

Hartzler, R., & Blair, R. (Eds.) (2019). *Emerging issues in mathematics pathways: Case studies, scans of the field, and recommendations*. Austin, TX: Charles A. Dana Center at The University of Texas at Austin.

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

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Chapter 14

Mathematics Pathways and Equity: Considering Progress from Multiple Perspectives

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Abstract

If progress is a matter of perspective, then what perspectives should practitioners and policymakers consider when viewing mathematics pathways through an equity lens? To broaden and deepen the beneficial impact of the mathematics pathways movement, practitioners and policymakers should understand and address equity and student success implications from multiple perspectives held by communities critical to enacting and sustaining change and continuous improvement. This chapter describes four perspectives on equity and student success and concludes with recommendations for successfully obtaining and maintaining “permission” to support broad scale and continuous improvement of mathematics pathways implementation.

Introduction

High-quality mathematics pathways support success for all students, especially underserved populations, by combining strategies for moving students more quickly into credit-bearing gateway mathematics courses that are aligned with programs of study, with strategies for continuously improving teaching and learning (Burdman, Booth, Thorn, Bahr, McNaughtan, & Jackson, 2018; Rutschow, Diamond, & Serna-Wallender, 2017). Effective approaches to mathematics pathways implementation at the lower division postsecondary level are led by faculty members through a process that the Dana Center Mathematics Pathways (DCMP) describes as an educator-driven, administrator-supported, and policy-enabled approach to systemic and sustainable change (DCMP, 2018). “Cycles of mutual permission-giving” are key to successfully enacting this change at scale by engaging stakeholders across multiple levels of the education ecosystem (Cullinane, 2013). In other words, communities of educators, administrators, and policy actors working together must support and be engaged in enacting mathematics pathways at scale to implement the kind of meaningful and long-lasting change that benefits all students, especially underserved communities.

However, there are various perspectives on the goals and priorities related to strategies for advancing student success and equity (Lubienski & Gutiérrez, 2008). Furthermore, approaches to student success often include a mix of strategies, not all of which are explicitly equity focused. This chapter first describes equity and student success from the perspective of multiple communities, and then provides recommendations based on these perspectives for research, policy, and practice related to the mathematics pathways movement.

Community Perspectives on Equity and Student Success

There is broad consensus that equity and equality are substantively different concepts. This difference involves fairness, as opposed to sameness, and the acknowledgment of disparities when considering strategies for supporting all students’ success and for pursuing social justice (Council of Chief State School Officers [CCSSO], 2018; Gutiérrez, 2012).

Consensus-derived artifacts about equity, diversity, and student success such as position statements, mission and vision statements, strategic plans, and priority initiatives offer insights into the ways in which the communities from which they derive externally communicate their collective perspectives on these issues. The authors studied several artifacts developed by communities of mathematics educators and professionals, administrators, and policy actors—communities whose perspectives are especially relevant to analyses of equity, student success, and mathematics education. Of particular interest were answers to the following questions: How do these communities publicly describe the people, goals, barriers, and solutions in addressing the issues of equity and student success? In other words, they hope to achieve equity and student success for whom, for what purpose, and how?

Not all artifacts reviewed from these communities convey a perspective on equity. Many solely describe commitments to equality, especially of access and outcomes, or solely of diversity. Almost all equity-focused artifacts contain common elements and keywords, including references to all students, fairness, excellence or quality, disparities or gaps, and meaningful or relevant content and learning experiences. In almost all artifacts, words such as “excellent” or “high-quality” describe the type of learning experiences and resources for which

communities advocate (American Association of State Colleges and Universities, 2018; National Association of Mathematicians, 2018). In many of these materials, communities state that the focus of their efforts is on all students and sometimes pair that statement with an emphasis on the types of student groups that they seek to serve, using phrases such as “especially for...” (American Mathematical Association of Two-Year Colleges, 2005). Other artifacts were singularly focused on specific student groups (American Indian Higher Education Consortium [AIHEC], 2012; Association for Women in Mathematics, 2012; Benjamin Banneker Association, Inc. [BBA], 2017; Hispanic Association of Colleges & Universities, 2018). When describing the barriers or problems communities seek to address, most artifacts contain words such as “disparities,” which include references to resources, outcomes, and representation (National Council of Supervisors of Mathematics [NCSM] & TODOS: Mathematics for ALL [TODOS], 2016). Several artifacts emphasize the importance of student access to “relevant” or “meaningful” content and learning experiences (Association of Mathematics Teacher Educators, 2015; CCSSO, 2018).

