



The Mathematics of Opportunity:

Rethinking the Role of Math in Educational Equity

By Pamela Burdman | November 2018 | EXECUTIVE SUMMARY



Beginning in kindergarten and continuing into college, mathematics is not just an academic subject: It's a key mechanism in the distribution of opportunity. Even as math expectations can serve as a foundation for academic success by supporting quantitative literacy, they can also operate as a filter that literally stops many students in their educational tracks.

This role creates an imperative for educators to ensure fairness and equity in the pursuit of achievement. A useful definition of equity, proposed by math education scholar Rochelle Gutierrez, is “the inability to predict mathematics achievement and participation based solely on student characteristics such as race, class, ethnicity, sex, beliefs, and proficiency in the dominant language.”¹

Low rates of math proficiency and high rates of remedial math course-taking, especially among underrepresented populations, reflect the limitations of current practices and policies. They also underscore the inequitable conditions in which students learn, the often-questionable ways in which their learning is assessed, and the influence of racism and other forms of discrimination. Simply put, the promise of mathematical literacy—to “expand professional opportunity, understand and critique the world, and experience wonder, joy, and beauty,” as defined by the National Council of Teachers of Mathematics (NCTM)—is not being fulfilled.

Traditional math practices appear intended to winnow students out: Only in mathematics, for example, is an accelerated pace needed to reach an Advanced Placement course. Aspiring doctors are expected to complete calculus, even though physicians rarely, if ever, use it. Fairness and equity demand policies and practices designed to enable students to acquire the quantitative literacy that prepares them for future success, not to ration opportunity.

Numerous reforms and initiatives are being attempted to improve equity in mathematics, but it is essential that they are grounded in evidence, aligned across educational segments, and monitored for their impact on equity. This report, *The Mathematics of Opportunity*, is intended to contribute to that goal by providing a framework for dialogue, policy adoption, and implementation, and by informing a forthcoming research agenda to further guide the field.

In the “Aftermath”: Benefits & Costs

The costs—both psychic and economic—to individuals and society of not effectively and equitably educating students in math are great: Despite considerable efforts by the math profession, a majority of the U.S. population dislikes and fears mathematics. Too many students receive the message that they are incompetent in mathematics, often resulting in math anxiety that can permanently limit individuals’ horizons. Such messages are conveyed through teaching practices, including ability grouping and tracking. Worse, even students who do navigate the high school math gauntlet may be told by colleges that they lack the skills they need: Up to 80 percent of community college students have been placed into remedial courses.

Since current practices confer a valued pedigree and access to other opportunities, students who benefit

may see little reason to support reforms. However, math education leaders and math associations increasingly have concluded that change is needed—for the benefit of students, for the sake of equity, and for the future of the math discipline.

The Architecture of Math Opportunity

How does math influence opportunity in such a significant way? Research and analysis suggest that the architecture of math opportunity is:

- undergirded by **misconceptions about math ability**,
- scaffolded by **existing educational inequities and stereotypes**, and
- reinforced by **math’s use as a marker or pedigree** that confers access to opportunities.

The beliefs that only some people are good at math, that there is a single right way to do math, and that speed is central to math ability interfere with effective learning. Such misconceptions are especially potent in reinforcing the ways some students are already disadvantaged due to racial or other biases. Furthermore, the use of math requirements with little regard for their relevance further cements the way math policies ration opportunity and reinforce inequity.



Equity Dimensions of Math Education

This architecture is reflected in four interconnected dimensions of math education, and emerging practices in each suggest avenues for advancing equity:

Content

The historical emphasis on preparation in algebra is tied to the fact that advanced algebra courses prepare students for calculus. Calculus is needed to pursue some STEM fields and often is viewed as a hurdle for admission to selective colleges. Since other material—such as statistics—is more relevant for most students, and most majors don’t require advanced algebra, at least 20 state higher education systems have begun to offer diversified math pathways. Colleges in these states offer non-algebra-based general education math courses, and may not require students to demonstrate Algebra 2 proficiency before taking those courses.

New Directions

Research has found that some pathway initiatives have tripled and quadrupled math completion rates for community college students. High schools are also broadening their conception of math content, as the Common Core State Standards support (1) use of an “integrated” curriculum associated with strong math performance, (2) the addition of content such as statistics and probability, and (3) a set of mathematical “practice standards” that emphasize quantitative literacy skills.

