

NCTM's *Catalyzing Change
in High School Mathematics:*
Our Role in the

MID

In April 2018, NCTM released *Catalyzing Change in High School Mathematics: Initiating Critical Conversations*, a long-needed and well-articulated position for transforming the core purposes, structures, instructional practices, essential mathematics concepts, and organization of high school mathematics. Although *Catalyzing Change* intentionally targets high school mathematics, those of us focused on middle school should also become well informed. The key

The success of *Catalyzing Change* is contingent on the preparation and experiences that students bring with them to high school—which is the role of middle schools. We have the shared responsibility of providing an equitable mathematics education for each and every student.

DILE

Sarah B. Bush

recommendations in *Catalyzing Change* hold true and permeate middle school mathematics. Without systemic change within middle schools and in the articulation between middle school and high school, efforts to implement the key recommendations of *Catalyzing Change* will be disparate and extremely challenging to accomplish. Simply said, it is our job in the middle to work alongside our high school counterparts to do our part in dismantling the status quo.

Essentially, we must prepare middle school students to enter *Catalyzing Change's* reimagined vision for high school mathematics rather than the experience many students have today.

Let's dive into the four key recommendations of *Catalyzing Change* and consider our role as middle school mathematics educators and stakeholders: (1) Move toward de-tracking students, (2) de-track teachers immediately, (3) consider the student learning experience, and (4) create common learning experiences.

4 KEY RECOMMENDATIONS

Move Toward De-Tracking Students

The first recommendation of *Catalyzing Change* for us to consider in the middle is the de-tracking of students in mathematics. *Catalyzing Change* makes a strong recommendation that students should complete four years of mathematics in high school. It also advocates for a shared common pathway for all students in high school for the first two or three years. Then, a student's final one or two years of high school mathematics learning is based on a college and/or career path and interests. For this reason, it is important for us to examine de-tracking students in the middle.

Student tracking has been well researched. Some key issues include the following:

- Students are often placed into different tracks by various non-academic factors including but not limited to race, gender, socioeconomic status, language, and perceived academic ability (Stiff and Johnson 2011).
- The learning opportunities in different tracks can be substantially different. This qualitative difference is a systemic issue because it perpetuates the idea that only some people can be successful in mathematics and is an issue of equity

because only some students have access to mathematics instruction that prepares them for college (Boaler 2011).

- Students placed in tracks that have less access to high-quality mathematics instruction have a fundamentally different learning experience than those students not placed in such tracks (Stiff and Johnson 2011; Tate and Anderson 2002).

There is clear evidence that de-tracking students leads to the success of more students (Boaler and Staples 2014; Burris and Welner 2005). We can all agree that students should not be denied access to the instruction needed to become mathematically literate and that students should not have qualitatively different mathematics learning experiences.

Middle schools play a foundational role in student tracking. The course pathway (or track) that a student takes is often decided when a student enters middle school. In essence, a student's perceived mathematical ability in grade 5 may very well determine the highest mathematics class taken in grade 12, if a class is taken at all. A student's mathematical fate should not be determined at age ten. The course pathways that a high school offers are most often a continuation of the course pathways of its feeder middle schools. Although de-tracking might seem like an impossible feat, *Catalyzing Change* offers evidence of it being done successfully (NCTM 2018, pp. 18–19). In the middle, we must find a way to rebuild our structures to dismantle tracking and instead implement effective intentional and targeted interventions for students who need additional support. Further, there is no race to calculus, and schools should not succumb to perceived parental or district pressure to accelerate. In the limited cases in

which acceleration is warranted, it should be done appropriately. In other words, "care must be taken to ensure that opportunities are available to each and every prepared student and that no critical concepts are rushed or skipped" (NCTM 2016, p. 1).

De-track Teachers Immediately

Just as with students, teachers too are often tracked. *Catalyzing Change* brings to the forefront the long-standing practice of more experienced teachers, or teachers seen as the most effective, being assigned to teach the upper-level mathematics courses, whereas teachers with the least experience are assigned to teach the lower-level courses or to those students who have the greatest need (Darling-Hammond 2007; Strutchens, Quander, and Gutiérrez 2011). Let's face it, as middle school educators, we know that this is not just a phenomenon that takes place in high schools; it happens in our backyard as well.

We must play our role in ensuring that each and every student has equitable access to the most effective and experienced teachers. As recommended in *Catalyzing Change*, middle schools should also balance teacher assignments to include a variety of courses. An alternate way to de-track teachers is to create teacher teams for common teaching and assessment development and analysis, or change teacher assignments every two or three years. In addition to creating equitable structures for students, balancing teacher course assignments can help to broaden their vertical knowledge of curriculum, reduce new teacher burnout, foster collaborative learning communities that include experienced teachers, and in that learning community create a shared sense of responsibility for all students (Gutiérrez 2002; Strutchens, Quander, and Gutiérrez 2011).

