The Campaign for College Opportunity

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EQUITABLE COLLEGE PREPARATION

Greater Equity in Higher Education Through Math Opportunity

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Preface

Over 50% of American students in our public schools are Latinx, Black, Asian American, Native Hawaiian and Pacific Islander (NHPI), or American Indian/Alaska Native (AIAN). Tapping into their talent and ensuring their access to a college education is essential to our future economic power and the success of our multi-racial democracy. Despite the historical exclusion and current underrepresentation of many Americans in our colleges and universities, in June 2023, the Supreme Court of the United States severely curtailed the use of race in higher education admissions, prohibiting the consideration of an applicant's racial status as part of that process.

Race-conscious admissions helped ensure America's colleges and universities were more diverse. Without it, there is a greater urgency for college leaders and policy makers to review current practices for equity, and to identify solutions that provide a fairer approach to preparing students for college, admitting them, and supporting their success. Towards that aim, the Campaign for College Opportunity is releasing a series of briefs, including this one, as part of our Affirming Equity, Ensuring Inclusion and Empowering Action initiative. The series will elevate practices that support the college preparation, admission, affordability, and success of Latinx, Black, Asian American, NHPI, and AIAN students, ensuring America does not return to an era of exclusion in higher education.

Overview

This brief focuses on the important role that math requirements contribute to inequity in access to college, in particular the value placed on calculus, even though it is not an essential course for students who are seeking non-STEM degrees. The boost earned by students who are fortunate enough to have access to calculus, a benefit unequally distributed across our high schools, is problematic. In this paper, the authors offer alternative approaches to ensure course requirements make sense for students given their higher education goals and for limiting the impact of one math course that is not essential for all students.

If education is the great equalizer in this country, then mathematics might be the great divider. Consider these disparities: In 2019, only six percent of Black and nine percent of Latinx high school students earned credit in calculus, compared to 18% of White students and 46% of Asian American students. Similarly, students at schools in the highest-income quartile are three times as likely to take the course as those in the bottom half.[1] Yet calculus exerts a big influence on students' college prospects: Selective colleges routinely view it as a gold standard in admission.[2]

As higher education institutions contend with creating racially inclusive student bodies in a post-affirmative action world, they must address the outsized role that mathematics courses play in restricting access to college. AP Calculus, an advanced high school math course meant to prepare students for science, technology, engineering, and mathematics (STEM) majors, is often used as an arbitrary admissions screen, especially at highly selective elite institutions. But 47% of high schools do not offer any form of calculus,[3] and Black and Latinx students are more likely to attend these schools.[4] This overreliance on a course that is not available to all students and not educationally necessary for non-STEM majors creates a systemic disadvantage for some students based on where they attend school.

Furthermore, these practices drive the inaccurate perception that calculus is a must-have for college success—regardless of a student's college or career interests. A solid grounding in mathematics is crucial in the 21st century. Calculus is one way to build such a foundation. But so are advanced courses in areas such as statistics and data science, which also foster critical thinking skills that are indispensable for achievement in college and beyond. They're also more aligned with many students' interests and more relevant to the fields many will pursue. While it is important that education systems equalize access to calculus, they also need to make other rigorous courses more available for students whose aspirations do not rely on proficiency in calculus.

At the same time, colleges must update their approach to admissions. **No single course should have so much sway over admissions decisions—and certainly not one that is not a required course for most majors,** or a course that is out of reach for many historically underrepresented students as a result of systems that track students in or out of math pathways beginning in middle school or even earlier.[5]

For too long, arbitrary mathematics requirements have served as unjust gatekeepers that impede equitable college access. Colleges need to expand the range of math courses that they value in admissions and make those priorities more transparent. Doing so will help colleges identify diverse talent and enable students to hone the math skills that align with their aspirations and with contemporary careers. It will also honor the long-standing position of leading math societies.

Leading Math Societies Caution Against Overreliance on Calculus

The Mathematical Association of America and the National Council of Teachers of Mathematics have repeatedly articulated their concern that an over-emphasis on calculus in high school can undermine students' math proficiency and engagement, while deterring students from learning areas of mathematics that may better match their interests.

