Getting Started with Equity

A Discipline Brief for Equity in Mathematics: Natalie Hobson, PhD

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Contents

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About the Contributors

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About the Supporting Organizations

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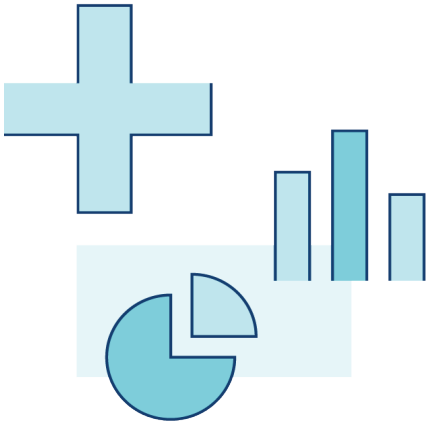
Discipline Brief: Equity in Mathematics

Natalie Hobson, PhD, Assistant Professor of Mathematics and Statistics at Sonoma State University

Summary of equity-related areas of concern



Inequities are woven into our mathematics education system and manifest themselves in many ways. Some of the most obvious forms of these inequalities include who we deem suitable to take math, what we teach in math, and how we teach math. Though quantitative reasoning skills are essential for students' success in work and life, math achievement in school has historically been a filter for sorting students into academic and career tracks. As such, math performance acts as a gatekeeper to prevent certain students from educational advancement.

At the college level, inequities begin with placement tests which prevent some students from accessing college mathematics. Rigid pathways through math remediation and completion often require students to complete (and pay for) several developmental courses prior to accessing courses that are relevant to their majors or interests. Once in a math class, student outcomes can be greatly impacted by instructor bias and societal stereotypes of who can and cannot do math.

Over the past decade, nationwide reform efforts have begun to address some of these concerns in math equity. In particular, many college systems have made widespread policy and curriculum changes to their placement techniques and developmental math programs. Studies have shown[1] that these reforms are helping more students succeed, but are not necessarily closing the gaps in success between underserved students and their more privileged counterparts.

Suggestions for change

Departments and colleges must address specific challenges and barriers to math achievement faced by racially minoritized and poverty-affected populations. Some of these challenges include access to college materials and information, stereotype threat, math anxiety, instructor implicit bias, and tracking. The suggestions below will help departments and faculty address some of these factors and create more equitable department structures.

Diverse Pathways

Offer diverse pathways and corequisite math courses to allow for students with a variety of interests to succeed in college math.

- Students should be admitted into classes based on their ability, work ethic, and motivation rather than on their background or high school experience. All high schools do not offer the same opportunities to students. A students' past educational experience should not dictate what opportunities they are afforded in higher education.
- Placement requirements need to be clearly communicated to students so that they enroll in the appropriate math course that is aligned with their interests and aspirations and will fulfill their graduation requirements.
- Pathways through college mathematics courses should include relevant courses for students and allow them to start satisfying requirements for their degree right away. This helps avoid the risk of frustration with the discipline of mathematics and reduces students' financial burden.
- Schools should conduct equity audits of their developmental mathematics pathways (e.g., stretch and corequisite courses) to determine if these programs are meeting the needs of underserved students.

Sense of Belonging

- Create a department and classroom culture where students feel a sense of belonging.
- Encourage faculty to personally welcome their students and learn their names early on in the term.
- Provide open spaces where students can work together in groups. These spaces can be equipped with whiteboards and large tables to encourage group collaboration.
- Write and post a department mission statement that welcomes all students.
- Offer student clubs and groups that represent minoritized students (e.g., Society for Advancing Chicanos/ Hispanic and Native Americans in Science or Association for Women in Mathematics).
- Remind students that there are no "math people" and that mathematics understanding requires effort and practice.
- Honor students' growth and hard work in substantive ways, like including teamwork or participation as part of students' grades.

Student-Centeredness

Use student-centered instructional practices that engage students in conceptual understanding of math and give students a sense of ownership over their learning.

- Include projects and assignments with multiple approaches that allow students to contribute their own interests and knowledge.

