both sectors (*Beyond the Rhetoric*, 2010, p. 7). The readiness standards are specifically focused on the skills in writing, reading, and Math. The Southern Regional Education Board along with the National Center for Public Policy and Higher Education issued a policy which developed a statewide readiness model for accomplishing these systemic linkages across the various components of reform (*Beyond the Rhetoric*, 2010, p. 8). The model agenda is summarized below:

1. ! College readiness standards must be formally adopted by K-12 and postsecondary education.
2. ! High school testing must measure progress on the specific state adopted standards.
3. ! Public school curriculum should reflect the specific statewide readiness standards.
4. ! Teacher development should address the effective teaching of college readiness standards.
5. ! Placement decisions by colleges and universities must use the adopted readiness standards.
6. ! State accountability systems must create incentives across P-16 for college readiness and completion.

The policy would help the education system overall improve. Colleges and K-12 systems would work together to align curriculums and prepare students more effectively for college. States are looking to improve the pipeline for high school students into college and when the two work together, the pipeline is already developed for the students. The national priority of increasing the number of students who graduate college starts with decreasing the gap between college eligibility and college readiness. The National Center for Public Policy and the Southern Regional Education Board reviewed a study done by Achieve the Dream from 2010, which indicated 31 states have defined college readiness standards:

Equally important, no more than six states have translated their readiness standards into specific performance level expectations with school testing based on the statewide readiness standards. Even fewer states have strengthened school accountability systems to measure, report, and emphasize improvements in college readiness. Finally, few states are developing comprehensive approaches to ensure that both practicing and prospective teachers are prepared to teach to college readiness standards. (*Beyond the Rhetoric*, 2010, p. 11)

Role of the Students

A significant amount of research at community colleges has focused on using high school grade point average (GPA) and placement scores together as a predictor of student success. Long Beach City College conducted a study in 2013 with the Long Beach Unified School District which used high school grades as a way to help determine whether a student needed developmental courses instead of relying just on the placement testing scores. The study reviewed 1,000 students from the high school that were starting classes at the community college. Using the new method of reviewing both high school GPA and placement testing, student success in courses was deemed successful. Study results indicated that 53% of the group took transfer-level English courses in their first semester, while only 5.5% of students from the same high school took transfer-level English the previous year, meaning they were ten times more likely to jump directly into credit-bearing English (Fain, 2013). The overall pass rate was 62%, which was close to the college's typical pass rate in English (Fain, 2013). Overall, this study suggests that using placement test scores and high school GPA together has been successful in placing students into college-level courses. In 2016, North Carolina's community college system was slated to be the first to adopt GPA as a multiple measure statewide (Bailey & Jaggars, 2016, p. 10).

Students coming right out of high school might have the content knowledge, but is that the most important thing? GPA captures important noncognitive skills that tests do not (Barshay, 2016). Hodara states in a *U.S. News* report that (2015), "It's likely that if you have a high GPA, even if you're in an easy class, you likely showed up and turned your homework in, and did things that are important for college readiness and success" (n.p.). In a study of full-

time students who attended University of Alaska between 2008 and 2012, Hodara found that students with a 3.0 high school GPA, or a B average, were at least 25 percentage points more likely to pass college-level classes with a C or higher than students who had a 2.0, or a C average, in high school (Hodara, 2015). In the study, Hodara reviewed college entrance exams, placement exam scores, and their relationship to college course grades. There appeared to be only a minor association. A study by the American Institute for Research found that a 3.0 GPA or a B average in high school is predictive of college readiness. High school GPA could be a good indicator that a student is prepared for college courses. If high school GPA becomes an indicator, then remediation could be used for students who are below the cutoff GPA. For example, if a student has a 2.8 GPA on a 4.0 scale, then they would have to take one developmental course or a certain number of hours of remediation before they could enroll into general education courses.

The Community College Research Center led a study on predicting college success by using placement tests and high school grade point average. The resulting article discussed students who place into developmental level courses and how their academic career is longer, instead of diagnosing the students' genuine needs. Belfield and Crosta (2012) considered "this 'diversion effect' by looking at pathways of students above and below the cutoffs and by investigating longer-term outcomes in college" (p. 3). Particularly, the diversion effect might have less influence on college GPA than on credits earned (Belfield & Crosta, 2012, p. 3).

High school transcripts may be another avenue in deciding if a student needs developmental or college-level courses. A review of a high school transcript may reveal cognitive competencies that can be seen over a four-year period instead of one placement

score. A student's effort in high school as indicated by the total number of courses taken and credits earned may also be a useful predictor (Belfield & Crosta, 2012, p. 3). Finally, course failure (F grades) may indicate a student is deficient in a particular subject (Belfield & Crosta, 2012, p. 4).

Placement testing and high school transcripts in combination with each other may capture different underlying traits. A student's understanding and determination are also expected to be important, as is college readiness. Whereas placement tests provide information that is primarily centered on subject-specific knowledge and general cognitive ability, high school transcripts may yield more information across the range of attributes (Belfield & Crosta, 2012, p. 3). Thus, the optimal decision rule may be to combine information from a placement test and a high school transcript (Belfield & Crosta, 2012, p. 4).

Increasingly, colleges also experiment with approaches that supplement placement exam scores with other indicators of student readiness (Bailey & Jaggars, 2016, p. 9). While many colleges are interested in understanding students' broader noncognitive abilities such as motivation or "grit," most focus on high school academic records for two reasons (Bailey & Jaggars, 2016, p. 9). First, high school performance indicators such as overall GPA, Math course-taking and GPA, or English course-taking and GPA are concrete to measure and relatively easy to gather (Bailey & Jaggars, 2016, p. 9). Secondly, research suggests that adding GPA as a multiple measure will help reduce placement error rates, in large part because GPA helps to capture noncognitive attributes such as academic motivation (see Figure 3). The figure shows that students were not placed in the proper course more often using just a placement test score as compared to using high school GPA or high school GPA and placement testing scores

combined. Placing students by only placement test scores could be an issue and one area that could be researched more in the future.

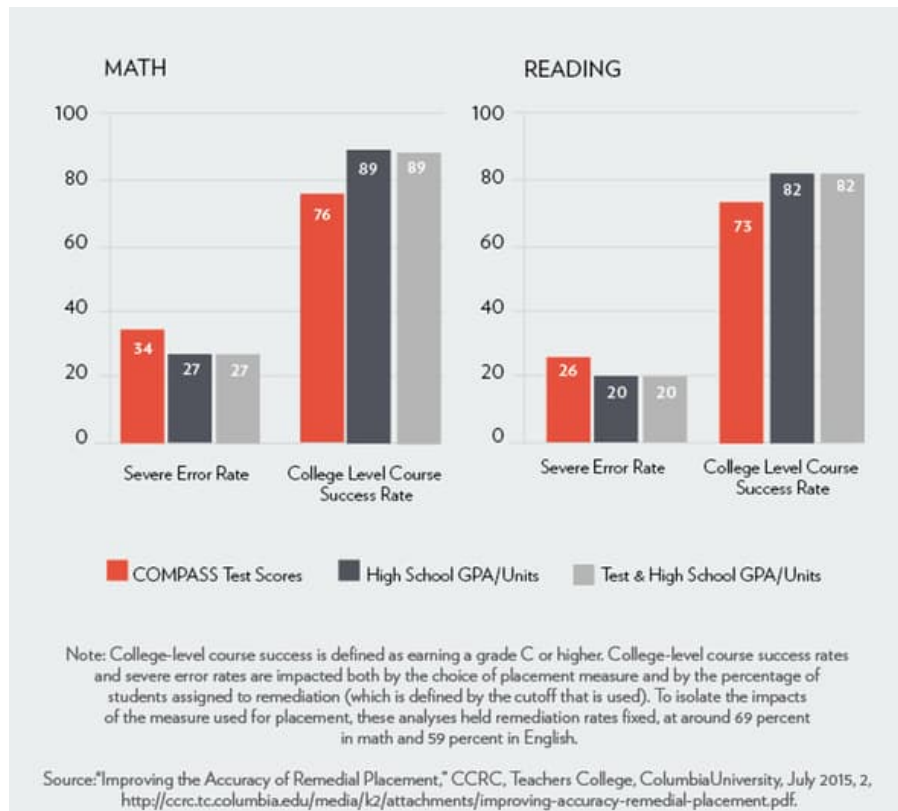


Figure 3: Predicted Percentage Rates of Severe Placement Errors and College-Level Courses Success by Assessment Method (Statewide Study)

One way to help students who need to take developmental courses is to use the accelerated programs design. This shortens the timeframe of remedial education, thereby providing students with fewer natural exit points and reducing the likelihood that life events will pull students away from college before they enter college level courses (Bailey & Jaggars, 2016, p.11). The accelerated programs model is implemented after placement testing. Accelerated programs try to teach competences more closely tied to college-level programs and opportunities. These programs should provide students with a safe space and support

system while practicing college-level work. It is not geared toward repeating the high school curriculum but getting them ready for college-level courses. Bailey and Jaggars (2016) discuss that most acceleration models include one or more of the following design elements: paired courses, compressed sequences, or co-requisite support courses (p. 11). Paired courses combine two sequential developmental courses into a single semester, while maintaining the number of required credit hours (Bailey & Jaggars, 2016, p. 11). Compressed sequences reduce the number of required credit hours, often by eliminating redundancies or content that is irrelevant to the student's program of study (Bailey & Jaggars, 2016, p. 11). In the co-requisite model, students enroll directly in college-level Math or English but also enroll in a paired developmental support course (Bailey & Jaggars, 2016, p. 11). An example of the co-requisite model is when students enroll in a developmental English course while also being enrolled in a transfer English course at the same time. The same professor teaches both sections and students work on developing skills that are needed for the college-level English assignments. Students earn credit for both courses; after the semester is over, the student is ready to enroll in the next level of English, if necessary.

In general, acceleration models improve students' likelihood of enrolling in and completing college-level Math and English, particularly if those models include additional academic supports to help students succeed with the increased pace and challenge of the accelerated curriculum (Bailey & Jaggars, 2016, p. 11). Students need to have an option to remediate face-to-face or on a computer to sharpen up those skills, they are deficient in. The success and great publicity about the Accelerated Learning Program (ALP), has helped the program grow across the country. In 2014, Tennessee took the ALP concept and applied it to

the Math courses at ten community colleges. The study involved 1,000 students, in which students across a range of placement test scores (12 to 18 on the ACT) were enrolled in a college-level Math course (Algebra II, Math for the Liberal Arts, or Probability and Statistics) while engaging in required support (Bailey & Jaggars, 2016, p. 12). Normally, students who possessed deficient skills according to an ACT score would have been placed into developmental Math instead. The students were given the support outside the classroom to help them succeed in the college-level Math course.