"Although calculus can play an important role in secondary school, the ultimate goal of the K–12 mathematics curriculum should not be to get students into and through a course in calculus by twelfth grade but to have established the mathematical foundation that will enable students to pursue whatever course of study interests them when they get to college," the two organizations said in a 2012 statement.

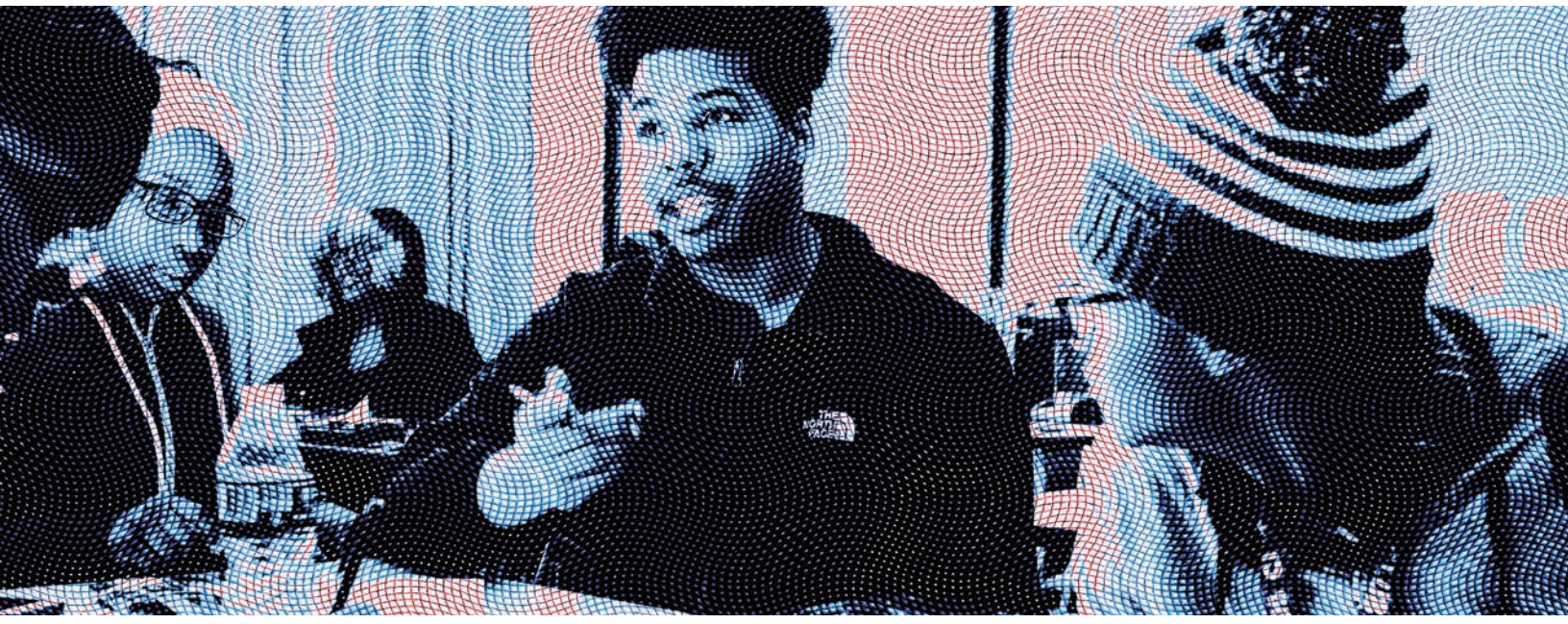
In 2022, they reaffirmed that position, stating, "A high school calculus course should not be the singular end goal of the PK–12 mathematics curriculum at the expense of providing a broad spectrum of mathematical preparation."

Broadening Math Requirements

While calculus has traditionally been considered the pinnacle of high school math, many high schools have begun to offer a broader array of advanced math courses. States have a role in encouraging such moves, as several have done. Georgia, for example, offers a modernized Algebra II course, which incorporates statistical reasoning and data science concepts in a technology-enhanced format. Ohio has introduced four algebra equivalent courses—Statistics and Probability, Quantitative Reasoning, Data Science and Foundations, and Discrete Math/Computer Science—to serve students who do not intend to pursue calculus-intensive careers.