These artifacts also imply various framings of equity and student success that can be conceptualized as narratives, or perspectives on success for whom, for what purpose, and how. Four perspectives and their associated narratives are presented here in simplified form for the purpose of clarity and discussion: *access*, *outcomes*, *diversity and inclusion*, and *social justice*. Each narrative can be viewed with either an equity or equality lens.

Access

The access-focused artifacts that were reviewed by the authors emphasize all students, but when they focus particular groups, they include low-income students, students of color, English learners, and students with disabilities (CCSSO,

2017). Access goals reference closing opportunity gaps; ensuring equal or equitable (depending on the lens employed) access to quality education, resources, and support; and ensuring that personal and social identifiers are not obstacles to accessing educational opportunities nor predictors of access to resources (CCSSO, 2017; National Conference of State Legislatures, 2018; National Council of Teachers of Mathematics [NCTM], 2014). Barriers to achieving these goals include disparities in opportunities or differential access to high-quality teachers, curriculum and instructional opportunities, and too high expectations for mathematics achievement (NCTM, 2012). A primary solution to address these barriers is to provide all students with the unique supports they need to succeed, including effective instruction and leadership, challenging content, and differentiated funding and supports (Atchison, Diffey, Rafa, & Sarubbi, 2017).

Based on these artifacts, an access narrative might sound like this: *All students, especially underserved student groups or those in underresourced learning environments, deserve access to high-quality inputs and learning opportunities. However, disparities in access and opportunity continue to persist, preventing student success. Prominent solutions include providing equal or differentiated funding and supports that include effective instruction and leadership, challenging content, and differentiated or unique supports necessary to succeed.*

According to Gutiérrez (2012), access refers to “tangible resources,” including teachers and environments, and is reflective of an “opportunity to learn” equity mindset. This framing of access is in keeping with the perspectives described above. Gutiérrez also cautions that “a focus on access is a necessary but insufficient approach to equity, in part because equal access assumes sameness” (p. 19). Notably, as described above, many contemporary artifacts emphasize that access is about providing targeted supports

based on individual need. The artifacts also align with Flores' (2007) research advocating for a reframing of “achievement gaps” in terms of “opportunity gaps” to focus attention on lack of access, rather than “deficit models” that use factors such as culture, poverty, and parental education to explain low performance relative to widely adopted benchmarks.

Outcomes

The outcomes-focused artifacts that were reviewed reference all students, but also emphasize underserved populations, underrepresented students, low-income students, and students of color (American Association of Community Colleges & Association of Community College Trustees, 2016; American Council on Education, 2017; Bennett, 2017; State Higher Education Executive Officers Association [SHEEO], 2017). Outcomes goals focus on educational achievement, including completion of college-level courses, college completion, and post-collegiate outcomes (Bennett, 2017; Kaikkonen, 2017). Barriers emphasize achievement gaps or disparities in educational outcomes and inequities in college readiness (Association of American Colleges & Universities [AAC&U], 2015; SHEEO, 2017). Solutions include programs for nontraditional adult students and targeted, evidence-based intervention strategies, including redesigned mathematics pathways, predictive analytics, and scaling high-impact practices (National Association of System Heads, 2018; SHEEO, 2017).

Based on these artifacts, an outcomes narrative might sound like this: *All students, especially “underprepared” and historically underrepresented and underserved student groups, should be supported to meet or surpass academic achievement and attainment objectives, including college readiness and completion. However, achievement and attainment gaps persist and*

prevent the field from realizing success for all students. Prominent solutions include targeted, evidence-based programs and interventions.

Researchers and other influencers have written extensively about themes related to outcomes or achievement in equity and student success, including the strengths and weaknesses of these narratives. The outcomes perspective is often characterized by its data-driven focus. For example, Schmitz (2015) describes collective impact efforts as focusing on the “technical aspect” of equity, or the use of data to “disaggregate results and work to achieve better outcomes for those who are farther behind.” The Center for Urban Education (2018) identifies four kinds of educational outcomes related to equity: completion, retention, excellence, and access. The use of these four terms in this way is different but related to the use of the terms in community-developed artifacts. Gutiérrez (2012) describes perspectives on student outcomes as a dimension of equity that she refers to as “achievement,” which is measured by “tangible results.” Both Gutiérrez (2012) and Leyva (2017) note that outcomes perspectives often do not overlap with perspectives related to students’ identities. Lubienski and Gutiérrez (2008) discuss the differences between achievement and advancement perspectives, and the tradeoffs involved in adopting either perspective.