Students have had great success in the ALP program, but there are opportunities to have students remediate before they sign up for courses. For example, colleges that use Accuplacer or ALEKS-PPL for Math placement have the option to offer students learning modules to help gain skills. Both products assess a student's deficiencies, so students can work on those areas specifically. Students would have the option to commence remediation before enrolling or do a program like ALP if they do not want to remediate on their own and retest.

Colleges are working to make Math curricula and instruction for underprepared students more relevant to students' goals by creating two or three distinct Math pathways (Bailey & Jaggars, 2016, p. 13). For example, underprepared students interested in science and technical fields might still be required to complete an algebra-intensive developmental program, while students interested in criminal justice might complete a statistics-oriented program, and those interested in humanities might complete a quantitative reasoning program (Bailey & Jaggars, 2016, p. 13). Three models are being used by states like Texas and California that show promising results for students. The three models are the California Acceleration Project pre-statistics pathway, the Carnegie Foundation for the Advancement of

Teaching's Quantway/Statway model, and the New Mathways Project (NMP). Each of these new projects are collecting data and forthcoming results will be shared in the near future.

Typically, Math pathways consist of a two-semester sequence that allows students to complete a college-level Math course relevant to their program of interest within one year (Bailey & Jaggars, 2016, p. 13). In the Carnegie's Statway, students enroll in a year-long program that replaces the college's algebra sequence, as well as a college-level statistics course (Bailey & Jaggars, 2016, p. 13). Bailey & Jaggars (2016) states that, "Rigorous analysis of Statway suggests that these students were three times more likely to complete college-level Math in one year than their similar peers were in two years" (p. 13).

Having the Math pathways as an option for students to excel in the developmental Math curricula helps students accelerate through the traditional Math courses. While some Math pathways require students to demonstrate a certain level of readiness prior to entry into the pathway (often in arithmetic), others allow students with any Math placement score to enter (Bailey & Jaggars, 2016, p.13). The Statway model and the California Acceleration Project helped students who are only one level below college-level Math but can help students at all levels of basic Math skills.

The New Mathway's Project uses different techniques to help engage students. For example, faculty members try to use real data sets and contextualize Math problems within real-life situations (Bailey & Jaggars, 2016, p. 15). Instructors also require students to work in small groups to solve problems, leading to active and engaging classroom sessions (Bailey & Jaggars, 2016, p. 15). Another way instructors engage students is through questioning, rather than just lecturing to the students. Another area that is added on to the New Mathways Project

is a three-hour success course that teaches students how to be successful in college. At the City University of New York (CUNY), an intensive full-time program designed for students with multiple remedial needs was designed and is one semester long. The program consists of 25 hours a week learning the instructional philosophy at the college level. Started in 2010 to 2011, the program began with 400 students and grew to 4,000 for the 2013 to 2014 school year (Bailey & Jaggars, 2016, p. 12). One study found that, compared to students in traditional sequences, CUNY students were almost twice as likely to graduate within three years and more than twice as likely to graduate with a GPA of 3.0 or higher within three years (Bailey & Jaggars, 2016, p. 12).

Conclusion

Over the past 40 years, there have been changes made with placement testing and there are still changes slated to happen in the future. Colleges all around the country question how placement testing should be used. Placement testing is used to place students into courses. Based on their placement test score, the student will place into developmental or transferable courses. Rates of students enrolling in developmental education have increased in the past ten years, but there is research that still questions if taking developmental courses is the best avenue for students who must remediate. There are products available students may use to remediate instead of taking a course. Another area of concern is to make sure the cut scores are valid and reviewed on a regular basis and not just when a new test is available. When reviewing the cutoff scores, colleges need to review student data to analyze where students were placed and the success of those students. Other factors affect success in a course, but

those factors are not being reviewed to determine success – just the scores compared to the final grade.

Are there other indicators that colleges could review instead of placement test scores?

There is early research on using high school GPA as an indicator and a student's success in particular courses while in high school. Colleges could look at high school GPA and placement testing scores to get a well-rounded evaluation of the students. Students are given options to enroll in accelerated learning programs that help students advance through developmental courses faster, while still learning the skills needed for the transferable courses. Another approach is the K-16 model where school districts and colleges work together to align curricula to prepare students for college. The pathway model for students in certain areas of study is currently being researched and may be an option in the future for students. Placement testing is ever-changing, and there are new options being researched and analyzed to make it easier for students to enroll in transferable courses and result in success. Remediation is crucial for students who do not have the skills needed to place into transferable courses, and there are different ways to go about remediation.

CHAPTER THREE: METHODOLOGY !

Introduction *

This current research investigated students who placed into developmental Math and choose to remediate in the testing product used for their initial assessment. After they retested, did the students increase their placement score? Research was conducted using a selected sample size of students from an open-door, open-access, comprehensive community college in the Midwest. All new incoming students need to complete an application, and as an open-door institution, all students are accepted to the college. Students who do not meet the Math readiness standards, as stated in Item #1 below, have to be assessed before enrolling. Testing of Math readiness can be determined two different ways. However, student course readiness is assessed before a student can secure enrollment. Course enrollment is aligned to placement scores. Students have two options for Math placement:

1. ! Students must meet one of following multiple measures: submitted an acceptable testing score from ACT-22 on the Math portion or SAT-520 on Math portion, Advanced Placement (AP) -3 or higher on calculus or statistics exam, Partnership for Testing of Readiness for College and Careers (PARCC)- 4 or higher on Algebra II or Integrated Math III, or a student who took Algebra I, Geometry, and Algebra II with a C or above in high school.
2. ! Complete ALEKS or Accuplacer testing on-campus: Accuplacer score in Elementary Algebra is above or below 80, or ALEKS-PPL score is above or below 45.

As noted earlier, many students in the state of Illinois do not enroll in a Math course their senior year of high school because they have already satisfied the graduation requirement. As a result of not studying Math for one year, there may be a loss of Math terms

and processes. One common assumption in cognitive psychology and neuroscience is that we cannot possibly remember everything because our brains would not be able to hold memories of each and every experience and perception over a lifetime (Bar, 2011). Bar also states, “What we learn, what stays in memory, are novel bits of information about our universe, which enrich the pool of scenarios on which we can later produce predictions” (n.p.).

For this study, students have the option to remediate to demonstrate skills such as dividing fractions and/or performing an algebraic equation through the Math remediation products ALEKS-PPL or Accuplacer. Each product determines the remediation that students need to concentrate on through the initial placement test taken. Students wanting to enroll into a Math course for Fall 2016 will take the placement test through one of two products. Students who are assessed as needing developmental Math will be given the option to remediate through the product they assessed. The student cannot retest for at least 48 hours and will not be required to remediate. In short, remediation is optional. The data was collected from June 1 through August 26, 2016. The student information and placement scores were collected through the college’s student enterprise system.

Students who tested into a college-level Math course were disqualified from the sample because the study only examined developmental Math remediation. A student not satisfied with an initial score listed under Item #1 above, may retest using ALEKS-PPL or Accuplacer. The student will schedule to take a Math placement test and then, if the student is not satisfied with placement scores, that student will receive an access code from the testing center staff. Students may then select to remediate by using the products (ALEKS-PPL or Accuplacer) online services. Some students may decide not to remediate as it is not required for retesting.

Students must wait a minimum of 48 hours from testing completion to retest. When retesting, students will use the same product from the initial measure. The retest outcome will determine if the student places into developmental Math or a transferable Math course.

Students were placed in two category groups: ALEKS-PPL and Accuplacer. Placement into each group was determined by the days of the week that the student took the initial on-campus placement. ALEKS-PPL was given on Monday, Wednesday, and Friday of the odd weeks of the month and Tuesday and Thursday of the even weeks of the month. Accuplacer was given on Tuesday and Thursday of the odd weeks of the month and Monday, Wednesday, and Friday of the even weeks of the month. The duration of the study was until a sample size of 20-0 students in each product category group had remediated.

The researcher collected the initial placement scores, the retest placement scores, the number of hours the student spent remediating according to online reports, age, ethnicity, and gender. The college's student enterprise system recorded placement scores. The number of hours the student remediates were collected by the remediation product and then reported to the college's testing center. The researcher examined which remediation product helped students place into transferable Math with the help of the remediation completed through the ALEKS-PPL or Accuplacer.

Research Questions

1. ! Does the online Math remediation product (Accuplacer or ALEKS-PPL) increase a student's Math placement score?
2. ! Is there a relationship between the Math remediation product and the type of Math course (transferable or developmental) a student places into?
3. ! Do statistical differences exist in remediation hours among age groups or by gender?

- a. ! Is there a difference in the number of remediation hours completed between the 18 - 24 and 24 and older age categories?
 - b. ! Is there a difference in the number of remediation hours between males and females?
4. ! Is there a relationship between the Math placement product and a student being successful in their Fall 2016 Math course?

Successful grades in developmental Math courses is defined as a final grade of C or higher for the student to advance to the next level in the Math sequence.

Hypothesis

- There is no relationship between the online Math remediation product and the increase in placement score the student receives.
- There is no statistical difference between the Math placement products ALEKS-PPL and Accuplacer in placing students in transferable or developmental Math courses after remediation.
- There are no statistical differences among age groups or gender and the remediation hours completed.
- There is no relationship between the online Math remediation product and student success in their Fall 2016 Math course.

Assumptions

The following assumptions were made about this study, which are basic principles that are accepted as true, based on reasoning but without proof (Polit & Beck, 2010, p. 1453). It is assumed that students who took a standardized exam, such as the ACT or Math placement exam, applied themselves and took the exam seriously to achieve the highest score they could be based on their ability. Students want to achieve the highest score on the placement exam in order to be placed into a transferable Math course for degree completion. Additionally, because enrolling in developmental Math courses will cost the student more time and money,

testing into a transferable Math course is favorable. Finally, the findings of this study could help other testing centers decide on an online remediation component.

Limitations and Delimitations

The limitations of the study are shortcomings of the study that are outside the researcher's control for, and the delimitations are choices made by the researcher ("Diving Deeper," n.d.). Since the testing placement criteria into Math courses vary between institutions, the researcher decided to study incoming students from only one Midwest community college. The study findings could be used to see if similar results could be identified at other community colleges.

