



EXECUTIVE SUMMARY

Multiple Paths FORWARD

Diversifying Mathematics as a
Strategy for College Success

JUST  EQUATIONS


cshpe
sixty years
CENTER FOR THE STUDY OF
HIGHER AND POSTSECONDARY EDUCATION

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With support from the California Community Colleges Chancellor's Office, The James Irvine Foundation, and College Futures Foundation, three organizations — WestEd, Just Equations, and Center for the Study of Higher and Postsecondary Education at the University of Michigan — have joined forces to publish this report. Its goal is to inform California community colleges in their implementation of new student success policies by shedding light on the use of multiple math pathways across the country.

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WestEd is a nonpartisan, nonprofit research, development, and service agency that works with education and other communities throughout the United States and abroad to promote excellence, achieve equity, and improve learning for children, youth, and adults. WestEd has more than a dozen offices nationwide, from Massachusetts, Vermont, Georgia, and Washington, DC, to Arizona and California, with headquarters in San Francisco.

Just Equations reconceptualizes the role of mathematics in ensuring equal opportunities for students. An independent resource on the role of math in education equity, Just Equations works across educational segments and advances evidence-based strategies to ensure that math policies give all students the quantitative foundation they need to succeed in college and beyond. Just Equations is a project of the Opportunity Institute, in partnership with LearningWorks, Policy Analysis for California Education, the Education Trust—West, and the Campaign for College Opportunity.

Center for the Study of Higher and Postsecondary Education at the University of Michigan is the nation's premier higher education program. Center scholars are dedicated to improving higher education and to training students to do the same, applying expertise in organizational behavior and management, public policy, academic affairs, and student development, assessment, and evaluation.

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Executive Summary

California community colleges are implementing a new law, [AB 705¹](#), that is intended to improve students' completion of college degrees and credentials. A central objective of the law is to increase students' likelihood of completing math requirements in one year or less. Providing students with multiple pathways to fulfill those requirements is one strategy California community colleges can use to achieve that objective.

Historically, the algebra-to-calculus pathway has been many colleges' default math requirement for students. However, over the last decade it has become clear that this pathway doesn't reflect changes in the types of quantitative skills that students need in their lives and careers. Numerous mathematics-related associations and faculty organizations have advocated diversified math pathways that address the range of undergraduate majors and career goals. These educators have recommended that colleges develop additional non-algebra pathways to ensure that students gain a solid foundation in such important concepts as statistics, modeling, and quantitative reasoning.

The need for alternative math pathways is underscored by research into the factors that limit college completion rates. Both nationally and in California, the vast majority of incoming community college students have been placed into remedial, or developmental, math sequences that emphasize basic algebra and that are designed to prepare students for algebra-intensive pathways. This practice has particularly affected underrepresented-minority students, who are more likely to be placed into remedial sequences. Many students never make it out of the developmental sequence and, thus, are unable to fulfill requirements for graduation or transfer.

In response, postsecondary institutions have begun rethinking their approach to math preparation. In addition to making changes in placement policies and prerequisites, many are offering more than one pathway through mathematics and are working to align those pathways with students' academic and career goals. In one respect, higher education institutions in California have been leaders in this trend: Both community colleges and public universities in the state accept alternative courses such as statistics to fulfill students' math requirements.

However, until recently, the state's four-year institutions specified that community college math courses needed to have a remedial prerequisite — intermediate algebra — in order to qualify as a transfer course. In most colleges, this expectation has been applied to any student placed into remedial math, even if the student intended to take statistics, which doesn't generally assume knowledge of intermediate algebra. As a result, community colleges' work to diversify mathematics pathways in California has focused on general education courses, not remedial sequences. In an effort to preserve students' opportunity to pursue a bachelor's degree, few of the state's community colleges have offered

1 https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB705

remedial mathematics pathways designed to prepare students for statistics and quantitative reasoning, despite evidence that such alternative pathways can improve student success. A new, broader definition of quantitative reasoning general education courses that was recently adopted by the California State University (CSU) system eliminates the explicit intermediate algebra requirement, thus freeing community colleges in the state to diversify remedial math courses.

California is one of at least 24 states that are implementing diversified math pathways. These pathways help ensure that students enroll in mathematics courses that are aligned with their program of study; are able to complete a non-remedial course within one year; and benefit from evidence-based curriculum and pedagogy. Preliminary research has found that initiatives to diversify math pathways have yielded two, three, and four times the gateway course completion rates of traditional pathways, often in less time.