- Honor students' multiple approaches and welcome mistakes as part of the learning process.
- Class time should include opportunities for students to collaborate and work together in smaller groups.

Communicate Expectations

Make course expectations explicit so that students without family knowledge of the college experience do not have to work harder to know what is required of them.

- Consider the cultural assumptions being made in each assignment or assessment.
- Provide students with assignment rubrics so that expectations are clear. Communicate to students how to use the rubrics while completing their work.
- Provide explicit information to students about navigating college and class resources (e.g., tutoring centers and advising services on campus, course LMS homepage and office hours).
- Communicate to students how often they should be studying for the class or checking their learning management system (LMS) for announcements.
- Destigmatize getting help on school work by rephrasing office hours and drop-in tutoring centers as an opportunity to take advantage of college resources rather than a service for only those students who "need help."
- When writing assignments, ask yourself, "what does someone need to know in order to be successful?" "What are the hidden assumptions this assignment requires of the students?"

Bias Training

Provide professional development to faculty to help identify and mitigate implicit bias.

- Encourage faculty to attend workshops and conferences in which participants learn about and discuss diversity and inclusion.
- Educate yourself about systemic racism and its impact on education by reading and discussing books with colleagues.
    - *So you want to talk about race* by Ijeoma Oluo
    - *White Fragility* by Robin Diangelo
    - Podcast: Scene on Radio's Seeing White Season 2 The Color of Law: A Forgotten History of
    - *How Our Government Segregated America* by Richard Rothstein
    - Begin Again: James Baldwin's *America and Its Urgent Lessons for Our Own* by Eddie S. Glaude Jr.

Increase Access

Consider other ways to increase access to mathematics for minoritized students.

- Bring together faculty and students to discuss and collaborate on the specific needs of the students at a specific college or university.
- Develop ways to accurately measure and audit math courses, pathways, and majors for outcome differences that are correlated to racial and socio-economic identities. Develop approaches to diminish such disparities and continue to measure progress.

Further reading

References specific to equity in mathematics corequisite and pathways programs (Institution/ Department Level)

Brathwaite, J., Fay, M. P., & Moussa, A. (2020). Improving Developmental and College-Level Mathematics: Prominent Reforms and the Need to Address Equity. CCRC Working Paper No. 124. Community College Research Center, Teachers College, Columbia University.

https://ccrc.tc.columbia.edu/publications/improving-developmental-college-level-mathematics.html

From the abstract: “Informed by relevant research literature, this paper argues that the majority of reforms to developmental math education seek to remedy general barriers to student progress but are not typically designed to address equity gaps and, perhaps unsurprisingly, do little to reduce them. The authors examine issues of concern present in traditional developmental math education and how existing reforms—including assessment and placement reforms, acceleration reforms, contextualization reforms, and curricular and pedagogic reforms—aim to address these issues, noting if they are associated with reductions in equity gaps. The authors also explore the potential for targeted reforms in developmental math to more effectively address the factors that contribute to inequities in student outcomes, factors such as stereotype threat, math anxiety, instructor bias, and tracking. The paper concludes with recommendations for colleges.”

Burdman, P. (2018). The mathematics of opportunity: Rethinking the role of math in educational equity.

https://justequations.org/resource/the-mathematics-of-opportunity-report/

From the report description: "Just Equations' report The Mathematics of Opportunity describes how traditional approaches to mathematics education can contribute to inequity and highlights emerging approaches to change that equation. The goal is to ensure that math instruction is more equity-oriented and that math requirements are more valid and aligned across educational systems."

Just Equations. (2019). Redesigning the Mathematics of Opportunity: Principles for Equitable Math Pathways To and Through College.

https://justequations.org/resource/redesigning-the-mathematics-of-opportunity-principles-for-equitable-math-pathways-to-and-through-college/

This is a follow-up report from the Just Equations Burdman, P. (2018) article The mathematics of opportunity: Rethinking the role of math in educational equity. The principles for equitable math pathways in this follow up report are intended to further clarify the directions for policy and practice to improve math education's role in fostering equity that were originally discussed in the 2018 article.