The sample population was identified as incoming students who had applied to the college and signed up for the Math placement exam during the months of June-August. Since the college is a community college with open access, the sample population is expected to vary by age and gender. Students use the highest score obtained when determining Math readiness and placement into a Math course. ALEKS-PPL can be repeated five times within one year and Accuplacer can be repeated three times in a year. The remediation for ALEKS-PPL is six months from the time the student logs in to the modules, and then Accuplacer is available for ten weeks starting the day the student tests and receives the code. The testing companies that allow for the retests have established validity and reliability measures; however, it is important to note that even though the highest score is used to determine Math placement, the other scores remain in the student's profile. This study will compare all scores obtained by the student to determine if there is any impact on the remediation product used by both testing

companies. The college agreed to accept older test scores in Spring 2016, so now there is no time limit on the test scores or on how old the scores are in the student's profile. Students could be placed into Math courses based upon scores that are only a few months old to those that are several years old. The college does have students who return after being out of college for a period of time who may want to retest or use their old test scores for placement.

Inferential statistics were not used for all of the research because the sample size for Accuplacer tests was below the threshold of 15 students who tested into developmental or transferable Math courses. The researcher used descriptive statistics for the data analysis.

Student behaviors that may affect test scores could include amount of sleep, preparedness before the test, not taking enough time on the test, or other items that are out of control of the researcher. In addition, not all the human subjects who decide to complete a Math placement test will have the same competencies in Math. And, as noted, the students will be different ages; thus, there might be a variance in the time the student completed their most recent Math course.

Research Design

The design for this study was a non-experimental inferential statistical design. This design method was selected because the researcher is investigating possible correlations between a testing product and increases in a student's placement score. Data was pulled from the college's enterprise system and the Math placement product database. The placement product identified the number of hours each student completed before retesting. Data was not manipulated or tailored for this study since this was a retrospective review of the variables and

the results. The population studied consisted of any students who wanted to enroll in a Math course for the Fall 2016 semester and placed into a developmental Math course. They received an access code, so they could remediate before retesting if they choose to do so. Students who tested and then enrolled in a Math course for Fall 2016 semester were tracked based on that specific Math course. The final grade was reported to the researcher through the college's enterprise system to determine course success.

Therefore, a relationship between the Math remediation product and the type (transferable or developmental) of Math course a student begins. In short, it is hypothesized that remediation in both ALEKS-PPL and Accuplacer will increase the retest score. In addition, the number of hours that a student remediates may predict a student's success in their Fall 2016 Math course.

A dependent variable was testing into either a transferable or developmental Math course. Transferable courses are courses that are labeled 110 and above and provide transferable credit; developmental courses are labeled 109 and below and are labeled below level courses. In order to enroll into a transferable Math course, a student needs an elementary algebra score of 81 or above in Accuplacer and a 46 or above in ALEKS-PPL. Enrollment into a developmental Math course is a pre-algebra score between 1-99. The pre-algebra score will determine which developmental Math courses a student can enroll in.

The independent variables were successful course completion in the Fall 2016 Math course, their age, and gender. Course completion was determined by a student obtaining a grade of C or higher. Students who received a grade of a D or F were considered unsuccessful in this study. Gender and age data were pulled from the student database system.

The variables consisted of the number of hours spent on remediation and a student's placement scores. Nominal labels were applied to note transferable and developmental Math courses. A zero was used to indicate developmental Math and a one was used to indicate transferable Math. The final grade was noted as using a zero for not successful passing the course and a one for passing the course. Gender was labeled male or female.

Threats to Validity and Reliability

In this study, validity was impacted if data were entered incorrectly into the student database system or tracked incorrectly by the testing product. Their Math placement score determined if a student was college ready. If the data was not entered correctly, unreliable data was the result. If data was entered in error, that would not only affect validity, but also influenced reliability. The majority of the data in this study was nominal data; thus, in this particular study data input and extraction errors had the potential to impact reliability.

Threats to validity, both internal and external, exist. In this study, a convenience sample was used, and the findings were generalized for a larger population. The purpose of this study was to determine if remediation improves college readiness and course success in Math and which product does it more effectively. The information obtained was useful for understanding the Math placement products at a Midwest community college and may be used at other colleges. The findings of this study may inform other colleges on a Math placement product and how many hours a student needs to remediate before retesting. Admission to the college and testing of the student's ability in Math can also be determined by other exams, such as the ACT, SAT, high school courses taken, or course that are transferred to the Midwest community

college. Only students who did not have these scores or were not satisfied with their scores completed Math placement.

There were no concerns related to unethical treatment of any student because all students taking the Math placement exam who tested into developmental Math were given the opportunity to remediate and retest. All data collected was extracted from the enterprise system and the placement product itself. All data was aggregated so it will not be possible to identify individual students.

Prior to completion of this study, the researcher completed the necessary IRB approval process at the host institution. As stated previously, students were not at risk and their information was not compromised as a result of their participation in this study. All test scores at the institution are placed in a secure database and cannot be obtained without secure login identification as determined by employee level and/or institution duties.

Exclusions

The sample population in this study consisted of students who applied to the college and wanted to enroll into a Math course in the Fall 2016 semester. All students were classified as either testing into a transferable Math course or a developmental Math course. Additionally, the gender, age, and Math course the student enrolled in for the Fall 2016 semester were tracked. If a student chose not to enroll in a Math course for the that fall, data was noted that the information was not available. If a student tested into a transferable Math course upon first attempt, that student was eliminated from the study. After the first attempt, the determination was made if students wanted to remediate and retest.

Sampling

The sample population included all students wanting to enroll in a Math course for the Fall 2016 semester at Midwest community college. The students who tested into a developmental Math course after their first attempt were given the information to remediate in the areas they were deficient in and then retested. Students were not required to remediate before retesting but did have to wait 48 hours before retesting.

The data sample size (N) for this study was determined to consist of up to 73 students; 30 students retested in Accuplacer and 43 students in ALEKS-PPL. The study sample was separated into students who tested into a transferable Math course and students who tested into developmental Math courses. The study population was a convenience sample; however, there is no reason to believe that the sample population was composed of those who are not representative of the usual student population accepted into the college.

Data Collection

The data used for this study are maintained in the community college's enterprise system and can be extracted into a database. The system identified students who took the Math placement exam between the months of June through August. Data were collected on the students' initial pre-placement score, post-test score, age, gender, race, and the number of remediation hours completed for each student. Data were then analyzed in various ways. One way is which testing product was used and whether there an increase or decrease in the post-test score. The post-test score a student received determined if the student was placed into developmental or transferable Math course. Next, the total number of hours a student

remediated was collected among age groups and by gender. Lastly, the analysis of gender and/or age and if gender and/or age has an impact on remediation hours. The question that could be analyzed is the number of remediation hours based upon age and/or gender.

Data Analysis

In analyzing the data, the researcher included descriptive statistics. The total N included students from the Fall 2016 semester and any exclusions noted as previously outlined. The data were grouped according to placing into a transferable Math course or a developmental Math course by their Math placement score. Using a *t-test*, the groups were reviewed to see if any inferential statistical significance exists between Math remediation product and the change in the final placement score and Accuplacer and ALEKS-PPL and the type of Math course (transferable or developmental). Next, the researcher used a *chi-square* test for the total number of hours remediated by age and gender, as well as the Math placement product and a student's final Math grade for the Fall 2016. The independent variables were Accuplacer and ALEKS-PPL, a student's age and gender, and dependent variables of the change in the final placement score, the number of remediation hours, and if the Math course was transferable or developmental.

Descriptive statistics were used so the numbers were converted into percentages. After the Fall 2016 semester, grades were assessed to see which product placed students in the appropriate Math course which was determined by if the student was successful or unsuccessful in the Math course. A *t-test* was conducted to show if a relationship existed between the number of remediation hours and gender and/or age.

Conclusion

At the community college, a diverse population of students walk through the doors each semester intending to complete college-level Math courses. Some students will be ready for the for college-level Math, but others will need developmental Math. This study examined two different Math placement products, analyzing the hours of remediation a student completed, and then documented where they placed in the transferable or developmental course list. The student's final Math grades were then collected at the end of the Fall 2016 semester to determine if students were successful in the Math course in which they were placed.

After the research is evaluated and presented, the Midwest community college may decide which Math testing product they would like to use for at least one year. There are financial implications to the college because the cost of the placement test and the remediation product varies; currently, the college pays for the test. The results of this study may help the college to determine if students need to complete a set number of remediation hours before they can retest. Lastly, the successful completion of the Math course that a student was placed into is crucial to the success of the student in the future.

CHAPTER FOUR: RESULTS AND FINDINGS

Introduction

The purpose of this study was to identify which Math placement remediation product is most effective in increasing students' placement scores. Several factors could affect a student's placement score, for example, the length of time between Math placement assessments, when the student was in high school, and which Math courses were completed. The longer a student is out of high school could affect his or her placement score because the student may not remember how to do a specific Math application. For example, a student could not remember how to do fractions and that could affect their score in the algebra part of the assessment. The ability to decrease the number students who have to enroll in a developmental Math course before taking a college-level Math course would be beneficial for students and colleges.

This study looked at age bands to see if there was a relationship between a student's age compared to the number of hours the student remediated. Also, was there a difference between genders and a person's race in the number of hours remediated and at what level (developmental or transferable) did they retest? Finally, student success was determined if the student was successful (earning grades of A, B, or C) or unsuccessful (resulting in grades of D, F, Withdraw, or Withdraw Fail) in their fall Math course. Currently, the success rate at the community college, which the research was collected from, has a 70- 2% successful completion rate in a developmental Math course since 2012 (Figure 4). The goal is that more students test

into college-level Math, diminishing the risk of students avoiding developmental Math and not being successful at rates that hover around 30% for multiple years.

