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ABSTRACT Developmental mathematics, which is designed to prepare students for college-level mathematics courses, can be a barrier to students' success. In the United States, the majority of students placed into developmental mathematics courses fail to complete the developmental sequence. Alternative mathematics pathways offer some benefits when integrated with "just-in-time support" or expedited instruction on specific prerequisite concepts needed solely for the current lesson. This study compares two statistics courses taught at a public community college: a complete course taught in one semester and a two-semester version with just-in-time developmental content integrated into the course. The study found that students placed into the one-semester statistics course accumulated significantly more credits after one and two years of college. These students also completed an associate's degree within two years at a significantly higher rate than students placed into the two-semester statistics course. The study also found students deemed non-proficient by the college's placement exam, who also had a strong high school average were significantly more likely to earn a grade of A- or higher or a grade of B- or higher compared to students originally deemed proficient.

KEYWORDS *community college, developmental education, placement, co-requisite remediation, remedial mathematics, higher education, statistics pathways*

Introduction

In the United States, despite efforts to reform K-12 education, between 40% and 60% of first-year college students are deemed to be unprepared for college-level course work and require remediation in mathematics, English or in both subjects (Jimenez et al., 2016). To make decisions about mathematics course placement, nationwide, in the United States, 100% of community colleges and 85% of four-year colleges rely on high-stakes tests (Fields & Parsad, 2012). Remediation refers to the courses that students enroll in in order to prepare them for college-level course work. Similarly, developmental education was designed to strengthen students' academic skills, preparing students to be successful in credit-bearing college courses. It refers to a wide array of support services provided to students who are unprepared for college-level course work. However, instead, students assigned to one, two, or even a series of three levels of remedial courses often fail to complete the course sequence (Bailey et al., 2010). Although students assessed to be non-proficient could have gaps in their background or weaker study skills, mathematics remediation has been shown to be a significant obstacle, preventing students from earning a college degree (Bailey, 2009; Bailey & Smith Jaggars, 2016; Chen & Henke, 2017; Hoyt, 1999; Logue et al., 2016). In this article, following the lead of Bailey et al. (2009) and to vary the language, developmental education and remediation will be used interchangeably with no negative or positive connation implied in the word choice.

Although placement into remedial courses may negatively impact students, the impact on women, minorities and low-income students may be more pronounced.

American College Testing (ACT) reports benchmark scores that assess algebra college readiness (ACT, 2017). Students who score above the benchmark on the ACT algebra exam have a 75% chance of passing a college credit-bearing algebra course with a grade of C or higher (ACT, 2017). When assessing students' mathematics college readiness, a higher percentage of women, Blacks and Hispanics fell below the benchmark (ACT, 2017). As a result, female, Black and Hispanic students are overrepresented in remedial mathematics courses (Hagedorn et al., 1999) relative to White males. Low-income students are also more likely to be placed into a remedial course (Jimenez et al., 2016). The 2018 Student Success Score for the state of California tracked students' ability to exit mathematics remediation within a six-year period in community colleges. The percent of Black, Hispanic and White students who have not successfully exited mathematics remediation within six years was 78%, 64% and 59%, respectively (Student Success Initiative, 2018). This gap in remedial course completion contributes to a racial gap in degree completion. An unpublished study found that more than half of the racial community college degree completion gap was a result of remedial mathematics placement decisions (Edley, 2017). As a result, the single remedial track leading to college algebra has been called a civil rights issue (Edley, 2017). Developmental education, though a well-intentioned intervention designed to boost students' skills, has not only failed to meet this goal but, in fact, may be contributing to widening rather than closing the race, gender and socioeconomic status education attainment gaps. For readers who are working to make mathematics education more accessible and the outcomes of placement more equitable, this research can serve as a primer by demonstrating how colleges can streamline alternative mathematics pathways to help close persistent race and gender based degree completion gaps.