The three most common types of mathematics pathways found in other states are a statistics pathway, a quantitative reasoning pathway, and an algebra-based pathway for science, technology, engineering, and math (STEM) majors that require calculus. Other pathways include math for elementary educators, math modeling, technical math, business math, symbolic logic, personal finance, and computer science. In addition, some colleges offer courses associated with specific trades, such as math for clinical calculations.

To identify the most prevalent math pathways in California community colleges, the authors examined the highest-level math courses taken by 900,000 students between fall 2009 and spring 2016. The analysis uncovered a wide variety of offerings, including 11 categories of math that are alternatives to the traditional algebra-based sequences. Overall, transferable alternatives to algebra-based courses accounted for 25 percent of highest-level math completions, with statistics emerging as the most developed of the alternatives. However, almost 50 percent of students only got as far as remedial math. Those students who stopped at remedial math accounted for two thirds of students who dropped out of college, more than half of students who earned a certificate, and 20 percent of students who transferred without an award. These findings are relevant because remedial courses are often misaligned with students' programs of study, focusing on algebra rather than on the types of quantitative skills needed for non-STEM majors.

Though California's higher education systems have not jointly recommended a set of math pathways through two-year and four-year colleges, this report reveals the extent to which the state's community colleges have been active in diversifying their math offerings. Many of the pathways in use in California have parallels to those that have been recognized by other states' higher education systems, as well as to those in CSU's new, broader definition of quantitative reasoning general education courses. Together, AB 705 and CSU's new policy present California community colleges with an opportunity to further diversify their math pathways and ensure that students have the specific quantitative skills they need for future success when they graduate and/or transfer.

AN OVERVIEW

Multiple Paths Forward

Diversifying Mathematics as a Strategy for College Success

Policy changes by California State University, along with the new AB 705 law, give California community colleges greater ability to diversify math pathways and ensure that students learn the quantitative skills necessary for success.

In response to recommendations from mathematics associations and faculty organizations, and research that shows algebra-intensive math requirements can be a barrier to completion, California has joined more than 20 states in implementing multiple math pathways that align with students' programs of study and enable them to complete a non-remedial math course within a year.

ACROSS THE US ABOUT
HALF THE STATES
ARE IMPLEMENTING
MULTIPLE MATH PATHWAYS

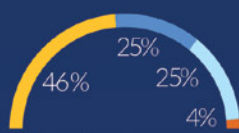
HERE ARE EXAMPLES OF HOW COLLEGES MIGHT ALIGN MAJORS AND PROGRAMS WITH ENTRY-LEVEL MATH COURSES

STATISTICS	Psychology	Social Sciences	Public & Protective Services	Library and Information Services	Media & Communication
QUANTITATIVE REASONING	Arts, Humanities & English	Applied Arts and Sciences	Hospitality & Culinary Arts	Agriculture & Natural Resources	Health Technologies
ALGEBRA-TO-CALCULUS	Biology	Engineering & Architecture	Math	Physical Sciences	Journalism
					Social Work

CALIFORNIA IS A LEADER IN OFFERING MULTIPLE PATHWAYS,

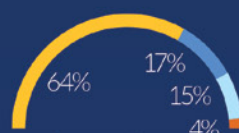
with statistics a common alternative to algebra. But making intermediate algebra a pre-requisite for transferable math has limited the types of quantitative skills students learn. Further diversifying math pathways and aligning pre-requisites can help students leave college with the skills necessary for ongoing study, careers, and life.

Highest-level math course taken by California community college students



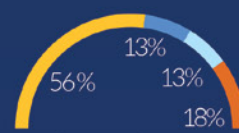
All Students

▲ A quarter of students take transferable non-algebra courses like statistics



Students who dropped out

▲ Two thirds of students who drop out stop at remedial math.



Students who earned a certificate

▲ Half of certificate earners stop at remedial math.

● REMEDIAL MATH ● NON-ALGEBRA, TRANSFERABLE TO 4-YEAR INSTITUTIONS
● COLLEGE ALGEBRA OR ABOVE ● NON-ALGEBRA, NON-TRANSFERABLE

Percentages based on analysis of courses taken by 900,000 students over 7-year period