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Available at **www.dcmathpathways.org/learn-about/emerging-issues-mathematics-pathways**

Chapter 12

Why Placement Based on Algebra Doesn't Add Up

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Abstract

Traditional college algebra placement policies, which too often rely on a single score that is generated from a computer-adapted placement exam to assess a student's ability to succeed in a course, have recently come under scrutiny for misplacing students and leading to unnecessary remedial coursework. Recent research studies demonstrate that algebra skills alone do not predict success in college-level mathematics and persistence toward a degree. To address the situation, educational institutions around the country are adopting mathematics pathways models. Pathways curricula provide students with mathematics content that is relevant to their major fields of study and eliminate a long, prerequisite developmental course sequence. This chapter presents evidence that placement in remedial/developmental algebra does not lead to student success in college courses or graduation. It then reviews placement practices that better assess students' knowledge and experience for predicting success in their chosen major fields of study. Finally, the chapter argues that students, along with the guidance of trained advisors, should advocate for their own placement through a holistic assessment of their skills, abilities, and career aspirations.

Introduction

Higher education policymakers, leaders, instructors, and students around the country bear witness to the serious scrutiny and criticism that college mathematics placement policies have experienced over the last decade. This scrutiny derives from awareness that approximately 60 percent of incoming community college students are placed—by subject experts—into developmental mathematics coursework that is meant to provide them with the necessary preparation for success in college (Bailey, Jeong, & Cho, 2010; Complete College America, 2012). However, it has become clear that these traditional placement practices not only place some students into developmental courses that are misaligned with their desired fields of study, but they also start many students on a long sequence of possibly irrelevant coursework. Because of this misalignment, students often leave college with a large student debt and/or without their college degree and gainful employment to help pay off that debt.

Students have the greatest likelihood of success in college when their mathematical capabilities are assessed more accurately by the use of multiple placement criteria that relate to their major fields of study (Ngo & Melguizo, 2016; Scott-Clayton, Crosta, & Belfield, 2014). While proficiency in algebra is essential for students whose program path eventually requires calculus, for students needing quantitative reasoning or statistics courses for their fields of study, the traditional assessment of algebra skills for placement purposes often leads to remedial coursework that is unnecessary. Mathematics pathways programs, in contrast, provide students with a sequence of mathematics courses that are relevant to their fields of study and which require no more than one semester of developmental coursework. This chapter will examine the current state of college mathematics placement policies, highlight studies to show why these policies need to change, and suggest more effective placement strategies to place students in shortened, relevant mathematics pathways programs.

What Do Mathematics Placement Tests Really Assess?

Traditional college mathematics requirements are built on a strong foundation of algebra. For example, many colleges require completion of an intermediate algebra course prior to enrollment in a college-level algebra or statistics course and proficiency in basic algebra for a college-level, liberal arts mathematics course that focuses on quantitative reasoning. With these policies, contemporary mathematics placement tests attempt to predict how well a student is expected to perform in a developmental algebra course. The assumption is that the depth of the assessed algebra skill level determines whether the student is prepared to pass any college-level mathematics course that builds upon the level of proficiency determined by the test. Students are deemed proficient in algebra after demonstrating on standardized placement tests that they are capable of completing a series of basic algebra problems such as reducing simple or rational expressions; solving linear, rational and quadratic equations; graphing equations; and factoring polynomials. To assess for this level of algebraic proficiency, colleges often use a single score on a placement test that they either develop on their own or adopt from commercial test designers such as the ACCUPLACER, a popular nationwide test developed by the College Board. Students who do not achieve an appropriate score on the algebra placement test are placed in remedial mathematics courses and are only deemed proficient after passing such courses.