For community college students, mathematics may be an impediment to graduating. Based on a review of the general education requirements posted on colleges' websites, many schools stipulate that all students must successfully complete at least one college-level credit-bearing mathematics course to graduate (The City University of New York [CUNY], n.d.; The State University of New York [SUNY], n.d.). To study persistence, researchers sampled 250,000 students across 57 community colleges and found that less than 50% of students completed the entire remedial course sequence to which they were assigned (Bailey et al., 2010). Therefore, reform in developmental education is needed. Although researchers have promoted and described the benefits of

alternative mathematics pathways, (Blumenthal, 2016; Steen, 2004), these paths often span multiple semesters (Carnegie Foundation for the Advancement of Teaching, n.d.) and, as a result, delay the accumulation of college credits. This article sheds light on the process of placing students who will not major in a science, technology, engineering and mathematics (STEM) field in alternative mathematics pathways that meet for more days and hours per week, or are spread out over multiple semesters. It expands the discussion of developmental alternative credit-bearing mathematics pathways for students who will not major in a STEM field. Additionally, it describes how colleges can streamline alternative mathematics pathways, which may be better aligned with non-STEM students' interests and majors. Students majoring in a STEM field need to complete a traditional sequence of mathematics courses consisting of algebra, pre-calculus and calculus, which is outside the scope of this paper. The paper investigates how non-STEM students can effectively and efficiently bypass long sequences of mathematics courses designed to fulfill a college's general quantitative requirement for graduation when given the opportunity to enroll in a streamlined, relevant mathematics pathway.

One potential remedy for the persistent low completion rate is to offer non-proficient students who will not major in a STEM field the opportunity to enroll in a college-level credit-bearing mathematics course such as quantitative reasoning, statistics or financial literacy with just-in-time academic support for developmental prerequisite skills. Recognizing the time and money students spend attempting to complete long sequences of developmental courses that have a negative stigma, just-in-time support gives students the opportunity to enroll directly in a college-level credit-bearing course. Timely academic support is provided to assist students in learning the subset of prerequisite skills just prior to material that builds upon them. For example, if a student assessed not to be proficient in mathematics wanted to take an elementary statistics course, many colleges would require that the student first complete a sequence of one or more remedial pre-algebra courses before being allowed to enroll in elementary statistics. By contrast, colleges that offer just-in-time developmental support allow non-proficient students to enroll in statistics without completing any developmental prerequisite courses. Just-in-time support provides timely instruction on prerequisite skills that will arise in the lesson being taught. A student assessed not to be proficient in mathematics who enrolled in a statistics course would not relearn how to factor binomials, since learning statistics does not

depend on knowing how to factor. However, a developmental student who enrolled directly in statistics would receive a refresher on how to plot points on a coordinate system and interpret the slope of a line just prior to learning how to create scatterplots and how to interpret the line of best fit. Just-in-time support removes the stigma associated with remediation and offers students the opportunity to accumulate credits.

Developmental Education: Cost Analysis

There is a psychological cost of referral to developmental education. Underprivileged students may not be well-prepared for college-level course work and, as a result, may be more likely to be assessed as needing remedial courses to catch up academically to their peers. However, placement into remedial courses stigmatizes students whose skills are lagging (Arendale, 2010; Juszkiewicz, 2016). This can reinforce the stratification of privilege and access. In addition to the psychological cost of developmental education, there is also a financial cost borne by both students and taxpayers. Developmental education costs students approximately $1.3 billion dollars per year (Jimenez et al., 2016). Taxpayers contribute approximately $7 billion per year to cover the cost of developmental education through loans and grants to students (Carter, 2017) with little return on the investment, given the low rate of persistence. To fully understand how severe the barriers to advancing are, it is important to describe why proficient students are sometimes incorrectly assessed to be unprepared for college-level course work.