These changes are occurring in the context of major shifts in college general education math requirements. Over the past decade, the majority of state higher education systems have adopted a "math pathways" approach, in which students meet their general education math requirements with a course aligned with their interests.

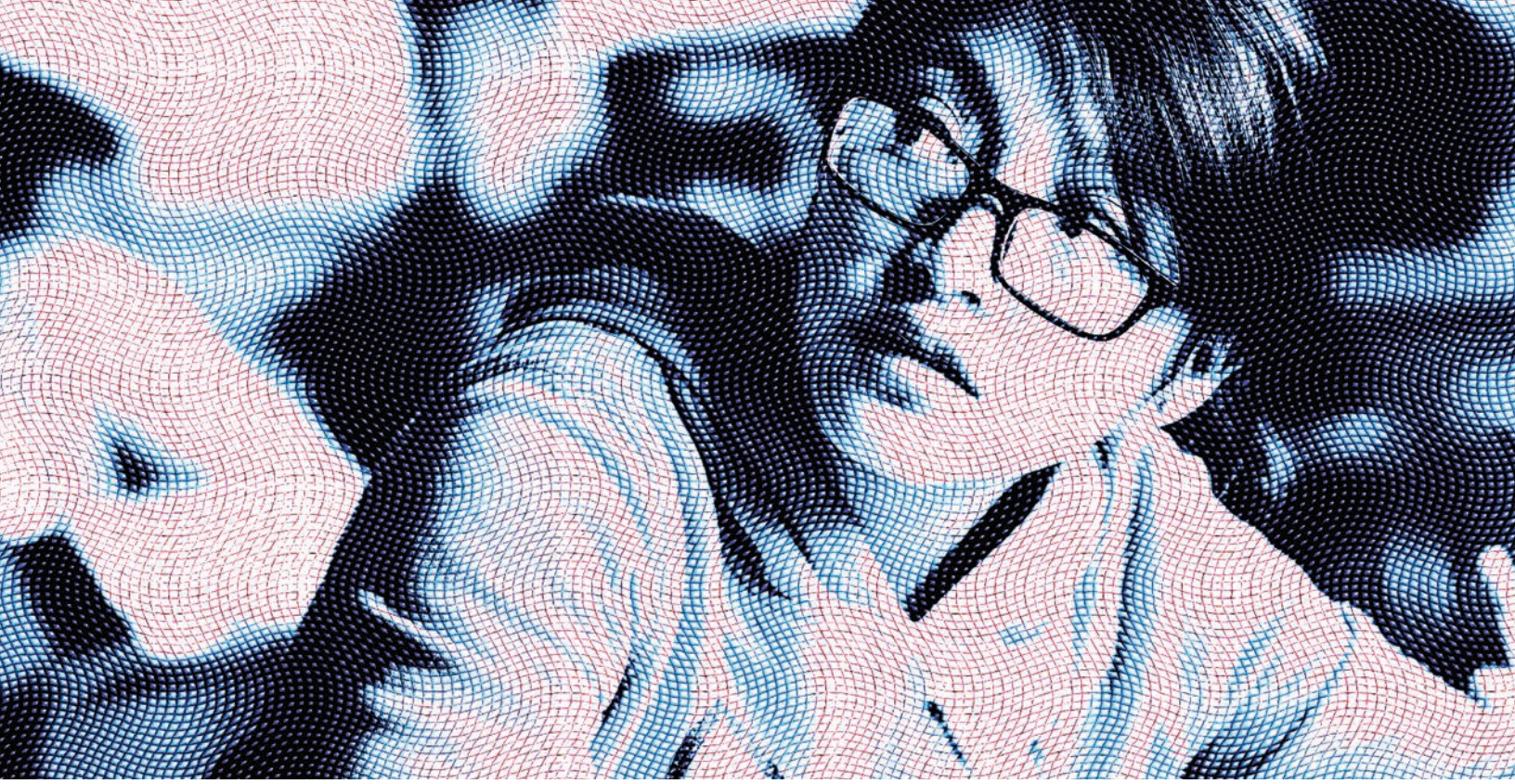
For students seeking to major in a STEM field, calculus is key, though some students begin in prerequisite courses such as college algebra or precalculus. Other courses, such as statistics, data science, quantitative reasoning, and mathematical modeling, prepare students majoring in areas such as social sciences, communication, and humanities, and are often the first course in the sequence.[6]