National Academies of Sciences, Engineering, and Medicine. (2019). Increasing student success in developmental mathematics: Proceedings of a workshop. National Academies Press.

https://www.nap.edu/catalog/25547/increasing-student-success-in-developmental-mathematics-proceedings-of-a-workshop

Proceedings from a workshop in which participants "explored how to best support all students in postsecondary mathematics, with particular attention to students who are unsuccessful in developmental mathematics and with an eye toward issues of access to promising reforms and equitable learning environments."

Purnell, R.D., & Burdman, P. (2020). Go Figure: Exploring Equity in Students' Postsecondary Math Pathway Choices.

https://justequations.org/wp-content/uploads/Just-Equations-2019-Report-Go-Figure-Digital-FullAppendix-3.pdf

This report examines the equity concerns of recently developed math pathways in some California colleges. The article claims that "new pathways need to be intentionally designed in ways that ensure they are not being used to track students of color away from majoring in lucrative STEM (science, technology,

engineering, and mathematics) fields." This article examines how students are choosing their math courses and math pathways and highlights "significant barriers for students navigating the selection process. These range from structural barriers, like limited access to or knowledge of available supports, to personal barriers like math anxiety."

References on persistence and retention in undergraduate STEM

Chasteen, S. (2021). Talking About Leaving Revisited Persistence, Relocation, and Loss in Undergraduate STEM Education.

From the abstract: This text "discusses findings from a five-year study that explores the extent, nature, and contributory causes of field-switching both from and among "STEM" majors, and what enables persistence to graduation. The book reflects on what has and has not changed since publication of Talking about Leaving: Why Undergraduates Leave the Sciences (Elaine Seymour & Nancy M. Hewitt, Westview Press, 1997)...[Each chapter addresses] key questions, drawing on findings from each related study source: national and institutional data, interviews with faculty and students, structured observations and student assessments of teaching methods in STEM gateway courses. … [T]his book affords the most comprehensive explanatory account to date of persistence, relocation and loss in undergraduate sciences."

Websites and organizational resources

A Pathway to Equitable Math Instruction (Focus on grades 6-8)

https://equitablemath.org/

From the website: "This toolkit was developed by a team of teachers, instructional coaches, researchers, professional development providers, and curriculum writers… [Framework] uses the Student Achievement Partners' Instructional Priority Content in Mathematics as a foundational guide for sharpening our content focus for this toolkit. We also recognized that educators need support in shifting their instructional practices to provide meaningful access to priority content while ensuring that those practices are research- and assets-based, and culturally responsive. We drew upon the principles of the California English Learner Roadmap and the Position Statement of TODOS: Mathematics for All as key resources for the development of the tools." The sources realizes "the disproportionate impact of COVID-19 on communities of color has exacerbated the historic and systemic inequities experienced by Black, Latinx, and Multilingual students. We therefore embraced the responsibility to simultaneously create equitable access to quality math instruction for 6th-8th graders in the 2020-2021 school year, while continuing to confront systemic racism and individual beliefs rooted in racism."

American Association for the Advancement of Science's (AAAS) Science, Technology, Engineering, Mathematics, and Medicine (STEMM) Equity Achievement (SEA) Program

https://seachange.aaas.org/

From the website: "SEA Change supports institutional transformation, with an initial focus on colleges and universities, enabling success in high quality education and research missions by ensuring that the full range of individual talent can be recruited, retained, and advanced in science, technology, engineering, mathematics, and medicine (STEMM)."

TODOS: Mathematics for ALL Excellence and Equity in Mathematics

https://www.todos-math.org/

From the website: "TODOS: Mathematics for ALL is an international professional organization that advocates for equity and excellence in mathematics education for ALL students - in particular, Latina/o students. As articulated in the mission and goals, TODOS advances educators' knowledge, develops and supports education leaders, generates and disseminates knowledge, informs the public, influences educational policies, and informs families about education policies and learning strategies. All of these goals ultimately result in providing access to high quality and rigorous mathematics for ALL students."

References relating to theory and research of mathematics education equity

Goffney, I., Gutiérrez, R., & Boston, M. (2018). Rehumanizing mathematics for Black, Indigenous, and Latinx students. National Council of Teachers of Mathematics.