Mathematics Placement Procedures

Typically, upon entry to college, before registering for classes, students take a high-stakes mathematics placement test to determine which course they should take. The four tests most often used to make decisions are the Scholastic Aptitude Test (SAT), American College Test (ACT), ACCUPLACER and Compass (Fields & Parsad, 2012). Because community colleges are generally open-access (College Board, n.d.) and hence less-selective, students are, on average, less prepared for college. Although some community college programs such as nursing or computer technology could have special admission requirements which include SAT or ACT scores, generally the open-enrollment policy for many other programs would mean that any high school graduate could enroll (College Board, n. d.). Therefore, many community college students either may not have taken the SAT or ACT exams or may not have scored highly enough to be exempt from having to take their college's

placement exam. High school students must register in advance to take the SAT exam (College Board, n.d.) and, as the test is not a surprise, students can elect to prepare. Additionally, information about practice questions is available on the site used to register (College Board, n.d.). By contrast, many students are unaware that they will be required to take a college placement test. Additionally, students may not realize the consequence of performing poorly. Students from five community colleges in California, most of whom had not been out of high school for more than two years, participated in a focus group and reported that they received little information about college placement (Venezia et al., 2010). Based on a review of college placement policies posted on schools' websites, students may receive little or no help to prepare for the placement test, nor is the opportunity to be retested guaranteed. These factors can negatively impact the score earned.

Despite the heavy reliance on placement tests, such tests are poor predictors of students' performance in college courses as measured by grade point average (GPA) (Belfield & Crosta, 2012). Although placement test scores are associated with college GPA, the association is weak (Belfield & Crosta, 2012). Two possible explanations for the weak association are that the predictive validity of the test is limited (Jaggars & Hodara, 2011) and that the test does not measure non-academic traits necessary for success in college. Non-cognitive characteristics such having a growth mindset (Sole, 2019) and openness to seeking help may be better aligned with and predictive of, one's ability to pass a college mathematics course. A single score on an unanticipated mathematics placement test may not capture traits that are likely to predict success in college.

Placement tests tend to misassign proficient students to developmental courses (Scott-Clayton & Belfield, 2015). By comparison, multiple measures provide a more accurate means of assessing students (Barnett & Reddy, 2017; Ganga & Mazzariello, 2019) and could reduce the percent of students assigned to remediation by approximately between 8 to 12 percentage points (Scott-Clayton, 2012). Another more accurate way of placing students would be to use either their high school transcript or GPA. High school GPA assesses traits that could predict success in college such as drive (Ganga & Mazzariello, 2019). If students were given the opportunity to immediately be placed into credit-bearing college courses, they could save money and more quickly accumulate credits (Ganga & Mazzariello, 2019). This is significant because a stronger rate of momentum in the first year of college has been shown to be associated with a

higher rate of graduation (Attewell et al., 2012). A recent study done statewide in California used decision trees to examine high school and college transcripts to shed light on what measures would most consistently predict success in college mathematics courses (Bahr et al., 2019). The research showed that cumulative high school grade point average was the most helpful measure used to predict how students would perform in college mathematics courses (Bahr et al., 2019).

Mathematics Alternative Guided Pathways

Some students are accurately placed but assigned to a traditional development course sequence preparing them for college algebra, which may be ill-aligned with their major and career aspirations. Non-stem students who need to take a mathematics course to satisfy a core general education requirement may find courses in quantitative reasoning, statistics or financial literacy more closely aligned with their interests. Often, these courses can be taken without first completing long sequences of remedial pre-algebra courses. Alternative mathematics course sequences may appeal more to non-STEM students. As new mathematics pathways emerged, the American Mathematical Association of Two-Year Colleges (AMATYC) made clear that for college-level mathematics courses that are not leading to calculus, students can be prepared for entry into credit-bearing courses without first mastering the material in developmental algebra courses (AMATYC, 2014). Two popular alternative mathematics pathways that emerged are quantitative reasoning and statistics. Both of these mathematics pathways can help students complete their college's quantitative graduation requirements in a timely manner, since neither relies on having mastered all of the material in a series of non-credit pre-algebra courses.