An Arbitrary Gatekeeper

Apart from programs such as engineering, calculus is not a stated requirement for admission to the vast majority of U.S. colleges and universities. Even highly selective institutions such as Harvard College and the University of Chicago stipulate that calculus is not preferred, particularly for students who are not seeking science or engineering degrees. Yet, when surveyed anonymously, the majority of admissions officers admit that they favor applicants with calculus on their transcripts.[7] High school counselors, too, believe that taking calculus is virtually a ticket for admission to selective universities, despite most colleges not listing it as a requirement. Counselors say they often encourage students to take the course—even if they have no interest in pursuing science or engineering—to improve their chances of admission.[8]

But whether students take calculus is often outside their control. The inequities begin in middle school, if not earlier. **Only students who are placed in an accelerated math sequence by the eighth grade are on track to take calculus in high school. That alone excludes vast numbers of students.** Furthermore, nearly half of high schools do not offer the course,[9] and many that do offer it provide limited seats. Not only is there evidence of racial and gender bias in counselors recommending students for AP Calculus,[10] but student surveys also show that counselors are less likely to recommend that Black and Latinx students take any advanced math course at all.[11] Furthermore, lower-income students have less access to college advising.[12] These patterns disadvantage some students in the competition for spots at selective universities and leave them less prepared to enter STEM fields.



Another reason the emphasis on calculus is problematic is that it motivates many ambitious students to rush through high school math courses without mastering the content. For the vast majority of students, taking calculus in high school does not lead to actual academic advancement. Fewer than 20% of high school calculus completers take a second- or third-semester calculus course when they get to college. What happens to the others? They repeat calculus, take a lower-level prerequisite course, take a course such as statistics that does not require calculus preparation, or take no math at all.[13] Such patterns are consistent with research showing that a top reason given by students for taking AP Calculus is to look good to colleges,[14] even if they reap no clear academic benefit.

Many of these students would be better off taking a different course. For example, students interested in fields such as psychology and political science could choose from courses in statistics, data science, discrete math, or another rigorous quantitative reasoning option. Research shows that such courses have the potential to reengage students who might have been turned off by prior courses in mathematics.[15] However, partly due to the perceptions about calculus' importance, high schools are less likely to offer such courses, teachers are less likely to be prepared to teach them, and counselors are less likely to recommend them to students applying to selective colleges.[16]

Best Practice: Math Expectations at the University of California

The University of California recommends four years of high school math, but only three are required for eligibility for admission to the system's nine undergraduate campuses. The system's faculty-led admissions board has long maintained that calculus is not required for admission. AP Calculus and AP Statistics carry the same weight in the admissions process.

"No single course, including calculus, determines an admissions decision," wrote the board in a 2016 statement. "Furthermore, students who go beyond the minimum math requirement should not view calculus as the only option. Other possibilities include discrete math, math analysis, pre-calculus, and statistics, with the best choice depending on a student's interests and preparation."

In 2020, the system further clarified its math expectations to note explicitly that advanced math courses such as statistics, probability, data science,* discrete mathematics, and some computer science courses count for the third or fourth year of high school math.[17]

Some UC engineering schools do place extra weight on calculus in their admissions processes. However, they also use a "holistic review" process to consider students' application in context. In that way, students who have not taken calculus—particularly if the course was not available to them—but are ready for a college-level mathematics course such as precalculus may be admitted. Several UC campuses have special programs to support such students' math preparation. For example, UC San Diego's Summer Bridge program has an introductory college math course for this purpose.

