

PREFACE

BROADENING THE CRITICAL CONVERSATIONS

Catalyzing Change in Middle School Mathematics: Initiating Critical Conversations is part of the Catalyzing Change Series, a collection of three books intended to initiate the critical conversations on policies, practices, and issues impacting mathematics education. In 2018, the first book in the series, *Catalyzing Change in High School Mathematics: Initiating Critical Conversations*, was published and provided the framework to engage stakeholders in initiating critical conversations for transforming high school mathematics education to ensure that every student has the mathematical experiences necessary for personal and professional success. The conversations and work from *Catalyzing Change in High School Mathematics* suggested that there was a need to broaden the critical conversations to include early childhood, elementary, and middle school mathematics. There appeared to be widespread agreement that the recommendations in *Catalyzing Change in High School Mathematics* had implications for early childhood, elementary, and middle school mathematics education. For example, the recommendation for a common shared pathway in high school must take into consideration the mathematics experiences at the other levels. That is, it is essential to consider what must happen in elementary and middle schools for a common shared pathway to become a reality in high school.

Several organizations have contributed to the conversation and have pushed for changes in policies in mathematics education. These conversations have focused on examining the purpose of school mathematics, policies on the tracking of teachers and students, support for equitable teaching practices, and policies impacting students' access to mathematics pathways to prepare them for future endeavors. Just Equations, a project of the Opportunity Institute, contributed to the conversation in two reports: *The Mathematics of Opportunity* (2018) and *Branching Out: Designing High School Math Pathways for Equity* (2019). *The Mathematics of Opportunity* report focused on four interconnected dimensions: (1) content students should know for their future endeavors; (2) instruction that employs equitable instructional practices; (3) assessment and unpacking the impact of high-stakes assessments; and (4) readiness and structures that focus on mathematics pathways. *Branching Out: Designing High School Math Pathways for Equity* argues for mathematics pathways that not only prepare students for postsecondary opportunities in science, technology, engineering, and mathematics but also mathematics pathways that prepare students for opportunities in journalism, politics, education, law, music, and areas

that align with students' interests. These reports align with the recommendations from *Catalyzing Change in High School Mathematics*.

While the Just Equations' reports focused on high school, TNTP's *The Opportunity Myth* (2018) reported on data from elementary grades through high school and found that differences in exposure to mathematics content and high-quality mathematics teaching lead to different mathematical learning experiences. Students who are marginalized (students of color, those from low-income families, emergent bilinguals, and students with disabilities) are less likely to spend an optimal amount of time engaged in mathematical reasoning and sense making. *Checking In* (2015), a report from the Education Trust, found that roughly three-fourths of mathematics assignments given to middle school students have low cognitive demand, overemphasize procedural skills and fluency without understanding, and provide little opportunity for students to communicate their mathematical thinking. This tendency was worse in schools with higher poverty levels.

Much has been learned from the work and conversations initiated by *Catalyzing Change in High School Mathematics* and other reports. The high school recommendations are not exclusive to high school; rather, they overlap with other grade bands in significant ways. This overlap led to thinking about how the recommendations for high school have implications for early childhood, elementary, and middle school mathematics. Several questions arose:

- How is the purpose of early childhood, elementary, and middle school mathematics similar and different from that of high school mathematics?
- How are equitable structures across early childhood, elementary, middle school, and high school mathematics similar and different?
- How are the needs of young children, elementary-age children, young adolescents, and high school-age students different for equitable teaching practices supportive of building positive mathematical identity and a strong sense of agency?
- How does a common shared mathematics pathway across early childhood, elementary, and middle school education support a common shared pathway focused on the essential concepts in high school?