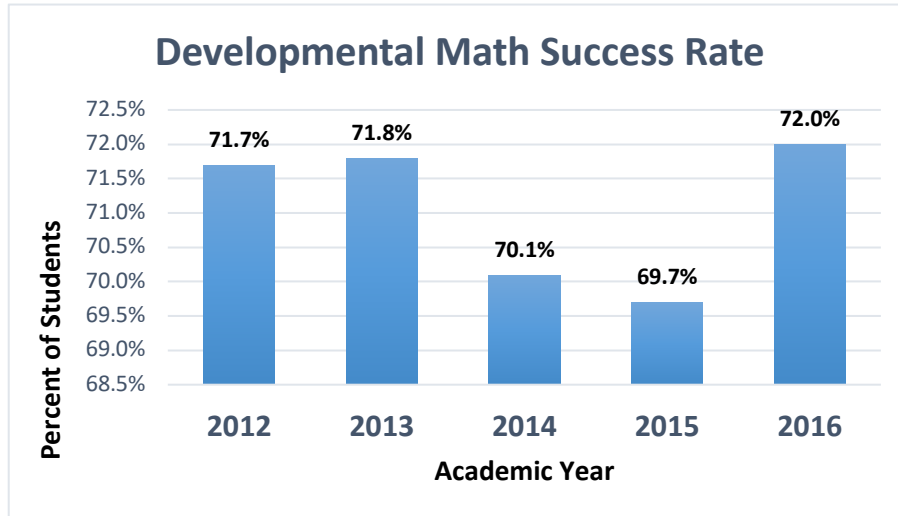


Figure 4: Developmental Math Course Success Rate

Descriptive Statistics Results

This study included a sample N of 72 incoming new students to a community college. The students took the Accuplacer or ALEKS-PPL Math placement test during the months of June through August 2016. The study included 43 female students, or 58%, while males represented 31 students, or 42%, as noted in Figure 5.

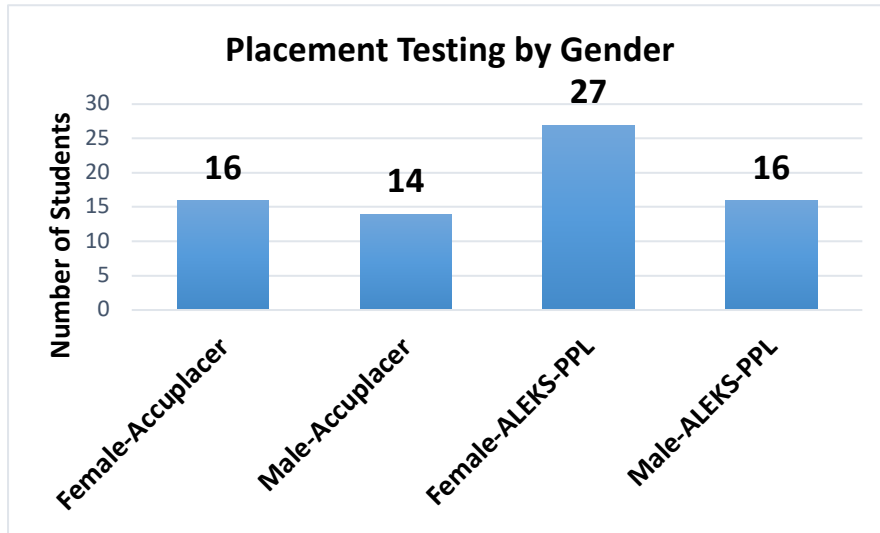


Figure 5: Math Placement by Gender

Figure 6, below, shows the age breakdown of the population that took the placement test. The age brackets were broken down into five categories: 16-19, 20-24, 25-29, 30-34, and 35-50. Age data was retrieved from the student enterprise system.

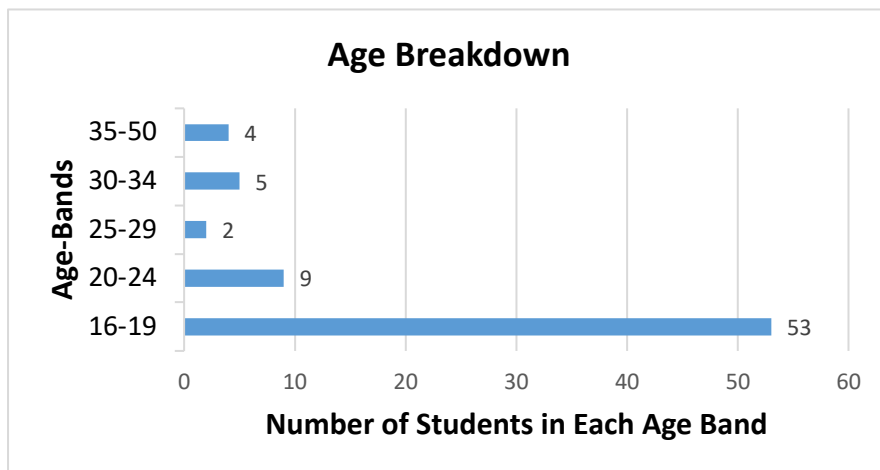


Figure 6: Placement Test Age Breakdown

For Accuplacer, Figure 7 highlights students' ethnicity, identified as Asian, Black, or Hispanic, for 9 students, or 30% of the research population. Caucasian students represented 21 students or 70% of the research population.

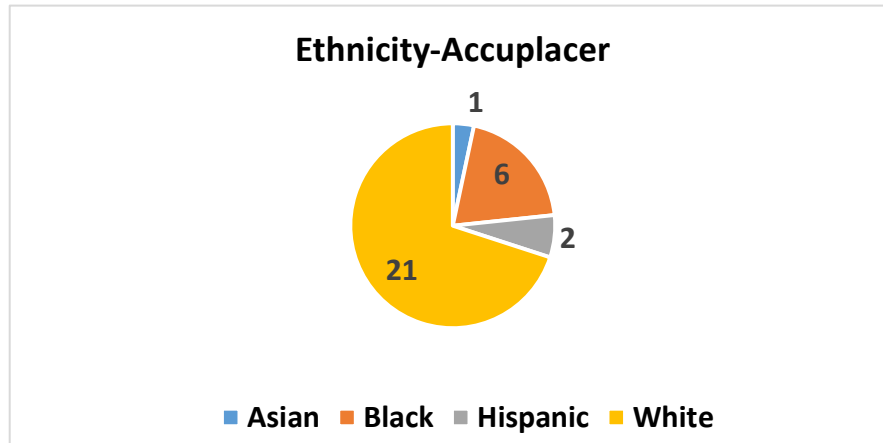


Figure 7: Ethnicity Breakdown for Accuplacer

For ALEKS-PPL, Figure 8 highlights students' ethnicity, identified as American Indian, Asian, Black, Hawaiian, and Hispanic, for 16 students, or 37% of the research population. Caucasians represented 27 students or 63% of the research population.

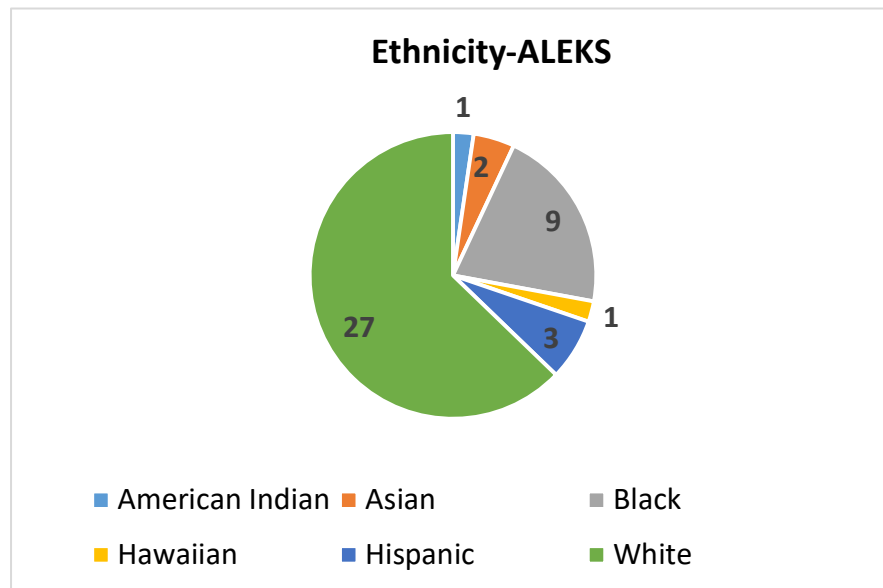


Figure 8: Ethnicity Breakdown for ALEKS-PPL

Figure 9 shows the number of students who enrolled into a Math course in the Fall 2016, which included 18 students or 58%. In addition, 12 students or 38% of students in the research population for Accuplacer did not enroll into a Fall 2016 Math course. Of those 18 students, 9 students or 29%, tested into and enrolled in a transferable Math courses and 10 students or 32% enrolled in a developmental Math course.

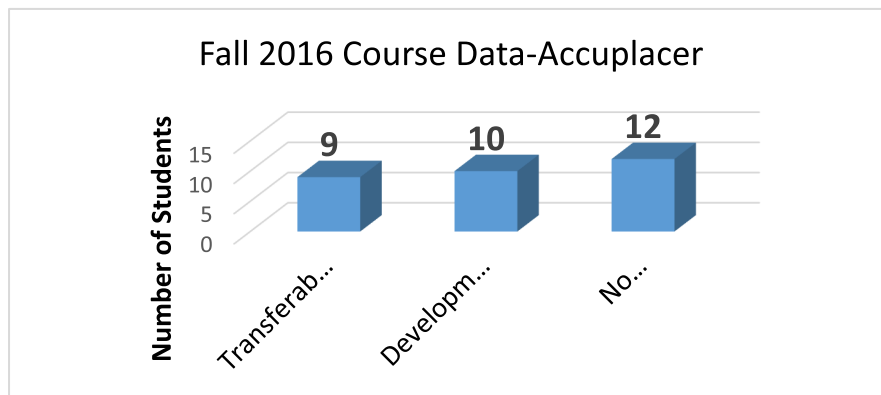


Figure 9: Transferable and Developmental Fall Enrollment-Accuplacer

Figure 10 illustrates the students who tested into and enrolled into a Math course in the Fall 2016 semester, which included 30 students or 67%, while 15 students or 33% of students in the research population for ALEKS-PPL, did not enroll into a Fall 2016 Math course. Of those 30 students, 16 or 36% tested into and enrolled in a transferable Math course and 14 students or 31% enrolled in a developmental Math course.