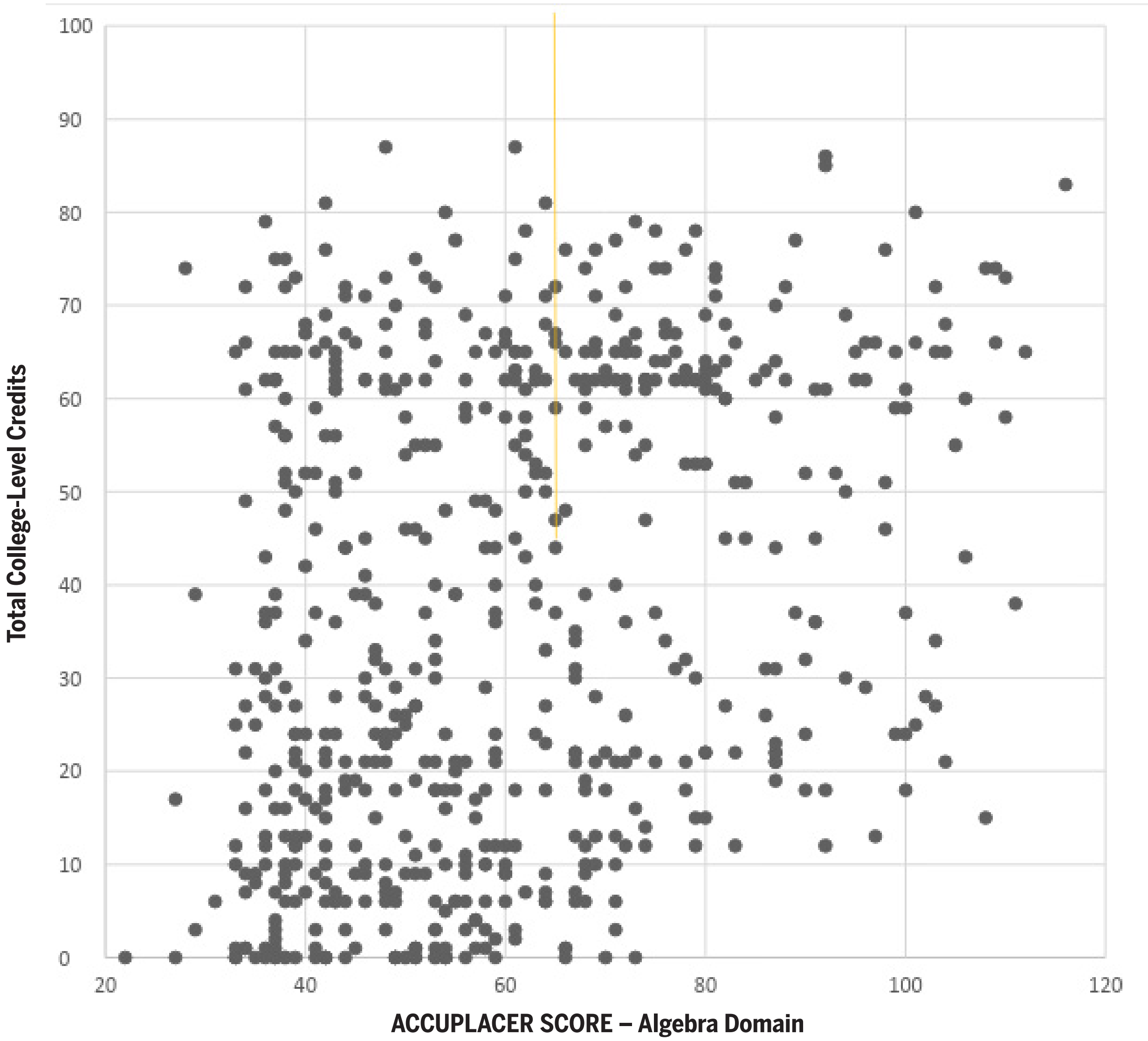
An issue with these commonly used placement practices is the focus on algebra. Proficiency in algebra is equated to proficiency in critical mathematical thinking, thus reinforcing the perception that algebra proficiency is critical for student success in any college-level mathematics course, even those that are not algebra-based. This perception has recently been challenged after numerous research reports have shown that 20 to 50 percent of recent high school graduates and up to 60 percent of students enrolling in community colleges are required to take remediation courses in mathematics (Bailey et al., 2010; Complete College America, 2012). Many students are placed by a single placement test score into sequences of up to three levels of developmental (non-college credit) algebra courses. These students are typically required to pass at least one remedial algebra course before taking a college-level mathematics course, even if that course is not algebra-based and does not utilize skills and knowledge required in the remedial course requirements. According to Complete College America (2012), only 22 percent of community college students will complete both their mathematics remediation and first college-level mathematics course in two years. This process leads to delayed degree attainment—or worse, many students leaving college without a certificate or degree.