The benefits of quantitative reasoning have been observed (Steen, 2001; Steen & Madison, 2011). Steen (2004) supports including quantitative reasoning in the college mathematics curriculum, arguing that without the opportunity to study essential but simple mathematics ideas, students will fail to meet key tenets that are part of a college education. Researchers have also described the value of graduating statistically literate students (Carver et al., 2016; Sole, 2015; Weinberg & Abramowitz, 2020). Additionally, educators have stressed the importance of being able to understand the results of surveys (Carver et al., 2016; Sole, 2015) and use and interpret data (Carver et al., 2016; Sole & Weinberg, 2017; Weinberg & Abramowitz, 2020).

Recent research has shown that students randomly assigned to a college statistics course with a co-requisite workshop were more likely to pass the course than those assigned to a remedial elementary algebra course (Logue et al., 2016). Moreover, students who took statistics rather than elementary algebra graduated from two-year colleges at a higher rate (Logue et al., 2019). The benefit of offering non-STEM students the opportunity to complete alternative mathematics pathways is clear.

However, there are drawbacks. Alternative mathematics pathways can span two or more semesters and may be scheduled to meet for a large number of hours relative to the number of credits earned. The Carnegie Foundation for the Advancement of Teaching created courses in quantitative reasoning and statistics with just-in-time developmental content integrated into the courses. However, despite the benefit of accumulating college credits at the start of one's college career (Attewell et al., 2012; Attewell & Monaghan, 2016), these pathways can span a full academic year. Research is needed to investigate both the feasibility and benefit of streamlining alternative mathematics pathways. By examining the impact initial course placement has on credit accumulation and graduation rate, as well as comparing the performance of student assessed not to be proficient in a streamlined course, this article hopes to fill this gap in the literature.

Method

Settings

Data from a small urban public community college located in the northeast was used to assess the value of streamlining a statistics pathway with just-in-time remediation by changing placement practices. The college serves a diverse, largely low-income population, demographically comprised of approximately 5% Asian, 28% Black, 58% Hispanic, 8% White and less than 1% in each of the other race/ethnicity categories. Sixty-seven percent of the students qualified to receive a Pell Grant. The majority of students are female (47% male; 53% female). These demographics are significant because research has shown that stereotype threat—the risk of conforming to negative stereotypes of one's racial, gender, ethnic, or cultural identity (Steele, 2011)—negatively impacts the test scores of females (Picho et al., 2013), Black students (Steele & Aronson, 1995), Hispanic students (Gonzales, Blanton, & Williams, 2002) and students with low socioeconomic status backgrounds (Croizet & Claire, 1998). This could increase the number of these students deemed not to be proficient placed into the two-semester statistics sequence.

The college chosen for this study is appropriate because it offers one-semester and two-semester statistics courses that all students are required to complete to satisfy the college's quantitative requirement for graduation. Students who are deemed to be proficient in mathematics enroll in the one-semester streamlined statistics course in the fall semester of their first year of college. Students who are deemed not to be proficient in mathematics take the two-semester statistics course. Proficiency is determined by an index that combines high school grade point average with SAT and Regents exam scores (City University of New York, n.d.). Proficiency can be demonstrated in other ways (See City University of New York, n.d.).

The content covered in the one-semester streamlined statistics course and the two-semester statistics course is identical. The two-semester statistics course covers half of the required material in the fall semester and the remaining required material in the spring semester. Just-in-time support for the developmental content is integrated into the two-semester statistics course on the small subset of pre-algebra topics needed to understand the course. For example, a brief refresher of the equation of a line and the interpretation of the slope and y-intercept would be taught before studying linear regression.

All students at this community college enroll full-time. The first year of community college is focused on completing several specific general education requirements and taking a few elective courses. Therefore, in the first year, all students' course schedules are quite similar. However, by taking the one-semester streamlined statistics course, students can accumulate credits more quickly. Additionally, if students complete only the first half of the two-semester statistics course, the credits could be difficult to transfer. Given the benefits of taking the one-semester statistics course, it is important to explore alternative means of evaluating proficiency to potentially increase the number of students who would be exempt from having to learn the same content in the two-semester statistics course.