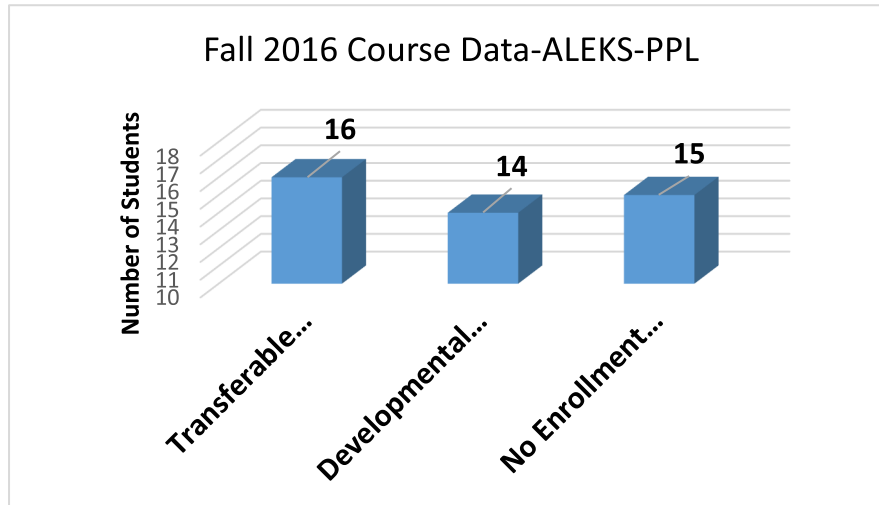


Figure 10: Transferable and Developmental Fall Enrollment-ALEKS-PPL

Figure 11 reports the number of hours that students remediated in both products. There was no required amount of time that each student had to remediate; therefore, variance is visible. Overall, 52 of the 72 students completed at least one or more hours of remediation, and some students remediated more than once and then retested more than once, totaling 79 points of data. Of those 52 students, 28 students or 35% remediated 0-2 hours; 27 or 34% remediated 3-5 hours; 12 or 15% remediated 6-8 hours; 6 or 8% remediated 8-10 hours; and 6 or 8% remediated 11 or more hours. On average, students who took ALEKS-PPL remediated 7 hours and students who took Accuplacer remediated on average only one hour.

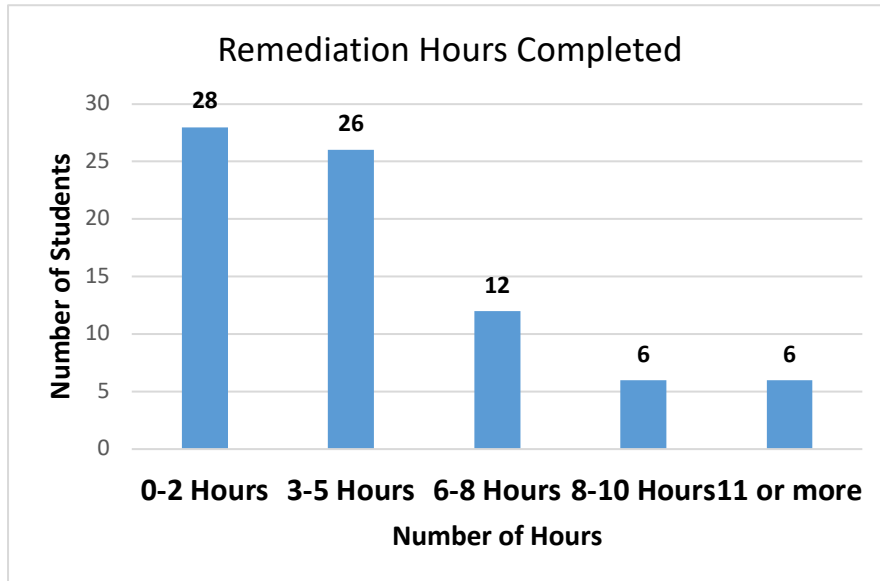


Figure 11: Overall Remediation Hours

Figure 12 represents if a student increased or decreased their score from their initial placement score in Accuplacer. There were 23 students who increased their placement score by one or more points and, of those 23 students, two students retested twice. One student completed the remediation and increased the initial score by 50 points. In Accuplacer, 7 students or 23% decreased their placement score from their initial test score. Additionally, of those 7 students, 5 decreased their score and did not complete any remediation in the software, Pearson My Math Lab. On average, students increased their score by 10 points when they retested in Accuplacer.

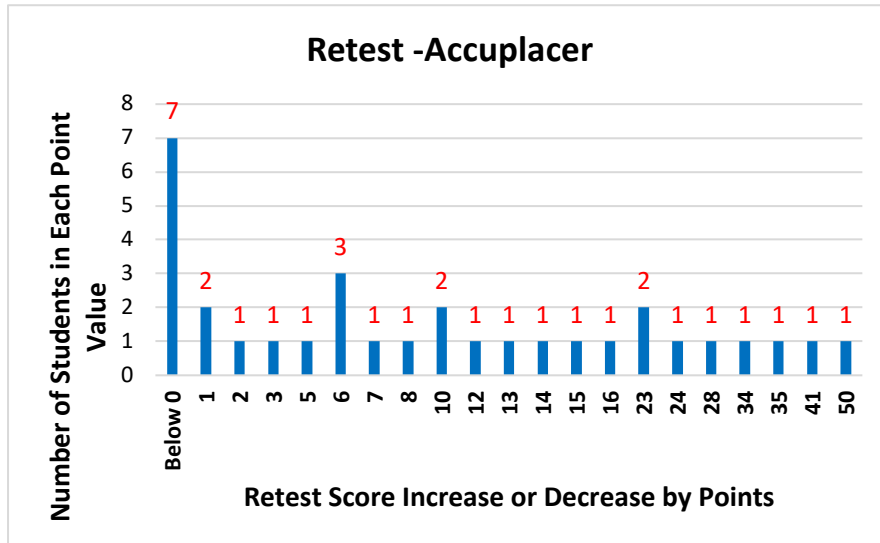


Figure 12: Number of Points a Student Increased or Decreased Placement Score from Initial Test Score-Accuplacer

Figure 13 represents if students increased or decreased their score from their initial placement score in ALEKS-PPL. Of the sample, 43 students increased their placement score by one or more points, and of those students, 6 retested 2-3 times. Two of the 43 students choose not to remediate at all, which neither positively nor negatively affected their test score because their scores stayed the same as their initial test score. On average, students increased their score by 12 points after remediating.

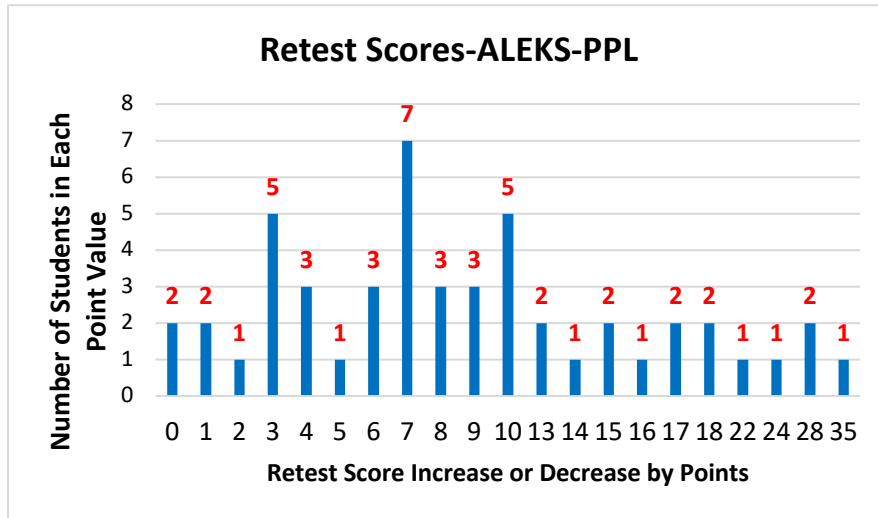


Figure 13: Number of Points a Student Increased or Decreased Placement Score from Initial Test Score-ALEKS-PPL

Figure 14 displays the final grades from the Fall 2016 semester for those students who took the Accuplacer placement test before classes started in August. Only 9 of the 30 students, or 30%, passed their developmental or transferable Math course successfully (earning a grade of C or better) and 9 were unsuccessful (earning grades of D, F, W, or WF). Of the students who took the Accuplacer placement exam, 9 did not enroll in a Math course during the Fall 2016 semester, and 3 of the 9 did enroll in Math course during the Spring 2017 semester (see Figure 15).

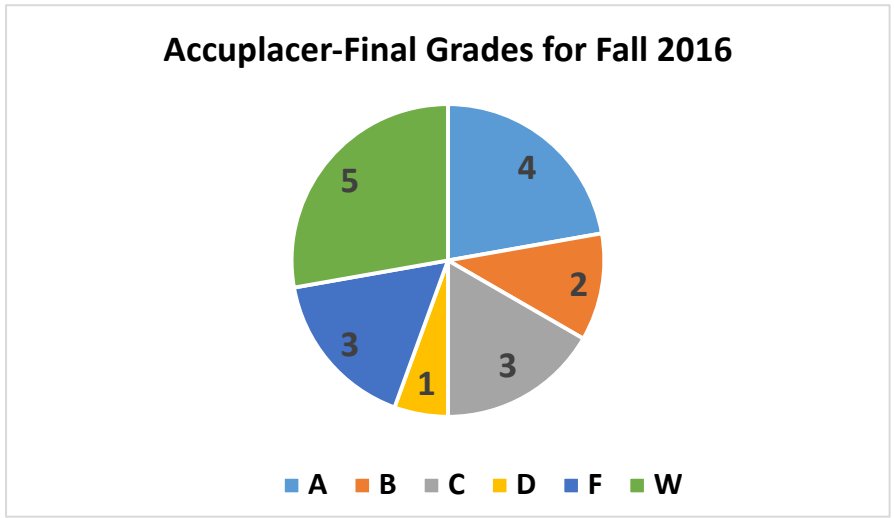


Figure 14: Final Fall Grades-Accuplacer

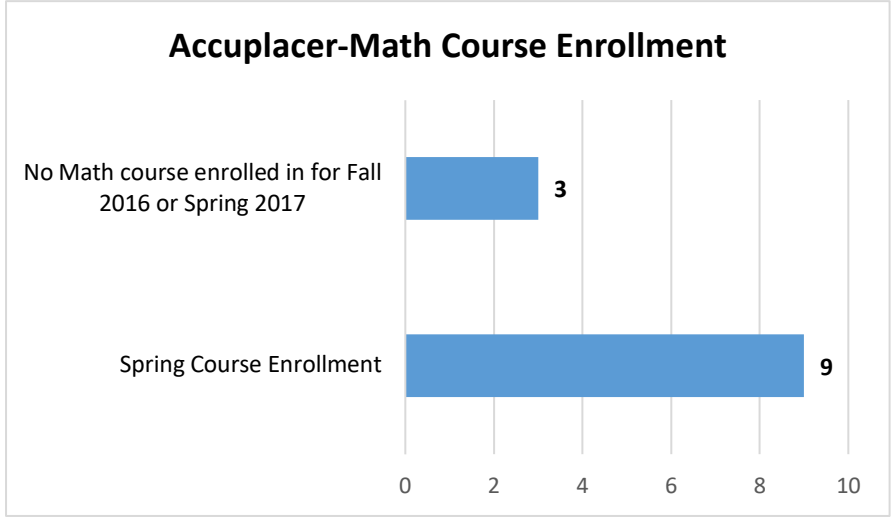


Figure 15: Math Course Enrollment-Accuplacer

Figure 16 reports the final grades from the Fall 2016 semester for those students who took the ALEKS-PPL placement test before classes started in August. There were 22 of the 31 students, or 71%, who passed their developmental or transferable Math course successfully (earning grades of C or better) and 9 who were unsuccessful (earning grades of D, F, W, or WF).