Placement and Student Success

Evaluating the actual impact that these traditional placement practices in remedial mathematics have had on student success has been a challenging task for researchers. Ideally, randomly assigning students who place in remedial mathematics courses to either remedial or college-level courses would provide the basis for a valid assessment of the impact of remedial placement. After considering the ethical ramifications of this approach, researchers have adopted a regression discontinuity (RD) approach to assess students who fall near a predetermined cutoff score for college-level placement that mimics random assignment without randomly changing a student's placement. States with mandated cutoff scores have allowed researchers to examine student success in college-level mathematics courses by comparing students who place right below and above the cutoff point to determine the effect of remediation. The rationale behind the RD design is that the participants who fall right above and right below the cutoff point are considered identical, so any difference in success can be attributed to the remedial placement (Melguizo, Bos, Ngo, Mills, & Prather, 2016; Shadish, Cook, & Campbell, 2002). Over the past decade, a few statewide studies have been completed in Florida, Texas, and Ohio using this approach. None of these studies reported any long-term positive impact of placement in remedial coursework (Bettinger & Long, 2009; Calcagno & Long, 2008; Martorel & McFarlin, 2011).

Using a similar RD design but focusing only on non-STEM students, a study of select New Jersey community colleges also showed no positive effect of placement in developmental algebra courses on success in college-level mathematics courses or persistence in college (Austin, 2017). Placement in or out of a developmental algebra course had no correlation to the number of credits a non-STEM student earned over a three-year period (see Figure 1). This study also found that students in their first semester in college, all of whom shared similar proficiency in algebra as determined by scores on the ACCUPLACER test, had a 20 percent higher chance of passing a college-level liberal arts mathematics course than a developmental elementary algebra course (Austin & Austin, 2017). Similar results occurred in a City University of New York (CUNY) study: Students had a 16 percent greater chance of passing a college-level statistics course paired with a supplemental workshop than they had of passing a developmental elementary algebra course (Logue, Wantabe-Rose, & Douglas, 2016). This research demonstrates that the placement in an elementary algebra course is unnecessary for many students to succeed in non-STEM pathways.

Figure 1. 3-year college-level credit totals for non-STEM students by their ACCUPLACER score



Proponents of traditional algebra curricula argue that the foundational skills students learn in algebra extend beyond mathematics courses into further areas of study and professional careers. In rebuttal, the National Center on Education and the Economy (NCEE) argues that algebra content does not provide an appropriate foundation for students in some college-level courses, specifically those that are not part of the statistics or calculus sequence (NCEE, 2013). On examining seven community college course listings across seven states, NCEE found that the majority of entry-level mathematics courses in most majors require little or no algebra skills to succeed, and that most of the mathematics needed to be successful in college is learned in middle school (i.e., arithmetic, ratio, proportions, expressions, and simple equations). Other evidence that developmental mathematics programs are not readying underprepared students for the mathematics they need in college-level courses is the number of students who do not persist but leave college with no credentials for better employment. Figure 1 illustrates a cluster of students to the left of the cutoff who earn few or no credits in three years. Finally, placement in developmental mathematics is shown to have a negative impact on long-term earnings for those who do enter the workforce (Hodara & Xu, 2016). Considering the abundance of recent research that highlights the negative effects of taking developmental mathematics credits on college success and future earnings, policymakers should carefully consider the best placement for students in relation to their career aspirations.