*At the time of publication, the inclusion of specific courses, including data science courses, as third-year courses in lieu of Algebra II was unclear for the 2024-25 school year pending a review due to concerns raised by UC's admissions board in July.

Math as an Indicator of Privilege

Why does math play such a disproportionate role in college admissions? In most disciplines, students do not need to start their trajectories toward an AP course by eighth grade. But, under the prevailing architecture of math opportunity, reaching an AP math course requires students to race through the curriculum and start the race in the eighth grade. Acceleration in middle school is the primary way to reach AP Calculus.[18] AP Statistics does not necessarily require acceleration but often holds less cachet with admissions offices.[19]

The prestige associated with calculus persists in the absence of clear or transparent admissions policies. Though few colleges require admits to have calculus on their transcripts, many institutions recommend that students take the most rigorous or advanced courses available to them. Unless colleges specify otherwise, the default assumption for students, parents, and high schools is that taking calculus is their safest bet. Some counselors refer to it as a "covert" requirement.[20]

As such, some students—particularly students seeking admission to highly selective institutions and those attending high schools with a strong emphasis on college going—actually face pressure to stack up AP math courses. While such hyper-acceleration benefits some students, taking two AP math courses exacts an unnecessary emotional toll on others.[21] The pattern is also not equitable, since many students lack the opportunity to take even a single calculus course. As originally designed, AP Calculus AB and BC were

intended as alternatives, with students taking one or the other—choosing either one or two semesters of college calculus—not both.[22]

Many admissions offices provide a bonus point or some other form of extra weight in the admissions process for AP courses and other advanced options, such as the International Baccalaureate and dual-enrollment college courses. However, differential access to such courses raises questions about the practice. So does the case of calculus, as a large majority of students who take it in high school repeat an equivalent course in college or take a lower-level math course. The recent introduction of AP Precalculus could complicate matters. On the one hand, it is intended to promote equity by providing an AP option that students can reach without accelerating. On the other hand, it provides an incentive for some students who would already be racing to AP Calculus to earn up to three bonus points in mathematics (four if they also take AP Statistics).

Best Practice: Flagship University Math Requirements - University of Illinois

Here is how the University of Illinois' flagship campus at Urbana-Champaign describes its math requirements for incoming freshmen:

STEM majors

A minimum of 3.5 years* of mathematics, including trigonometry or higher. Four years including calculus, if available,** is preferred.

Business majors

A minimum of 3.5 years of mathematics. Four years including statistics or calculus, if available,** is preferred.

Architecture, information sciences, and secondary education with a math focus

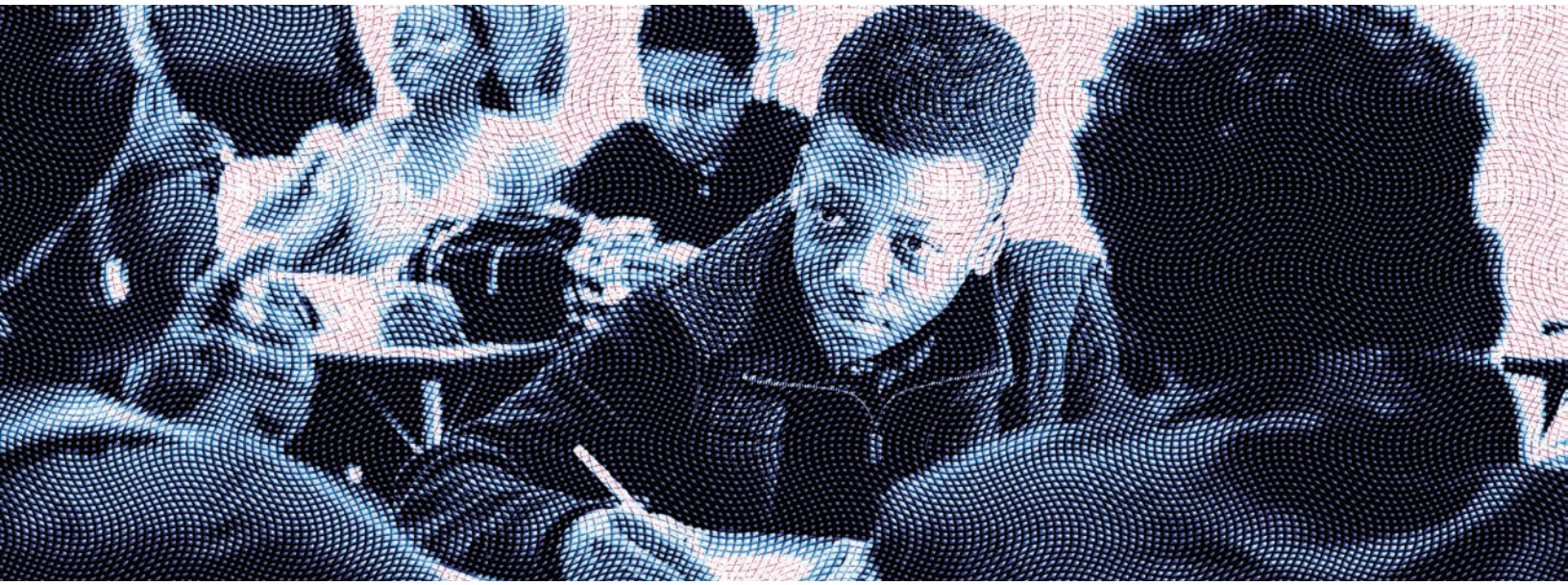
A minimum of 3.5 years of mathematics.