Participants and Design

Before the start of the fall 2018 semester, all first-year students whose high school average was equal to or above 83% ($n = 26$) were contacted by email and informed that because of their strong high school average, although the college's placement procedures had deemed them non-proficient, faculty believed they were proficient based on the fact that placement tests are poor predictors of success in college. Therefore, it seemed to faculty that overall performance in high school might be better aligned with and predictive of students' academic performance in college. This study was undertaken to determine if a change to the college's placement procedures could help capable students accumulate college credits at an accelerated rate. Although conversions between percent grade, letter grade and grade point average on a four point scale are not standard, an average of 83% is approximately equivalent to a B- or a B letter grade, which converts approximately to a GPA of 2.7 to 3.0. According to Belfield (2014), a simpler, more accurate rule to assess placement into developmental education would be to rely only on high school GPA. Students with a GPA below a specific threshold of 2.7 or 3.0 could be assigned to remedial courses (Belfield, 2014). Because a GPA of 2.7 to 3.0 is approximately equivalent to a grade range from 80% to 86%, a cutoff for placing students in a streamlined statistics course of 83% was used, which was chosen to be in the middle of the range.

Students were informed that although they were assigned to take a two-semester statistics sequence, faculty believed that they had the skill set needed to learn the material at a more accelerated pace. Students were given the option to remain in the two-semester statistics course and were informed that they would automatically be placed in the one-semester statistics course if a response indicating a preference otherwise was not received. Because the college has a week-long required summer introductory program, students would be on campus and could speak with either a faculty member or an advisor if they had any questions. Of the 26 students who were contacted, 22 were switched into the one-semester statistics course and four indicated that they wished to remain in the two-semester statistics course. Each of the 22 students enrolled in the streamlined statistics course that fit their schedule. None of the instructors teaching the streamlined statistics course knew the proficiency status of the students in this experiment.

Foundations of the Current Study

Prior to offering the one-semester course to students with a strong high school average but placing in the "not proficient" category, previous years data was assessed to provide insight into the potential impact of using students' high school average to override the college's decision about placement. To help determine how students deemed not to be proficient with a strong high school average might perform in the one-semester statistics course, the connection between high school average, course grade in the first half of the 2016 two-semester statistics course, and the number of college credits accumulated was assessed. A score roughly equivalent to a

student's cumulative high school average was used which considers outliers due to absences (E. Hertz, personal communication, November 20, 2019). The Pearson product-moment correlation coefficient indicated that there was a weak positive correlation between the high school average and the GPA students received in the first half of the two-semester statistics course [$r(225) = .21$, $p = .001$]. In general, the results suggest that students who do well academically in high school, tend to have higher GPAs in a college statistics course. This suggests that high school averages could be used to place students into a one-semester statistics course. To investigate, statistics course grades of "not proficient" students who had a high school average below 80 (an average below B-) and equal to or above 80 (an average above B-) were compared. The grade breakdown of equal to or above B- was selected based on placement recommendations Belfield (2014) suggested. Statistics course grades were divided into those equal to or above a C and those below a C, since students are placed on academic probation for scoring below a C in a course. Table 1 shows the distribution of grades students earned in two-semester statistics course.

The chi-squared test of independence showed there to be a statistically significant relationship between high school average and two-semester statistics course grade [$\chi^2(1, 309) = 4.19$, $p = .041$]. As indicated in Table 1, a higher percentage of students who had a high school average equal to or above 80 (53%) earned a grade equal to or above a C in the first half of the two-semester statistics course than students who had a high school average below 80 (38%). Given the strength of difference in the two-semester statistics course grades of students who had a high school average of 80 or higher, it seemed that some threshold for high school averages in the range of 80 to 86 could be used to more accurately place students deemed not to be proficient into the one-semester streamlined statistics course.