Collection of articles related to attending sto students' identities through learning, profession development that embraces community, and principles for teaching and teacher identity.

Gutiérrez, R. (2013). The sociopolitical turn in mathematics education. Journal for Research in Mathematics Education

From abstract: "This article highlights some promising conceptual tools from critical theory (including critical race theory/Latcrit theory) and post-structuralism and makes an argument for why taking the sociopolitical turn is important for both researchers and practitioners. Potential benefits and challenges of this turn are also discussed."

Gutiérrez, R. (2009). Framing equity: helping students 'play the game' and 'change the game. Teaching for Excellence and Equity in Mathematics. Todos; 1(1):5–7.

From abstract: This article introduces a framework for equity that entails the dimensions of Access, Achievement, Identity, and Power. Beyond knowledge and skills, teachers need an "equity stance" that embraces and works to balance the tensions between these four dimensions.

Hunter, J., Hunter, R., & Anthony, G. (2019). Shifting towards equity: challenging teacher views about student capability in mathematics. Mathematics Education Research Journal, 1-19.

From the abstract: "The Developing Mathematical Inquiry Communities (DMIC) project is a whole-school professional development intervention designed to support a shift towards more inclusive and equitable pedagogy in the mathematics classroom. This article examines the changes in teacher beliefs about ability grouping in mathematics classrooms over time as teachers reconstruct their pedagogical practices as part of DMIC. Analysis of teacher and student interview data illustrates the ways in which the shifts in practice at the beginning of the re-invention contrasted with those at the end of the first year. We use an adaptation of Valsiner's zone theory (Valsiner 1997) to explain how the changed classroom practices supported teachers to enact more equitable practices while also constructing a more expansive view of student capability."

Martin, D.Bl, (2019) Equity, inclusion, and anti-blackness in mathematics education, Race Ethnicity and Education, 22:4, 459-478, https://www.tandfonline.com/doi/abs/10.1080/13613324.2019.1592833

Michigan State University Libraries Bibliography of inclusive teaching resources in Mathematics:
https://lib.msu.edu/inclusiveteaching/math/

National Council of Teachers of Mathematics; Access and Equity in Mathematics Education

https://www.nctm.org/Standards-and-Positions/Position-Statements/Access-and-Equity-in-Mathematics-Education/

Schoenfeld, A. H., Floden, R. E. & The Algebra Teaching Study and Mathematics Assessment Project. (2014). The TRU mathematics scoring rubric. Berkeley, CA and E. Lansing, MI: Graduate School of Education, University of California, Berkeley and College of Education, Michigan State University.

http://ats.berkeley.edu/tools.html and http://map.mathshell.org/trumath.php.

Teaching for Robust Understanding of Mathematics (TRU Math) Framework includes five dimensions of powerful classrooms to help guide teachers and curriculum developers. These dimensions include: content, cognitive demand, equitable access to content, agency, authority and identity, and formative assessment.

Tang, G., El Turkey, H., Cilli-Turner, E., Savic, M., Karakok, G., & Plaxco, D. (2017). Inquiry as an entry point to equity in the classroom. International Journal of Mathematical Education in Science and Technology, 48 (sup1), S4-S15.

"In this paper, through aligning some characteristics of inquiry put forth by Cook, Murphy and Fukawa-Connelly with Gutiérrez's dimensions of equity, we theoretically explore the ways in which active learning teaching practices that focus on inquiry could support equity in the classroom."

The Mathematics of Opportunity: Rethinking the Role of Math in Educational Equity

NOVEMBER 2018

https://justequations.org/resource/the-mathematics-of-opportunity-report/

https://justequations.org/wp-content/uploads/design_principles_v1.pdf

Helpful Links

A Discipline Brief for Equity in Mathematics: Joel Amidon, PhD

References & notes

[1] Brathwaite, J., Fay, M. P., & Moussa, A. (2020). Improving Developmental and College-Level Mathematics: Prominent Reforms and the Need to Address Equity. CCRC Working Paper No. 124. Community College Research Center, Teachers College, Columbia University.