Lasting Change to the Current System

In an effort to address issues regarding lack of student success and misaligned content in early developmental mathematics, mathematics pathways (programs that guide students through a careful sequence of courses relevant to their fields) began to be developed in 2009. By Fall 2015, 58 percent of community colleges implemented redesigned mathematical pathways (Blair, Kirkman, & Maxwell, 2018). Over the last decade, organizations such as the Charles A. Dana Center (see the Preface in this monograph), Carnegie Foundation for the Advancement of Teaching, and the Community College Research Center, along with various statewide initiatives, have encouraged the education and mathematics communities to break the cycle of debt-with-no-degree by structuring curricula that focus on relevant and dramatically shortened mathematics pathways to provide students with opportunities to earn college-level credits as soon as possible (Charles A. Dana Center, n.d.; Community College Research Center, 2015; Hoang, Huang, Sulcer, & Suleyman, 2017). These pathways models include a STEM track, which prepares students for calculus through analysis of functions; a quantitative reasoning non-STEM track, which prepares students for career-relevant, mathematical competency through quantitative literacy; and a statistical reasoning non-STEM track, which prepares students for critical data analyses. Each of these degree pathways requires different areas and levels of mathematical preparedness. A valid assessment of students' mathematical capabilities as they relate to the various pathways is essential to ensure students are placed in the pathway where they will have the greatest likelihood of success in college, while also providing them with timely, relevant remediation as needed.

Placement in Pathways

Traditional placement policies assessing only students' knowledge of algebra are no longer considered appropriate for students in redesigned mathematics pathways programs. Placement into differentiated pathways requires multiple placement criteria. The College Board is scheduled to replace the widely used ACCUPLACER exam with the next-generation Accuplacer by January 2019 (College Board, 2017). This new test will expand the assessment of algebra skills to include quantitative reasoning and statistics among other changes. Even with the change to the test, the College Board recommends that placement tests be supplemented with other measures for better student placement. Multiple criteria include high school transcripts, student waivers, non-cognitive assessments, diagnostic tests, robust advising, and diagnostic placement tests. Institutions that have implemented at least one of these recommendations have shown some improvements in student success as a result of a switch to multiple measures placement policies (Bailey, Jaggars, & Jenkins, 2015; Couturier & Cullinane, 2015).

High School Transcripts

Today, the most recommended reform in placement policies is the use of multiple measures for assessing student preparedness, including consideration of high school transcript data. Key information in high school transcripts includes students' overall success in high school (grade point average) and their success in specific mathematics courses (type of last mathematics course taken, grade, and length of time since the course). Consideration of both high school GPA and the grade earned in the most recently completed mathematics class have shown to be more predictive of student success in college-level mathematics courses than traditional placement practices have been, but the logistics of including multiple measures, such as reviewing high school transcripts for all incoming students, can be challenging (Burdman, 2012). Colleges in states with easily accessible P-20 data systems are more readily able to factor high school information into an overall placement algorithm. Other colleges may only have the resources to review high school transcripts when students challenge their initial placement or use these additional measures when students place just above or just below a cutoff score.

No matter the challenges involved, research is clear that high school transcript evaluation processes should be used along with placement tests to evaluate college readiness (Belfield & Crosta, 2012; Scott-Clayton, 2012). One study conducted at a large community college in 2014 found that when high school transcript data were evaluated alone or in addition to placement test scores, placement error rates decreased while the overall college-level success rates increased (Scott-Clayton, Crosta, & Belfield, 2014). Ngo and Kwon (2016) also found that students who were moved out of developmental courses based on high school transcript data performed, over time, just as well as their counterparts who placed in college-level mathematics through a standardized placement test.

It is important to note that in these studies when high school transcripts were reviewed, high school algebra courses were evaluated in the context of placement into algebra-based pathways. Research that examined non-STEM pathways shows that a proficiency in algebra provides no impact on student success in non-algebra-based, general liberal arts college-level mathematics courses (Austin, 2017). This suggests that, dependent upon the student's desired pathway, a holistic evaluation of high school transcripts can provide more relevant information about a student's ability to perform in a college-level class than exclusive attention to past algebra course success.