Next, examining how placement impacts the ability to accumulate college credits provides further support for placing more students in the one-semester statistics course. Table 2 gives the mean and standard deviation for the number of total credits accumulated after one year and after two years of college for students who took the streamlined one-semester statistics course and the two-semester statistics course. Table 2 presents the results of the two independent samples t-tests assessing whether students were accumulating credits at a rate fast enough to be on track to graduate in two years.

After completing one year of college, the results of the independent-samples t-tests showed that students who took the streamlined one-semester statistics course earned significantly more college credits 23.32 (9.24) than did students who took the two-semester statistics course 16.89 (9.88), [$t(422) = 5.99$, $p < .001$]. After two years of college, the results of the independent-samples t-test showed that students who took the streamlined statistics course earned significantly more college credits 48.92 (17.88) than did students who took the two-semester statistics course 43.98 (16.88), [$t(309) = 2.33$, $p = .010$]. One might argue that students deemed to be proficient in mathematics may inherently be more motivated and hence more likely to earn credits at an accelerated rate. However, it is equally possible that placement into longer pathways, and the potential stigma that comes with this placement, disadvantages students who have the same drive and motivation. It is quite possible that the under-placement is preventing students from earning credits at the same rate. Because students would need to earn 30 credits per year to graduate from a community

Table 1

Frequencies and Chi-Square Results for High School Average and Two-semester Statistics Course Grade (N = 309)

	High School Average Below 80		High School Average Equal to or Above 80		
	n	%	*n*	%	$\chi^2(1)$
Fall Semester Course Grade					
Equal to or Above C	96	38%	29	53%	
Below C or No Credit	158	62%	26	47%	4.19*

Note. First-year students receive grades of NC (no credit), W (withdrew), or WU (withdrew unofficially) in place of receiving grades of F. These grades were counted as receiving a grade below a C.
*$p < .05$.

Table 2

Means Standard Deviations and t-test Results for the Total Number of Credits Earned by Years of College and Statistics Course

	One-semester Statistics		Two-semester Statistics			
College Credits	*M*	*SD*	*M*	*SD*	*t*	*p*
Year						
Year 1	23.32	9.24	16.89	9.88	5.99***	<.001
Year 2	48.92	17.88	43.98	16.88	2.33*	.010

* $p < .05$. *** $p < .001$.

college in two years, which is highly desirable, the total number of college credits earned was assessed.

On average, students placed in the two-semester statistics course did not accumulate credits at a pace that would earn them an associate's degree in two years. After completing two years of college, the mean number of credits earned by students who took the two-semester statistics course in their freshman year, 43.98 (16.88), was significantly less than 60—the number of credits required to graduate [$t(215) = -13.95$, $p < .001$]. After two years of college, the number of credits earned by students who took the streamlined statistics course in their freshman year, 48.92 (17.88), was also significantly less than 60, the number of credits required to graduate [$t(94) = -6.04$, $p < .001$]. One possible explanation as to why students in the one-semester statistics course also fell short of accumulating 60 credits is that students took less than 15 credits per term since only 12 credits are needed to remain eligible for federal financial aid. Given that the average number of credits accumulated in the streamlined pathway after two years was 48.92, it is conceivable that the largely low-income student population that the college serves—many of whom must, by necessity, balance work and school—sought to take the minimum number of college credits to maintain their status as full-time students. It is also quite possible that students did not realize that by taking fewer credits it would be impossible to graduate in two years.

Goals and Hypothesis

Full-time students should be encouraged to take 15 credits per term to complete an associate degree in two years (Complete College America, 2013). To further demonstrate the benefit of accelerated mathematics pathways, the connection between the statistics course students take their first semester of college and the two-year graduation rate was assessed. Students who took the streamlined statistics course, as well as those who took the two-semester statistics course, completed less than 30 credits and less than 60 credits, respectively, on average, after one and two years of college. Given the difference in the number of credits students were earning and size of the standard deviation, enrolling in the two-semester statistics course could lessen the chance of completing a 60-credit associate's degree in two years. Table 3 shows the number and percent of students who completed an associate's degree in two years, broken down by the statistics course taken.