Diversity and Inclusion

The reviewed artifacts that focus on diversity and inclusion center on historically underrepresented student groups or minorities, especially in higher education and in STEM disciplines or the mathematical sciences, and underscore the benefits for all students (American Association of Universities [AAU], 2015; Association of Public & Land-Grant Universities [APLU], 2010; Mathematical Association of America [MAA], 2018). Notably, some artifacts that focus specifically on inclusion use the term

marginalized groups, including “people of color, women, people living in poverty, people with disabilities (hidden or otherwise), individuals who identify as LGBTQ+, and individuals who identify as part of a religious minority” (Special Interest Group of the Mathematical Association of America on Research in Undergraduate Mathematics Education [SIGMAA on RUME], 2018). Diversity and inclusion goals include enhancing the diversity of faculty, staff, and students; increasing recruitment, matriculation, and retention; and “making excellence inclusive,” or attending to both demographic diversity and the climates and cultures that support student success (AAC&U, 2013; APLU, 2018; Society for Industrial and Applied Mathematics, 2017).

Barriers to achieving these goals include a lack of representation in senior roles, an unwelcoming atmosphere in postsecondary STEM classes and seminars, bias or low expectations, lack of awareness by students about STEM, and views that excellent education should be exclusive or “reserved for the few” (AAC&U, 2013; Association of Symbolic Logic [ASL], 2018; Society of Actuaries, 2018). Solutions include outreach events (e.g., conferences and workshops); engagement and mentorship programs; awareness-building among students in high schools, colleges, and universities; advising or encouraging students to advance or make continuous progress throughout their academic and professional careers; using race as one of many factors in making individual admissions and hiring decisions; and fostering environments that honor, respect, and embrace diversity (AAU, 2015; American Mathematical Society, 2018; American Statistical Association, 2016; SIGMAA on RUME, 2018; SOA, 2018). In addition, where the potential of students can be attained at the highest level possible, an initiative would focus on recruiting and inviting scholars to fully participate in the community and in leadership, attend to gender imbalance,

and develop opportunities for involvement (ASL, 2018; Denton, 2017; MAA, 2018).

Based on these artifacts, a diversity and inclusion narrative might sound like this: *All students, especially low-performing and historically underrepresented and marginalized student groups, should be proportionally represented and authentically engaged in academic and professional roles and environments, such that students advance in academic and professional pipelines, especially those of high value. However, disparities in representation and inclusion persist. Prominent solutions include the development of mentorship programs, and the fostering of welcoming learning environments and academic and professional cultures.*

Of Gutiérrez’s (2012) dimensions of equity, the goals of the diversity perspective most closely align with “achievement,” involving participation in the math pipeline, especially for underrepresented student groups. However, the focus on authentic engagement in the inclusion perspective aligns more closely with Gutiérrez’s “identity” dimension of equity, which is a response to the danger that some students experience to “play down their personal, cultural, or linguistic capacities in order to participate in the classroom or the math pipeline.” Aguirre, Mayfield-Ingram, and Martin (2013) describe attention to issues of identity as key to teachers’ development of “richer perspectives and practices” (p. 5-6) on issues of equity. Notably, the Center for Urban Education (2018) notes the potential weaknesses of perspectives focused on diversity:

... a diversity lens focuses only on bringing more students into an unequal pathway. In contrast, equity redirects resources to the pathways with greatest need to fix barriers and intentionally provide support. (p. 1)

Social Justice

The reviewed artifacts that focused on social justice reference all students or “American young people,” with an emphasis on groups that have been historically marginalized and underserved in mathematics education and society. A few artifacts centered exclusively on specific student groups, including African American students and students in Tribal Colleges (AIHEC, 2012; BBA, 2017; NCSM & TODOS, 2016). Goals described in social justice artifacts include both those that advocate for a systemic approach—“a just, equitable, and sustainable system of mathematics education for all children” (NCSM & TODOS, 2016, p. 1)—as well as those focused on curriculum—“to facilitate authentic, meaningful relationships between African-American students . . . and those who are responsible for their education” (BBA, 2017, p. 1). The barriers to achieving these goals include deficit views of mathematics ability; disparities in learning opportunities and outcomes in mathematics education based on race, class, culture, language, and gender; and mathematics as gatekeeper, or the use of mathematics as a gatekeeping tool to sort and rank students by race, class, and gender, beginning in elementary school. Solutions offered include acknowledgment that the current mathematics education system is unjust and grounded in a legacy of institutional discrimination based on race, ethnicity, class, and gender; and the creation and sustainment of institutional structures, policies, and practices as part of a systemic plan that leads to just and equitable learning opportunities, experiences, and outcomes for students.