Diagnostic Placement Tests

For institutions with limited means and resources to effectively examine individual student high school transcripts, detailed diagnostic placement tests may provide an economical method of assessing student readiness for college-level mathematics courses. Unlike computer-adaptive placement tests, diagnostic tests can provide a breakdown of content-specific skills assessment to better place students in appropriate mathematics pathways. Traditional computer-adaptive placement test results provide a single cutoff score associated with the broad topic of algebra to determine mathematics placement. While the new, next-generation ACCUPLACER does add quantitative reasoning and statistical content to their basic algebra assessment, the single cutoff score may not help educators determine if a student's score is reflective of their quantitative reasoning, statistics, or algebra knowledge. More detailed diagnostic placement tests may provide a better means for assessing students' non-algebraic skills by providing a detailed breakdown of the specific skills in which students are not proficient. In pathways programs where different knowledge may be needed for different paths, the single cutoff score on a computer adaptive placement test will not provide enough information to determine whether students can be successful in the course that relates to their path. Diagnostic placement tests, in contrast, can identify specific mathematical skill levels that can help determine whether students' current mathematical knowledge is sufficient for the specific college-level mathematics course needed for their career path.

Ngo and Melguizo (2016) found that colleges that switched from an in-state diagnostic mathematics test to a standardized computer adaptive test experienced greater placement errors with the computer adaptive test than with the diagnostic test, leading to the researchers' conclusions that diagnostic testing is more accurate at identifying specific mathematics deficiencies. Diagnostic tests can be used to determine if students need remediation in specific pathways. For example, students strong in quantitative reasoning but weak in algebraic reasoning could be placed directly into the college-level statistics course. If the same students were sorted with classic placement strategies, they would be required to take a developmental algebra course prior to taking statistics and risk a greater chance of never completing the degree.

Student Waivers

One of the most controversial of all placement policy changes is the use of student waivers. These waivers allow students to enroll directly in college-level courses with varying degrees of support, regardless of their placement test results. Passed in Fall 2014, Florida Senate Bill 1720 permits all students with a Florida high school diploma who enroll in the Florida College System to either skip the placement test or ignore their placement test results. In the first semester after implementation, enrollment in initial college-level mathematics courses increased by 10.6 percent. While the pass rates for these courses declined 6.9 percent, the overall completion rate increased by 4 percent, meaning more students were getting into and completing college-level mathematics once they could choose to bypass the remedial requirements (Hu, Park, Woods, Tandberg, Richard, & Hankerson, 2016).

Similarly, a small rural college in New Jersey saw graduation rates increase from 25 percent in 2014 to 39 percent in 2016, after it allowed students the choice of how to remediate (i.e., enroll in the full traditional course, participate in a quick review, or skip remediation entirely). To help them make the choice, students were provided extensive academic advising support along with informative statistical reports that detailed the likelihood of success if they chose the traditional remedial path (Austin & Austin, 2017).

Conclusions

Mathematics course placement criteria should be based on a holistic evaluation of student ability to succeed in the appropriate mathematics pathway that is relevant to their career path. Any remediation that is deemed necessary needs to be directly related to the content from the actual college-level courses the students will enter for their degree. Colleges implementing pathways cannot rely on a single, simple test score to determine student placement. Multiple criteria, such as standardized tests, diagnostic tests, and high school transcript data, should be reviewed by trained academic advisors who have honest conversations with students about their current mathematical abilities and future educational goals. Ultimately, students should be allowed to make the final advised, informed choice, as their determination may truly be the best predictor of success.

Given the choice and with appropriate consumer information, more students have elected to enter college-level classes directly with a greater chance of completing the college-level course and graduating than students who enrolled in developmental courses (Austin & Austin, 2017; Hu et al., 2016). To determine the best placement for success, students need to meet with advisors to review their degree goals and placement decision options, considering carefully how the options relate to available academic pathways. With so many different means currently available to evaluate student placement in mathematics courses, the academic advising component appears more vital than ever with regard to all student placement decisions. The time is now for collegewide placement policies to be implemented that do not rely solely on assessment of skills in algebraic manipulation, but rather include assessment of mathematical and quantitative reasoning abilities that align with students' desired fields of study. The multiple-measures practices described in this chapter have a better chance of aiming students toward success in relevant mathematics courses and college completion.

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