Catalyzing Change in Middle School Mathematics: Initiating Critical Conversations recognizes that the needs of young adolescents are different from elementary- and high school-age students and that policies, practices, and issues must consider the unique needs of middle school-age students. Students undergo significant developmental changes from elementary school to middle school. These changes contribute to how they see and understand the world, as well as how they see and understand their place in the world. The middle school learning environment must be

responsive to developmental changes that middle school students experience and be respectful of their needs and interests. Consequently, middle school mathematics should not only be rigorous and challenging but responsive to each and every student's background, experiences, cultural perspectives, traditions, and knowledge. Students should investigate mathematics within contexts that are interesting and relevant to them, such as those related to the arts, health and nutrition, humanitarianism, history, social concerns, politics, finances, career, technology, the environment, scientific inquiry, entertainment, sports, and play, which can serve as compelling and challenging catalysts for learning. Meaningful contexts provide opportunities for middle school students to apply important mathematical ideas to make sense of everyday life, and students should have ample opportunities to engage in mathematics through relevant contexts.

The 2018 National Survey of Science and Mathematics Education (NSSME+; Banilower et al.) report by Horizon Research suggests that many mathematics teachers believe that mathematics teaching and learning should be consistent with some of the practices highlighted in NCTM's Mathematics Teaching Framework (Smith, Steele, and Raith 2017), which supports developing positive mathematical identities as well as implementing equitable instructional practices. At least 85 percent of all teachers believed that (1) teachers should ask students to justify their mathematical thinking, (2) students should learn mathematics by doing mathematics, (3) most class periods should provide students opportunities to share their thinking and reasoning, and (4) students learn best when instruction is connected to their everyday lives. These findings suggest that student discourse (justifying, sharing thinking, and reasoning), using representations by doing mathematics, and making mathematics relevant to students' lives are significant practices for mathematics teaching and learning.

Grouping students by similar abilities is a serious challenge that needs critical conversations. The NSSME+ survey reported that 66 percent of middle school teachers either strongly agree or agree "Students learn mathematics best in classes with students of similar abilities." Grouping students by abilities for instruction in mathematics segregates students of different backgrounds into separate experiences on pathways leading to different outcomes. Too often, marginalized students are segregated into groups in which they are routinely exposed to instruction that is focused primarily on rote skills and procedures that do not stretch students' higher-order thinking and that gives limited attention to developing their conceptual understanding. Other students are sequestered into groups who experience mathematics according to the the four beliefs (e.g., focus on mathematical justification, doing, reasoning, and connections) described above. The four beliefs in the preceding paragraph and the belief in grouping students by similar abilities are contradictory and call for a much needed critical conversation.

The key recommendations for *Catalyzing Change in Middle School Mathematics* continue the conversations initiated in *Catalyzing Change in High School Mathematics*. Similar to high school, critical conversations in middle school should center on the following serious challenges:

- Broadening the purpose of school mathematics focused on the development of positive mathematical identities so that students can make purposeful decisions about their future endeavors
- Dismantling structural obstacles that stand in the way of mathematics working for each and every student
- Implementing equitable instructional practices to cultivate students' positive mathematical identities and strong sense of agency
- Organizing middle school mathematics along a common shared pathway grounded in the use of mathematical practices and processes to coherently develop deep mathematical understanding

The Catalyzing Change Series is part of an ongoing long-term collaborative process among stakeholders interested in making sure that each and every student has access to high-quality mathematics teaching and learning. NCTM will continue to support collaborative efforts through professional learning opportunities and additional publications that will provide vignettes and further examples to clarify and illustrate the recommendations put forward in the Catalyzing Change Series. The Catalyzing Change Series is intended to support dialogues on how best to support learners from early childhood through high school. This is critical work, and we invite all stakeholders to undertake the endeavor. There appears to be widespread agreement that the need for change in school mathematics is urgent. We can no longer afford to allow school mathematics to advantage the privileged few while disadvantaging and underserving a significant portion of learners. We must engage in the necessary critical work to nurture a democratic society where all can use, know, and understand mathematics to comprehend and critique the world through mathematics and to experience its wonder, joy, and beauty.

Robert Q. Berry, III
President 2018–2020
National Council of Teachers of Mathematics