Table 3

Frequencies and Chi-Square Results for Statistics Course and Two-Year Graduation (N = 430)

	One-Semester Statistics		Two-semester Statistics		
	n	%	*n*	%	$\chi^2(1)$
Graduated Within Two Years					
Yes	48	43%	76	25%	
No	63	57%	243	76%	15.13***

***$p < .001$.

The chi-squared test of independence showed there to be a statistically significant relationship between placement into an accelerated statistics pathway and completing an associate's degree in two years' time [$\chi^2(1, 430) = 15.13$, $p < .001$]. A significantly higher percentage of students who took the streamlined one-semester statistics course (43%) compared to students who took two-semester statistics course (25%) were able to complete an associate's degree in two years.

The purpose of this research was to examine the impact of offering students with strong high school average who had been assessed not to be proficient in mathematics the opportunity to take the one-semester statistics course. Because placement tests are designed to predict success in college courses, the assumption was that students deemed to be proficient, by assessing a combination of high-stakes tests and high school grades, would earn higher grades in the streamlined one-semester statistics course than students deemed not to be proficient.

Results

At the end of the semester, the grades of students deemed non-proficient and proficient were compared. Table 4 shows the number and percent of students receiving each letter grade in streamlined statistics course by proficiency status.

Students in the not proficient category were assessed not to be ready for the streamlined one-semester statistics course when using the college's proficiency index, which relies on a combination of high-stakes test scores and grade point average. To compare the groups and to assess the ability to transfer credits, three different grade ranges were used. The ranges used were: A- and higher, B- and higher and C- and higher. Three separate cutoffs were used to determine: (1) whether students would be less likely to excel, (2) if students would earn a grade that was high enough for admission into select programs, (3)

Table 4

Frequencies in Streamlined Statistics by Mathematics by Proficiency Status

	Not Proficient		Proficient	
Grade	*n*	%	*N*	%
A, A-	13	59%	96	38%
B+, B, B-	5	23%	52	20%
C+, C, C-	2	9%	42	16%
D	0	0%	17	7%
NC, W	2	9%	39	16%
WU	0	0%	9	4%
Total	22	100%	255	100%

Note. Grades of NC and W result when no credit is awarded. These grades do not factor into a student's GPA. Grades of F are not given in the first year. Grades of WU (withdrew unofficially) are given 0 quality points.

if the grade was high enough for the course to transfer and (4) if the grade was high enough for the course to transfer as a mathematics course rather than as an elective. Different colleges set different minimum grade requirements for courses to transfer (College affordability guide, n. d.). The grade ranges vary widely (College affordability guide, n.d.). If any difference were to be found, on the college's placement policy, the assumption was that proficient students would outperform non-proficient students, which clearly was not always the case.

The chi-squared test of independence showed there to be a statistically significant relationship between earning a grade of A- or higher in the one-semester statistics course and proficiency status [$\chi^2(1, 277) = 3.90$, $p = .048$]. In a one-semester statistics course, students assessed not to be proficient with a high school average of 83% or higher were significantly more likely to earn a grade of A- or higher compared to students assessed to be proficient. The results of Fisher's Exact Test showed there to be a statistically significant relationship between proficiency status and passing the one-semester statistics with a grade of B- or higher, $p = .040$. Students in the not proficient category were significantly more likely to earn a grade of B- or higher compared to students assessed to be proficient. Furthermore, the results of Fisher's Exact Test showed there to be no relationship between proficiency status and passing statistics with a grade of C- or higher, $p = .118$. The study was unable to conclude that students in the not proficient category were more likely to pass a one-semester statistics course with a grade of C- or higher compared with students in the proficient category.