All others

A minimum of three years of mathematics.

*Courses including applied business math, pre-algebra, computer processing, and information technology are not accepted.

**Students attending schools that do not offer a given course, such as calculus or statistics, are not penalized in the admission process, as long as they are ready to take those courses. Some UIUC programs, such as its engineering school, offer special support for students who have not had access to preparatory courses.



A New Role for Mathematics

Math courses can figure too heavily in the admissions process—whether in actual decisions or in the perceptions of students and counselors—in ways that undermine access to college, particularly for historically underrepresented students. But there are some simple steps that higher education institutions can take to evaluate students' high school math course taking in more equitable ways. Below we recommend some policy changes.

Policy Recommendations for Colleges and Universities:

- ✓ **Rethink requirements.** Colleges should eliminate arbitrary requirements. Courses should not be required just because they are hard—or expected for all students simply because a few majors rely on them. Admissions offices can work with faculty across disciplines to ensure that the range of math courses they accept explicitly go beyond calculus to include rigorous options aligned with various fields of study. Harvard's description of math courses that satisfy eligibility requirements for admissions is one example. For programs that require specific courses such as calculus, institutions should provide support for admits who could not take the courses in high school.
- ✓ **Be transparent with high schools, students, and families about new or existing requirements.** If calculus is not required for some or all programs, applicants should know that. Such transparency is essential, so that students know what is expected. Rather than saying, "Take as many advanced courses as you can," or "Take the most rigorous courses available," admissions offices should provide specific guidance. For example, "Have x years of progressively advanced math aligned with college and career goals." The University of Chicago lists a range of math course options and explicitly notes that credit in courses other than calculus is recognized in the admissions process. Vanderbilt University explains that calculus (along with physics and chemistry) is highly recommended for engineering applicants only.
- ✓ **Evaluate students' math course taking in context.** Part of advancing diversity and equity in college admissions requires recruiting in diverse settings and reaching schools that enroll first-generation Black and Latinx students and other underserved students. Students' applications should be evaluated holistically, so that those whose high schools do not offer specific courses are not penalized. For example, the University of Illinois Urbana-Champaign expects calculus for STEM students and either calculus or statistics for students applying to their business school (see page 11). However, the university explicitly notes that

students' records will be evaluated in the context of their high school's offerings. Columbia University's engineering school recommends math through calculus "unless you have already completed what is available at your high school." For state universities or systems, top-percent admissions plans, such as those in California and Texas, provide another way of evaluating in-state students' performance in the context of their opportunities[23] as does comprehensive review.