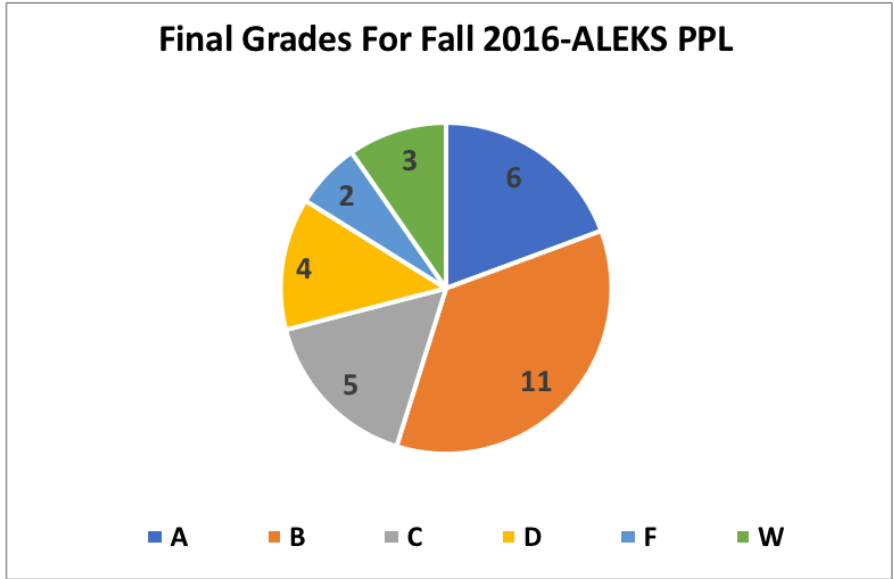


Figure 16: Final Fall Grades-ALEKS PPL

Figure 17 indicates that 10 students who took the placement exam did not enroll in a Math course during the Fall 2016 semester, and 4 of the 10 did enroll in Math course during the Spring 2017 semester. One student took the placement test and then enrolled into GED courses.

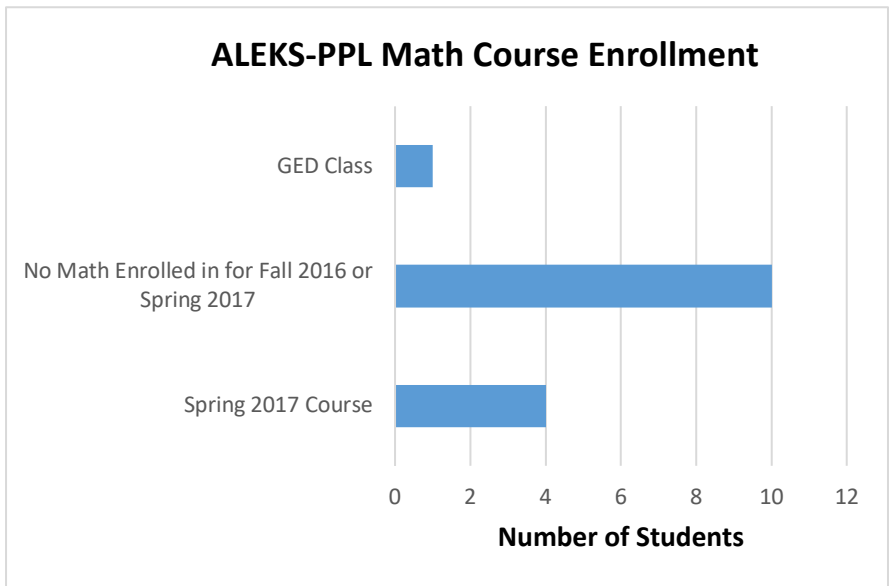


Figure 17: Math Course Enrollment-ALEKS-PPL

Research Question Results

Research Question #1: Findings and Results

Research Question #1 stated: Does the online Math remediation product increase a student's Math placement score? This question looked at both placement products and the initial placement score and the retest score(s) by each student.

The researcher ran a *t-test* by using the independent variable as the Math placement product (ALEKS-PPL or Accuplacer), and the dependent variable is the difference between the retest placement score and the initial placement score. The change could be positive or negative.

Table 1: Research Question #1, Group Statistics

	Test	N	Mean	Std. Deviation	Std. Error Mean
Initial Scores	AL	50	24.48	11.795	1.668
	AC	32	43.22	16.293	2.880
Retest Scores	AL	50	36.32	14.403	2.037
	AC	32	52.41	21.782	3.850
Score Difference between Initial Retest	AL	50	11.84	9.027	1.277
	AC	32	9.44	16.955	2.997

Table 2: Research Question #1, Independent Samples Test

	Levene's test for Equality of Variance		t-test for Equality of Means					98% confidence interval of the difference	
	F	Sig.	t	df	Sig. 2-tailed	Mean Diff.	Std. Error Diff.	Lower	Upper
INITIAL SCORES									
Equal variances assumed	6.881	.010	-6.036	80	.000	-18.739	3.105	-24.917	-12.560
Equal variances not assumed			-5.630	51.608	.000	-18.739	3.328	-25.419	-12.059
RETEST SCORES									
Equal variances assumed	9.196	.003	-4.030	80	.000	-16.086	3.992	-24.030	-8.142
Equal variances not assumed			-3.693	48.380	.001	-16.086	4.356	-24.843	-7.330

	Levene's test for Equality of Variance		t-test for Equality of Means				98% confidence interval of the difference		
	F	Sig.	t	df	Sig 2-tailed	Mean Diff.	Std. Error Diff.	Lower	Upper
SCORE DIFFERENCE BETWEEN INITIAL RETEST									
Equal variances assumed	10.948	.001	.836	80	.406	2.403	2.875	-3.319	8.124
Equal variances not assumed			.737	42.385	.465	2.403	3.258	-4.170	8.975

The confidence level for ALEKS-PPL (Initial Score AL) would be 13 - 25 with a mean of 19 and the retest level would be 8-24, with a mean of 16. The confidence level for Accuplacer (Initial Score AC) would be 12-25 with a mean of 18.5 and the retest level would be 7-23 with a mean of 15. Overall, the mean for ALEKS-PPL is 30 and Accuplacer is 47.5. The significance level associated with the difference score is .465 (greater than .05), so the null fails to be rejected. The t-value measures the size of the difference relative to the variation in the data so the average t-value for ALEKS is 2.006 and for Accuplacer it is 1.937. There was no statistically significant difference in a student's retest score based upon the remediation product to which they were assigned. Students who took ALEKS-PPL had a greater positive change in retest scores greater than students who took Accuplacer, but the difference was not statistically significant. This was shown by the *p value* being .465 in the score difference chart. The results from Research Question #1 could be influenced by the number of hours spent in remediation.

Research Question #2: Results

Research Question #2 stated: Is there a relationship between the Math remediation product and the type of Math course a student places into? This question is important because the efforts of this research could influence a community college and guide research on

assessment product decisions to use for Math placement. Each product offers a remediation tool, which would provide students with an option to remediate on the areas they were deficient in which in part could increase a student’s overall placement score. The results from Research Question #2 could be influenced by the number of hours a student spent remediating. The researcher ran a chi-square test for this question and the results show that the significance level is greater than .05, so there is no relationship between the Math remediation product and the type of Math course a student placed into.

Table 3: Research Question #2, Cross-tabulations of Test Products

		Test Name		Total
		AC	AL	
Overall TC-DC	1	10	14	24
	2	9	16	25
Total		19	30	49

Notes: 1= Represents Developmental Course; 2= Represents Transferable Course

Table 4: Research Question #2, Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.166 ^a	1	.684		
Continuity Correction ^b	.013	1	.909		
Likelihood Ratio	.166	1	.684		
Fisher's Exact Test				.773	.455
N of Valid Cases	49				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.31.

b. Computed only for a 2x2 table

Research Question #3: Results

Research Question #3: Do statistical differences exist in remediation hours among age groups or by gender? Is there a difference in remediation hours completed between 18-24 and

24 and older age categories? Is there a difference in the number of remediation hours between males and females? The researcher ran a *t-test* for this question. The independent variable was age or gender and the dependent variable was the number of remediation hours completed.

Table 5: Research Question #3, Group Statistics by Age

	Age	N	Mean	Std. Deviation	Std. Error Mean
Remediation Hours	1	60	4.18	5.429	.701
	2	13	7.69	8.664	2.403

Notes: 1 = Represents the Age Group 18-24 years old; 2 = Represents the Age Group 24 and older

Table 6: Research Question #3, Independent Samples Test by Age

	Levene's test for Equality of Variance		t-test for Equality of Means				98% confidence interval of the difference		
	F	Sig.	t	df	Sig 2-tailed	Mean Diff.	Std. Error Diff.	Lower	Upper
REMEDICATION HOURS									
Equal variances assumed	3.073	.084	-1.881	71	.064	-3.509	1.865	-7.228	.210
Equal variances not assumed			-1.402	14.108	.183	-3.509	2.503	-8.874	1.856

Notes: 1 = Represents Female; 2 = Represents Male

Table 7: Research Question #3, Group Statistics by Gender

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Remediation Hours	1	43	5.19	7.430	1.133
	2	30	4.27	3.886	.709

Table 8: Research Question #3, Independent Samples Test by Gender

	Levene's test for Equality of Variance		t-test for Equality of Means				98% confidence interval of the difference		
	F	Sig.	t	df	Sig 2-tailed	Mean Diff.	Std. Error Diff.	Lower	Upper
REMEDICATION HOURS									
Equal variances assumed	1.382	.244	.620	71	.537	.919	1.482	-2.036	3.875
Equal variances not assumed			.688	66.569	.494	.919	1.337	-1.749	3.588

The p-value in both t-tests were greater than .05, so it is not statistically significant. The age significance was 0.64, so age is approaching statistical significance. The mean for age was 4.18 for ages 18-24 and 7.69 for the 24 and older age category, which means that the 24 and older groups remediated for more hours than the 18-24 age group. Similarly, the mean for men was 4.27 hours and females were at 5.19 remediation hours, meaning females remediated an hour more than males.