Discussion

Because at least 50% of the differences in degree completion by race arise from the assessment and placement of students into non-credit developmental courses, placement into mathematics remediation has been called a civil rights issue (Edley, 2017). The pace of reforming assessment practices and increasing the number of mathematics pathways offered to non-STEM students to fulfill colleges' quantitative requirements has been slow. Therefore, although the American Mathematical Association of Two-year Colleges recognizes that pre-algebra and intermediate algebra need not be the prerequisite for alternative mathematics pathways (AMATYC, 2014), non-STEM students continue to be placed in long traditional remedial pathways. Faculty may believe this track provides a better foundation for all students; yet, research has shown that students are more likely to pass statistics than elementary algebra (Logue et al., 2016). Students might have been more motivated and, as a result, worked harder to complete a credit-bearing statistics course compared with a non-credit elementary algebra course. It is important to be mindful of the fact that students who complete an alternative mathematics course, depending on the major they select, may need to complete a sequence of courses leading to algebra.

This study builds upon research that has shown that the high school GPA could be used to more accurately assess and place students in college courses (Scott-Clayton & Belfield, 2015). Given the lack of alignment of placement exams, which typically focus on pre-algebra skills and statistics, this study relied on high school averages to place students into an accelerated statistics pathway instead. Although some colleges offer pathways in statistics that span multiple semesters, findings from this study (Table 4) highlight the value of placing students classified as "developmental" but also having a strong high school average directly into a one-semester statistics course. The students in this study with strong averages and originally classified as not proficient, were more likely to earn a grade of A- or higher and B- or higher in a one-semester college statistics course than those students classified as proficient. Hence, these students seemed to be appropriately placed. The results suggest that some students placed using a combination of high-stakes tests and grades were being under-placed. Two benefits of placing non-proficient students with sufficiently high averages into accelerated courses are that it removes any stigma that could be potentially associated with a slower paced course sequence and it accelerates the accumulation of credits (Table 2).

The results of this study also show that non-proficient students placed in a longer mathematics pathway do not accumulate as many college credits (Table 2) as their peers after two years. As this study has shown, the percent of students placed in the one-semester statistics course who graduated from a community college in two years (Table 3) was significantly higher than the percent of students placed in the two-semester statistics course. The data suggests students initially deemed non-proficient who had performed well academically in high school could be successful in an accelerated alternative mathematics pathway. Given the results of this study, it is unclear why some educators assert that the *best* option is to schedule courses for more hours spread out over more days for multiple semesters. Just as the "remedial" label negatively stigmatizes students, it is possible that perceptions about what "remedial" students can accomplish impacts decisions.

Limitations

Streamlined alternative statistics pathways seem more feasible now, having assessed these findings. However, there were two limitations relating to the study's design and execution. The most significant limitation was that the sample size was relatively small. Based on guidelines when using high school GPA to place students in college courses, (Belfield, 2014), only 26 students initially deemed non-proficient had an average that was high enough to be offered the opportunity to enroll in the more accelerated statistics course. Given the positive results of this study, further studies are needed with larger sample sizes to confirm the findings and to collect data over more than just one semester to measure the impact. Additionally, it is possible that students with documented learning disabilities may prefer to remain in the two-semester course and might perform better in the two-semester statistics course. Given a larger sample size, researchers may want to explore if students with documented learning disabilities would benefit from being placed in streamlined pathways. Another limitation of this study was that the pathway studied is unique and not offered at all colleges. The positive results from altering placement procedures for a statistics pathway may not apply to other mathematics pathways. Research that examines if these results could be extended to other alternative mathematics pathways or more traditional pathways would seem to be warranted, because it is beneficial for students to accumulate credits at a more accelerated rate.

Conclusion

This study demonstrated that altering the means of assessing and placing students and offering non-STEM students the opportunity to complete streamlined alternative mathematics pathways helps students excel and accumulate credits in an expeditious manner. Adding days and hours to courses can disadvantage students by making it more challenging to find part-time employment or by failing to fully develop the independence needed as students progress to more advanced courses. It is critical that colleges find ways to remove barriers preventing non-STEM students from satisfying general quantitative requirements for graduation, while simultaneously encouraging those students with an interest in majoring in STEM, to remain in these fields.

Acknowledgements

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