Based on these artifacts, a social justice narrative might sound like this: *All students, especially student groups that have been historically marginalized and underserved in mathematics education and society, deserve to learn in a just, equitable, and sustainable system of mathematics education in which students succeed and critically*

apply knowledge and skills to learning about and addressing social issues. However, deficit views, disparities in mathematics learning opportunities and outcomes, and the use of mathematics as a gatekeeping tool persist and prevent the achievement of this goal. To overcome these barriers, advocates recommend acknowledging the injustices of the current system and taking action at multiple levels of the system to create and sustain institutional structures, policies, and practices that lead to just and equitable learning opportunities, experiences, and outcomes for all students.

For those social justice advocates focused on curriculum, this perspective aligns closely with Gutiérrez’s (2012) description of the Identity dimension of equity in which students have opportunities to see themselves in the curriculum and have a view of a broader world. However, to several researchers and advocates, this perspective is primarily about power or empowerment. Gutiérrez describes the “power” dimension of equity as taking up issues of social transformation at many levels, including using mathematics as an analytical tool to critique society. In 2016, the National Council of Teachers of Mathematics (NCTM) endorsed a joint position statement on social justice with the mathematics professional associations National Council of Supervisors of Mathematics and TODOS: Mathematics for ALL. One of the ways in which NCTM is acting upon this endorsement is by embracing the concept of empowerment in its guidance for teachers and including topics of student identity, agency, and teaching mathematics for social justice (Larson, 2016).

Discussion and Recommendations

This chapter provides a framework for examining commonly raised questions about equity and mathematics pathways while viewing mathematics pathways through an equity lens. The first part of the chapter adjusts readers’

vision to align with equity lenses, or various perspectives on the definitions of equity in mathematics education and related goals. Based on equity implications of these perspectives, the chapter concludes with recommendations for stakeholders at multiple system levels who are engaged with or considering engagement with the mathematics pathways approach to student success.

The artifacts described in this chapter represent the product of negotiated consensus of the mathematics, administrator, and policy communities, more so than research and commentary by any single thought leader or other representative. As described earlier, effective implementation of mathematics pathways at scale depends on these communities negotiating and forming a collective vision and plan for student success.

Multiple approaches are represented in each community's artifacts. Indeed, multiple approaches are often used by the same organization—frequently in the same artifact. Given the complexities of student success, it is reasonable and likely preferable that organizations adopt multiple approaches to form a multidimensional student success strategy.

The recommendations in this section are based on the findings from a review of these artifacts.

1. Identify dimensions of equity and aligned metrics.

When stakeholders representing multiple communities come together, it is critical that their discussions are informed by data and evidence. However, currently available reports tend to focus on access and attainment. Although these data are important, they do not provide enough information to fully evaluate progress for those whose equity and student success goals are aligned with diversity and inclusion or social justice perspectives. At the same

time, the four perspectives described in this chapter are not distinct enough to support the identification of aligned metrics. Researchers should identify valid and reliable metrics aligned with multiple distinct dimensions of equity expressed by the mathematics, administrator, and policy communities. For example, these dimensions might include access, attainment, advancement, authentic engagement, and empowerment. Once developed, practitioners and policymakers should utilize metrics that are aligned with multiple dimensions of equity when evaluating the progress of mathematics pathways approaches.

2. Consider equity implications for planning and action from multiple perspectives.

Practitioners should use multiple perspectives to consider the equity implications of mathematics pathways approaches when planning for implementation and continuous improvement. Policymakers should consider and address the potential tradeoffs and unintended consequences of narrowly attending to particular dimensions of equity, outside of or disconnected from a comprehensive strategy for equity and student success.

3. Support stakeholders in considering multiple perspectives.

Stakeholders should strive to engage in open conversations to address questions about equity and mathematics pathways that reflect various priorities and perspectives. For example, concerns about tracking have frequently come up in discussions with practitioners (Boaler, 2011; Burris, Welner, Wiley, & Murphy, 2008; Stiff, Johnson, & Akos, 2011). These concerns are often rooted in a desire to ensure that students from underserved communities are able to enter into and persist in particular “pipelines” (e.g., STEM) to upward mobility. To engage in this discussion,

stakeholders would need data related to access, attainment, and advancement dimensions of equity. With data and guidance to facilitate conversations among those with diverse perspectives, stakeholders at multiple levels of the system would be better equipped to develop effective and long-lasting solutions.

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