There were 306 hours of total remediation completed in both products. Females completed 194 hours or 63% of the total number of hours completed. Males completed 112 hours or 37% of the total number of hours completed. There were more females in the overall study, but generally, females did complete more remediation hours than males.

Research Question #4: Results

Research Question #4: Is there a relationship between the Math placement product and a student being successful in their Fall 2016 Math course? Tables 9 and 10 show the breakdown of how many students were part of the research and how they did in their Fall 2016 Math course. Table 11 reports students who took the Accuplacer placement test and 9 or 50% successfully passed their Math course, while the other 9 or 50% were unsuccessful in their

Math course. Table 10 reports students who took ALEKS-PPL placement test and 22, or 71%, were successful in their Math course, and 9, or 29%, were unsuccessful in their Math course. Overall, 31 students successfully passed their Math course in which they were placed, and only 18 were unsuccessful. The students who were unsuccessful received a D, F, or withdrew from their Math course. Students who placed into a developmental Math course needed to receive a grade of C or higher to advance to the next Math course, according to the college's requirements. More students were successful in the Math course they were placed in when they took the ALKES-PPL placement test, compared to Accuplacer. Also included in the data are 26 students who took the Math placement test but never enrolled into a Math course during the Fall 2016 semester.

The researcher ran a *chi-square* test based upon the students' final Fall 2016 Math grade.

Table 9: Research Question #4, Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Overall Results *	50	100.0%	0	0.0%	50	100.0%
Test Name						

Notes: 1=Represents Successful of A, B, C; 2=Represents Unsuccessful of D, F, Withdraw

Table 10: Research Question #4 Overall Results, by Test, Cross-tabulation Count

		Test Name		Total
		AC	AL	
Overall Results	1	10	21	31
	2	10	9	19
Total		20	30	50

Table 11: *Research Question #4, Chi-Square Tests*

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.037 ^a	1	.153		
Continuity Correction ^b	1.277	1	.258		
Likelihood Ratio	2.029	1	.154		
Fisher's Exact Test				.235	.129
N of Valid Cases	50				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.60.

b. Computed only for a 2x2 table

The significance level is greater than .05, so there is no relationship between the Math remediation products and a student being successful in their Math course. Students who took ALEKS-PPL had a success rate of 70%, compared to students who took Accuplacer with a success rate of 50%.

Conclusion

The study sample consisted of 73 incoming students at a Midwest community college who took the Math placement test to be able to enroll into a Math course during their career at the college. The sample consisted of 42 females and 31 males, which is consistent with the overall enrollment at the college, equaling 55.2% females and 44.8% males (Illinois Central College, n.d.). Caucasian students represented 48, or 66%, and 25, or 34%, represented minority students. The overall college population is 78.4% Caucasian, 11% African American, 4.9% Hispanic, 2.4% Asian, .4% American Indian, .1 Native Hawaiian, and 2.6% two or more ethnicities (Illinois Central College, n.d.).

Students who completed at least one or more hours of remediation increased their Math placement score on average by seven points. More females completed remediation hours. Almost half the students who remediated in Accuplacer or ALEKS-PPL placed into a transferable Math course for the Fall 2016 semester. There were eight students in the study who remediated more than once and then retested. Those eight students increased their placement score by an average of 5.5 points.

CHAPTER FIVE: CONCLUSIONS AND IMPLICATIONS

Introduction

The purpose of this study was to evaluate two Math remediation products offered to students who were placed into developmental Math courses. Accuplacer and ALKES-PPL were the two Math placement products used in the study. Each product had a different remediation product offered to students who initially placed into developmental Math during the months of June to August 2016. The data compared the sample population related to gender, age, and ethnicity to determine if any differences in remediation hours were evident. Examining the outcome of the students' Fall semester 2016 Math course grade was important to the community college where the research was collected. Student success is essential to improving completion rates for hundreds of thousands of college students who are placed in developmental education each year (*Developmental Education, 2013*).

Coley, Coley, & Lynch-Holmes (n.d.) state that, "States are increasingly moving to higher education funding formulas that allocate some amount of funding based on performance indicators such as course completion, time-to-degree, or transfer rates" (p. 5). In some states, funding also is tied to the number of degrees awarded to low-income and minority student graduates (Coley, Coley, & Lynch-Holmes, n.d., p. 5). According to the National Conference of State Legislatures, 25 states currently have a performance-based formula in place, including Ohio and Tennessee (Coley, Coley, & Lynch-Holmes, n.d., p. 5). Other states are watching the results carefully and in some parts of the country, particularly the Northeast and Midwest, will

experience declines in the number of high school graduates over the next decade, making student success and retention a clear priority (Coley, Coley, & Lynch-Holmes, n.d., p. 5). Developmental education is an important part of retention and student success because students who take one or more developmental education course are at a higher risk of not continuing their education career.

Addressing Remediation

In the study, the researcher found that the majority of students who remediated increased their placement score when they retested. On average, students who remediated increased their score by ten points in Accuplacer and 11 points in ALEKS-PPL, which placed some students into a transferable Math course for the Fall 2016 semester. Students would have paid \$420 for a three-unit developmental class, so completing the remediation could save students hundreds of dollars.

Students entering college often do not understand how their performance on a placement test could influence their course taking in college (Burdman, 2012, p. 18). This could lead to students not preparing for the test or racing through the questions. Burdman (2012) also states, "The prevalence of under-placement also suggests the possibility that some students could score better if they had a chance to brush up "(p. 18). The remediation product for both tests had a positive effect on students who choose to remediate. Providing that quick brush-up option instead of a semester-long developmental course will be a positive benefit to students in the future. Six students tested into transferable Math courses that choose to remediate and retest. Those six students remediated an average of 2.5 hours and increased

their score by 12.5 points. Half of those six students were successful in their fall Math course, two were unsuccessful, and one did not enroll in a Math course that semester. There was a limited amount of data, but the same outcome was that remediation helped increase Math placement scores.

Students who are still in high school or just graduated should be more familiar with the material because they have learned it more recently. The data showed that the 20 and older age-band on average remediated five hours and the 16-19 age-band completed 6 hours. In addition, on average the oldest age-band increased their scores by 9 points in ALEKS-PPL and 31 in Accuplacer. The 16-19 age-band on average increased their scores by 9 in ALEKS-PPL and 6.5 in Accuplacer. Overall, providing a quick review option will help students of all ages increase their placement scores and work on those areas of deficiency.

There were 42 females and 30 males represented in the research. On average, males increased their score by 15 points and averaged about 3.5 hours of remediation. Females increased their score by an average of 5.5 points and remediated 3.7 hours. Overall, gender did not affect the results and the increase in scores points back to the remediation that was completed by the student. Looking at the overall comparison of the various ethnicities in the research, representation is comparative with the overall college population (Illinois Central College, n.d.). The percentages are as follows:

- Caucasians: 78.4%
- Black/African American: 11.0%
- Hispanic (any race): 4.9%
- Asian: 2.4%

- American Indian/Alaskan Native: 0.4%
- Native Hawaiian/Other Pacific Islander: 0.1%

Reviewing ethnicities on average, non-Caucasian students increased their score by 22 and Caucasians by 23 points. Minorities remediated on average 4.3 hours and Caucasians 3.2 hours. Overall, this data suggests that there is no significant difference between ethnicities. Reviewing all of the data in this study which included age, gender, and ethnicity, there was no significant difference in any of the categories.

After reviewing the research questions and the data that was presented in the t-test and *chi-square* analysis, there is not a significant level of difference between Accuplacer and ALEKS-PPL remediation products. The significance levels for Research Question #1 was .465 and Research Question #3 was .64, so they fail to reject the null. The mean for students who retested from their initial test score to their retest score was 12 for ALEKS-PPL and 9 for Accuplacer. Students who remediated in ALEKS-PPL increased their score by three more points compared to students who remediated in Accuplacer. An area that there was a difference was the success of students, which was determined by their final grade. Though the differences were not statistically significant, students who took ALEKS-PPL had a 70% success rate compared to 50% with students who took Accuplacer. Similarly, though there were no statistically significant differences by gender or age, females completed more remediation hours than males, and the 24 and older age group completed more hours. Other factors were not collected during the research that could have affected a student's success in their fall Math course. Overall, both remediation products helped students improve in areas they were

deficient based on research questions that were tested. Students did increase their scores with both products and both products placed students into transferable and developmental courses.

Recommendations

Recommendation #1: Placement using multiple measures

Multiple measures look at more than one piece of information in order to recommend placement for a student. Instead of relying solely on that one test score, institutions consider high school grade point average (GPA), number of years since a particular course, student self-reported information, other test scores, etc., to make course placement decisions or recommendations for the student ("Why Accuplacer?" n.d.). This is different than accepting an ACT or SAT score because that is accepting one test for another and placement still relies on a single indicator. An option in Accuplacer that some colleges can incorporate is background questions and student responses to determine course placement. For example, in California at least sixty-five percent of the state's 112 colleges embed questions within their computerized assessment asking about students' experience in the subject, self-reported high school grades, and other relevant experience (Venezia, Bracco, & Nodine, 2010, p. 14). The difficulty of implementing a system like this is what pieces of information about a student would be practical or helpful in making a more precise placement decision.

Another area colleges have looked at is using high school GPA to automatically place students into transferable level courses. Students must maintain a certain GPA to be able to be automatically placed into transferable level courses. Burdman (2012) states that, "High School grades are by far the most commonly mentioned supplemental measure" (p. 11). One of the

barriers to this recommendation is the shelf life of the GPA and if that measure should be accepted for students who have been out of high school more than two years. This is a decision that would have to be answered if this measure is put into place. Another barrier for the community college where the research was conducted is that summer and fall registration open before all area high schools hold graduation ceremonies. This could be an issue for those students who want to get an early start right after they graduate high school. The alternative measure is that the student would take the placement test to ensure they have a seat in a particular course.