Instruction

Observers of U.S. classrooms have noted a misplaced emphasis on speed, performance, giftedness, test scores, rules, and procedures, as opposed to learning, depth, context, thought, values, and creativity. Changing these approaches is central to making math pedagogy more effective.

New Directions

Instructional practices need to be equitable, culturally responsive, and provide opportunities for students to see themselves in the curriculum and to engage in collaborative, inquiry-based work. New approaches to teacher recruitment, training, and professional learning are also essential, with the aim of diversifying the math teaching force.

They also call for lower-stakes ways of measuring student progress. Formative assessment is used to inform students and teachers of students' needs in order to improve teaching and learning, not to penalize or rank students. Support is also growing for performance assessments, which offer more authentic evaluation of skills through, for example, research investigations, capstone projects, or open-ended, real-world problems.

Readiness Policies & Structures

Factors such as *how many* and *which* math courses students take, when they take them, and how they perform—along with test scores— help determine the opportunities available to students. High school math graduation requirements vary considerably by state and may not align with public university admissions requirements. Ambivalence has surrounded Algebra 2: Recently, some states have added it as a high school graduation requirement, even as others have eliminated it. In a possible middle ground, the NCTM has proposed eliminating some “obsolete legacy content” from Algebra 2. Tracking is also a concern: Though it has not improved math performance overall, considerable pressure exists for schools to allow some students to accelerate through the curriculum to make their college applications more competitive. This practice has helped drive the “race to calculus” that is prevalent in U.S. high schools.

Assessment

Tests are routinely used to rank and sort students, whether for course placement, scholarships, or college admissions. Timed tests also contribute to the overemphasis on speed in mathematics. Many tests provide exposure to mathematics through the myopic lens of right and wrong. In addition, high-stakes tests have been shown to have a disparate impact on marginalized students. Furthermore, their predictive validity is limited.

New Directions

The limitations of standardized tests have led some colleges to eschew their use for both remedial placement and admissions.

New Directions

Determining students' pathways through mathematics is a high-stakes practice, especially in the transitions from middle

school to high school and from high school to college. Issues include racial bias in ninth grade math placement, as well as the disparate outcomes of assigning all students to algebra in eighth grade. Some school districts have reversed course, delaying algebra until high school, when more students are ready for Algebra 1—especially since the new eighth grade standards are essential for high school preparation. Under this policy, students can accelerate during high school to reach calculus.

Consonant with those moves are initiatives to increase the variety of 12th grade math courses that prepare students for college. And, for those who may still not be ready for a college math course, colleges are substituting traditional remedial math courses with “co-requisite” strategies: This approach, which places students in college-level math courses with concurrent support, has produced fourfold improvements in math course success—along with dramatically lower equity gaps.

Toward a New Mathematics of Opportunity

Education equity calls for new ways of preparing students and assessing learning to foster mathematical literacy for success in college and in life. Rather than face arbitrary requirements, students should be able to pursue math pathways relevant to their interests, once they have learned key content. It’s essential that new non-algebra pathways offer rigorous content and don’t serve to divert women and students of color from STEM fields. While some leading math associations and higher education institutions are questioning the race to calculus, as long as calculus remains a gatekeeper, limiting access runs counter to equity.

Without appropriate design, accelerated high school pathways can undermine equity by promoting arbitrary sorting and tracking at the expense of alignment, relevance, and support for students. Minimizing tracking in math, while providing the instruction and support students need, will help ensure that all students have the chance to prepare for college.

The new architects of math opportunity are re-building structures across all dimensions of math education. It’s critical to continuously evaluate new policies and practices to ensure they have a positive impact on student success and equity.

Aligning them in a common vision is also important in order to eliminate systemic impediments in educational pathways, stimulate innovation, spark dialogue, and lay a cross-segmental foundation for new policies. Stunning progress has been made in recent years as a result of some of the initiatives mentioned in this report. That momentum has greatly increased the potential for a new mathematics of opportunity to reshape the way students traverse education systems. Growing that potential to advance equity will allow mathematics to fulfill its intended purpose—and offer more students a chance at college success.