Colleges need to be especially careful about any preferences for calculus, which can levy a penalty on students who were effectively shut out from the opportunity to take the course. Some high schools provide information on their offerings as part of a profile submitted with students' applications. When colleges do not have access to such information, they can use other resources, such as the Civil Rights Data Collection, the AP course audit, and a neighborhood database to gain a more comprehensive picture of students' opportunities. However, colleges do not typically have information on middle school placement policies, which disproportionately affect opportunities for Black, Latinx, and low-income students. They also may not know whether a high school rations access to calculus by offering limited sections.

The need to address such information gaps points to the importance of collaboration among education researchers, high school teachers, college faculty, and admission officers to inform approaches to admission. While K–12 tracking must be tackled, new approaches for admissions offices to identify such disparities are also essential to ensure that a student's middle school math placement does not dictate their college opportunities.

- ✓ **Exercise caution about bonus points for high school calculus.** Postsecondary institutions should review their practice of assigning extra weight for AP courses. This is particularly true of AP Calculus, given that large numbers of students repeat the equivalent course in college. For example, if AP Calculus AB does not qualify a student to take Calculus II, the course might merit less consideration in the admissions process. For the same reason, the practice of accruing multiple bonus points for AP courses in the calculus sequence deserves review as well.

Policy Recommendations for Public School Leaders:

K–12 schools also have a role to play in ensuring equitable access to counseling and advanced learning opportunities, including calculus. K–12 leaders can boost participation in higher-level courses by creating more inclusive selection and eligibility processes.

These include:

- ✓ **Disaggregate AP course taking patterns.** Districts can track patterns of AP course enrollment and completion by student group and research barriers to access. Leaders can also review advanced learning eligibility requirements, analyze them for racial disparities, and develop strategies to increase those opportunities.
- ✓ **Adopt automatic enrollment policies.** Districts can also promote advanced learning opportunities for students of color by automatically enrolling students who meet eligibility requirements for advanced coursework.
- ✓ **Build intentional and active recruitment pipelines.** This can include conducting targeted outreach to students of color and providing math preparation and ongoing support for students who show promise.

Policy Recommendations for State Policymakers:

- ✓ **Automatic course placement.** States can support such efforts through policies such as requiring schools to automatically place students into advanced courses based on prior performance. For example, the state of Washington required all school districts to implement an automatic enrollment policy by the 2021–2022 school year after a pilot project produced large increases in underrepresented students participating in accelerated learning.

  North Carolina was one of several other states to experience similar success with automatic enrollment policies. A 2018 law required schools to automatically place high-scoring students into an advanced math class, rather than relying on teacher recommendations. That school year, more than 8,000 students who previously would have been placed into regular or remedial math were given access to advanced math courses. An update in 2019 required districts to begin offering high school level math to high-achieving 8th grade students. The state also offers grant funding to support educators in adopting automatic enrollment programs.
- ✓ **Require data on access to advanced course work.** It is important that state education departments also monitor access to advanced course work by requiring school districts to publish disaggregated data annually by student group, as Colorado has done.
- ✓ **Set goals for expanding access to underserved student groups.** States should set clear and measurable standards and goals for expanding access to underserved student groups and monitoring their subsequent success.

Math Equity Is Key to Higher Education Equity

The way math has been used in admissions has contributed to inequitable representation of Black and Latinx students in the most selective higher education institutions. It has also had repercussions for the math preparation of millions of students a year, narrowing the focus of K–12 math education and undermining learning for far too many. The demise of race-conscious admissions casts a spotlight on this long-standing injustice and the urgency for action.

There is a lot of room for improvement in high school math education, and colleges and universities play an important role in creating the conditions for that improvement to manifest. In addition to education schools and STEM departments—which are often involved in efforts to improve K–12 education—**college admissions offices are central to supporting change by dismantling structures that have operated to preserve privilege rather than to expand opportunities.** As a result, college and university leaders need to assess their current admissions practices more broadly to address the challenges faced by students applying to their campuses. College leaders should recognize and provide accurate signals to students, families, and high schools about the range of mathematics courses that will prepare students for 21st-century success and not allow an over-emphasis on calculus to stand in the way of equitable college access.

To learn more about strategies for expanding math opportunity, please visit www.justequations.org

Endnotes

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