In the state of Connecticut, there is legislation that limits developmental education and mandates colleges and universities to use multiple measures to determine whether students require college-readiness support (Burdman, 2012). According to Burdman (2012), Braden Hosch, director of policy and research for the Connecticut State colleges and universities states, “There are some pilots we will be conducting to begin getting that data in. We’ll probably start with the high school grades piece because it’s something that we know works really well as a predictor” (p. 12). Hosch also states that he has not talked to “a single person who objects to using high school information for college placement” (p. 12).

The Midwest community college where the research was performed is piloting a study with high school GPA and college-level English course in the Fall 2017 semester. There are five Applied Science degree programs that use high school GPA, instead of the Accuplacer reading placement score for those students who did not place into college-level English. One reason these five programs are piloting this measure is because the programs are struggling to fill to capacity due to the college-level English requirement. The pilot program would allow students

with a high school GPA of at least a 2.6 on a 4.0 scale be admitted with department approval. On average, there are 120 students in total for the five programs and there are between 15-20 students who were placed only into college level English for the fall. The students will not receive extra support or help throughout the fall and their final grades will be tracked to see if this placement measure is successful or unsuccessful for the college. The college will evaluate the data for the future of using high school GPA not just in English courses, but possibly for Math placement also.

Currently, the only way a student can be placed into a Math course at the community college would be to have a testing score from ACT, SAT, Advanced Placement, Partnership for Assessment of Readiness for College and Careers (PARCC) in Algebra II or Integrated Math III, Accuplacer, or ALKES-PPL. This is a barrier to students, especially to those that are not good at Math, requiring them to take another test before enrolling could affect enrollment in Math courses at the college. Removing this barrier might improve the placement of students who do not do well on standardized tests that are administered.

Recommendation #2: Math Bridge programs to replace developmental courses

During the Summer and Fall 2016 semesters, the Midwest community college Math department created a Math Bridge program for students who tested into developmental Math and need to refresh or strengthen their Mathematical skills. The program uses ALEKS-PPL to refresh Math skills and hopefully improve placement scores into a higher developmental course or to a transferable Math course. This program has had success and should continue in the future. The Midwest community college could consider using Accuplacer instead of ALEKS-PPL, but cost could become a factor as to why not to use Accuplacer.

Students must apply to the program, which is free for those who are accepted. The coordinator of program contacts the student to arrange a time to come in for a Math Bridge orientation (Illinois Central College Math Bridge, n.d.). The assessment will identify Math deficiencies. Following the assessment, the staff will show the student how to use the Prep and Learning Modules in ALEKS-PPL to provide necessary practice (Illinois Central College Math Bridge, n.d.) that focuses on identified deficiencies.

The program had 20 students enrolled for Summer 2016 and 15 enrolled in a Math course for the Fall 2016 semester. On average, the students remediated 14 hours and retested twice. There were ten students who passed their fall Math course successfully and one withdrew. The summer students on average increased their placement score by ten points. During the Fall 2016 semester, there were 27 students in the program and the students remediated on average two hours and retested twice. The fall students on average increased their score by 11 points. The one area of concern was the students who increased their score by 20 - 30 points, took a higher-level Math course in the fall, and were not successful. For example, one student tested into intermediate algebra and then retested and received the score to take college algebra and college trigonometry but withdrew from both courses. There could be other reasons the student withdrew, but maybe starting into concepts of Math or general statistics could have been a better choice. This approach would cost less for students and they can do without instructor and college intervention.

Overall, the program is seeing the same results with the study that was done over the last summer by the researcher. The students who remediate for more than an hour increase their placement score on average by ten points. Ten points could move a student to a

transferable Math course or eliminate one developmental course. The goal of both studies is to track student success and that students are being placed into the correct level of Math.

Recommendation #3: ALP Courses to replace developmental Math courses

After reviewing the literature and all the data presented in Chapter Four, there is an opportunity to offer Accelerated Learning Program (ALP) Math courses for students. Students who have a test score within a certain point range of a transferable Math placement score could enroll in an ALP Math sequence. For example, the English department already offers ALP sections for students who place between 44-89 points on the Accuplacer reading comprehension test and a 3-4 on the Accuplacer WritePlacer. ALP English combines preparation for college reading and writing with the institution's college-level English course. The ALP offering is a six-credit course and meets four days a week for an hour and fifteen minutes each day. Students earn college credit and are able to move into a transferable course after they successfully complete the ALP course.

Many more Math course options are offered at the college. For example, some of the Math courses are concepts of Math, general education statistics, college algebra, finite Math, intermediate algebra, or elementary algebra. The Math department faculty at the community college would have to work together to see if combining an intermediate algebra course with a college algebra course would work. Students could meet four to five times a week and each class would assign a final grade. The other option could be to combine elementary algebra with concepts of Math. Both of these combinations could combine the developmental course right below the transferable Math course together for six credit hours. Another option could be combining two developmental Math courses together, so students could eliminate both

developmental Math courses in one semester instead of over two semesters. These options would need further research but are options that Math departments need to consider.

Further Research

During the research, more questions surfaced, and further research may prove to be beneficial to colleges and students. The following areas and questions arose which will prompt additional research in the area of Math placement and Math course completion.

Area for Future Research #1: Using H.S. GPA for placement

The literature review indicates that high school GPA is a data point that colleges can use to place students into college-level courses. Further examination of the sample population from the Fall 2017 semester study at the community college is necessary and then additional student groups need to be examined. Student success needs to be tracked through the first year to see if the GPA indicates students are college-ready for all courses, in particular, the general education requirements.

Area for Future Research #2: Completing remediation

Students who place into developmental Math courses could be offered the option of remediating in a placement program selected by the college. The student could complete the remediation and then retest. Completion of remediation and student success would need to be tracked. On average, students could remediate at least one hour to be able to retest, as shown by the research data.

Area for Future Research #3: Accelerated Math course sequences

Explore an ALP option for Math courses. Combinations would have to be reviewed and studied, but this may lead to the college decreasing the amount of time a student spends in developmental Math sequences. Another option could be to review the remediation products and track if a student remediates in the product while being enrolled in a transferable Math course and the student passes both successfully, could they be allowed to continue on the transferable Math track?

Conclusion

This results from this study have the ability to positively impact students who need to take the Math placement test at the Midwest community college and may offer recommendations to other community colleges nationwide. Students who place into a developmental Math course at the college are successful, but the number of students enrolling in those courses could be decreased with a remediation option for those students. Several recommendations have been presented that could have a positive impact on the number of students who have to take a developmental Math course. The ability to decrease the number of students enrolling in a developmental Math would positively affect students and will positively affect the college and the surrounding community. Students would rather take a transferable Math course instead of taking one to three semesters of developmental Math courses, which cost students money, time, and decreases the college's completion time and rate. Overall, students need to have a required amount of remediation hours before retesting and for those students who do not test into a transferable Math course could still complete developmental

Math courses. Students need a variety of options and there cannot be just one. Making decisions from trend data gives students and colleges the ability to make evidence-based decisions that promote student success.

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APPENDIX A: FERRIS STATE UNIVERSITY IRB APPROVAL LETTER

FERRIS STATE UNIVERSITY

Institutional Review Board for Human Subjects in Research

Office of Research & Sponsored Programs, 220 Ferris Drive, PHR 308 · Big Rapids, MI 49307

Date: May 18, 2016

To: Dr. Sandy Balkema, Dr. Jill Wright and Ms. Emily Points
From: Dr. Gregory Wellman, IRB Chair
Re: IRB Application #160506 (*Placement Testing and the Math Remediation Process*)

The Ferris State University Institutional Review Board (IRB) has reviewed your application for using human subjects in the study, "*Placement Testing and the Math Remediation Process*" (#160506) and determined that it meets Federal Regulations *Exempt-category 1A/1E*. This approval has an expiration date of three years from the date of this letter. **As such, you may collect data according to the procedures outlined in your application until May 18, 2019.** Should additional time be needed to conduct your approved study, a request for extension must be submitted to the IRB a month prior to its expiration.

Your protocol has been assigned project number (#160506), which you should refer to in future correspondence involving this same research procedure. Approval mandates that you follow all University policy and procedures, in addition to applicable governmental regulations. Approval applies only to the activities described in the protocol submission; should revisions need to be made, all materials must be approved by the IRB prior to initiation. In addition, the IRB must be made aware of any serious and unexpected and/or unanticipated adverse events as well as complaints and non-compliance issues.

This project has been granted a waiver of consent documentation; signatures of participants need not be collected.

As mandated by Title 45 Code of Federal Regulations, Part 46 (45 CFR 46) the IRB requires submission of annual reviews during the life of the research project and a Final Report Form upon study completion. Thank you for your compliance with these guidelines and best wishes for a successful research endeavor. Please let us know if the IRB can be of any future assistance.

Regards,



Ferris State University Institutional Review Board
Office of Research and Sponsored Programs

Version 1.2015

APPENDIX B: ILLINOIS CENTRAL COLLEGE IRB APPROVAL LETTER

Illinois Central College

Herbert DaCosta, Chief Grants Development Office
& Chair of Institutional Review Board
1 College Drive
East Peoria, Illinois 61635-0001
Voice 309-694-5754 | Fax 309-694-5450

Date: 5/17/2016

To: Emily Points

From: Herbert DaCosta, Chair, Institutional Review Board

Re: IRB Action on Proposed Project

This memorandum is to inform you of the action taken on behalf of the College with regard to your research proposal titled, "Math Placement Testing and Remediation." Please be advised that I have determined that your proposal meets the requirement for an expedited review under 45 CFR 46.101(b)(2).

You are authorized to proceed with the proposed activities as presented in your IRB request. It is your responsibility as the investigator, to submit, in writing, changes or corrections that you make to any of the plans submitted for IRB approval prior to implementation of such changes or corrections. You must file a request for extension should you require data collection beyond twelve months from the date of this memorandum.

To maintain compliance with regulations set forth by the National Institute of Health, Protecting Human Research Participants, you are advised to complete the online training required by all principal investigators. If you have not already completed the training modules, or a similar training module, you can access the training at <http://phrp.nihtraining.com/users/login.php>. The training will take about 3 hours to complete and does not have to be completed all at once. Upon completion of the training, you should submit a copy of the certification of completion to the ICC-IRB.

Failure to comply within the parameters of the project as submitted, including the conditions set forth in this memorandum, shall forfeit your right to conduct research related to this proposal at Illinois Central College.