Consider the Student Learning Experience

One critique of the current landscape of high school mathematics outlined by *Catalyzing Change* is that students do not see the relevance of the curriculum and thus become disengaged. As high schools work toward making the progress set forth in the recommendations of *Catalyzing Change*, what we see taking place in the high school mathematics classroom will transform. High-quality tasks will take priority over quantity of problems as students become active participants in “doing” mathematics (Stein et al. 2000). In the middle, we must prepare students for this type of engaged, active learning. As described in *Catalyzing Change*, the kinds of tasks in which students engage impact the ways they see themselves as doers of mathematics and this connects to their mathematical identity.

As a mathematics education community, we can accomplish this by effectively enacting the eight high-leverage Mathematics Teaching Practices advocated by *Principles to Actions: Ensuring Mathematical Success for All* (NCTM 2014, p. 10):

1. Establish mathematics goals to focus learning.
2. Implement tasks that promote reasoning and problem solving.
3. Use and connect mathematical representations.
4. Facilitate meaningful mathematical discourse.
5. Pose purposeful questions.
6. Build procedural fluency from conceptual understanding.
7. Support productive struggle in learning mathematics.
8. Elicit and use evidence of student thinking.

Following the eight Mathematics Teaching Practices sets the stage

Fig. 1 This excerpt from *Catalyzing Change* illustrates supporting equitable mathematics teaching (NCTM 2018, pp. 32–34).

Mathematics Teaching Practices: Supporting Equitable Mathematics Teaching	
Mathematics Teaching Practices	Equitable Teaching
Establish mathematics goals to focus learning. Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions.	• Establish learning progressions that build students’ mathematical understanding, increase their confidence, and support their mathematical identities as doers of mathematics. • Establish high expectations to ensure that each and every student has the opportunity to meet the mathematical goals. • Establish classroom norms for participation that position each and every student as a competent mathematics thinker. • Establish classroom environments that promote learning mathematics as just, equitable, and inclusive.

for equitable teaching. *Catalyzing Change* provides a valuable crosswalk resource between the Mathematics Teaching Practices and Equitable Teaching (see pp. 32–34). **Figure 1** showcases an example directly from *Catalyzing Change* (p. 32) for “Establish mathematics goals to focus learning.” Supporting equitable teaching through the eight Mathematics Teaching Practices supports building the positive identity and agency that we must equip our students with as they enter a high school mathematics experience.

Create Common Learning Experiences

Catalyzing Change provides specific recommendations regarding the Essential Concepts in mathematics that each and every high school student should learn. These Essential Concepts span four key content domains: number, algebra and functions, statistics and probability, and geometry and measurement. The Essential Concepts are purposefully focused on the key mathematics that students need to be productive in both their professional and personal lives. Tasks are set in such important contexts as sustainability of resources and financial literacy, providing students

with authentic learning environments where they can apply important mathematical ideas to make sense of their world. Through this process, they are becoming mathematically literate as well as STEM literate (as in Bybee 2010).

In the middle, we can do our part to help with this recommendation by reading *Catalyzing Change* and carefully considering how the Essential Concepts in *Catalyzing Change* build from foundational knowledge that students develop in the middle grades. For example, we should discuss how students’ proportional reasoning should be developed in the middle grades to prepare students with the prerequisite knowledge needed to learn the Essential Concepts in *Catalyzing Change*. More holistically, we should take a closer look at how teaching and learning is approached in the middle grades and the types of experiences that we are giving students. We should engage students in authentic learning contexts (Mohr-Schroeder, Bush, and Jackson 2018), so that students are experienced, prior to high school, in applying and transferring the mathematics they learn to solve real problems. Schools should also

adopt a “Whole School Agreement” (as in Karp, Bush, and Dougherty 2016) in which mathematics teachers in a school work as a team to agree on common language, symbols and notation, models and schema, as well as no longer teach rules that will later expire (as in Karp, Bush, and Dougherty 2015). This practice leads to both vertical and horizontal articulation.

CALL TO ACTION

The success of the recommendations set forth in *Catalyzing Change* is contingent on the preparation and experiences that students bring with them to high school, which is the role of middle schools. If students do not receive equitable opportunities to take challenging coursework from highly qualified teachers and experience rigorous yet supportive expectations prior to high school, the success in implementing *Catalyzing Change* will be limited. Let’s be clear: It’s time to join forces by working as effective teams within schools and across grade bands. We have the shared responsibility of providing an equitable mathematics education for each and every student.

REFERENCES

- Boaler, Jo. 2011. “Changing Students’ Lives through the De-Tracking of Urban Mathematics Classrooms.” *Journal of Urban Mathematics Education* 4, no. 1 (July): 7–14.
- Boaler, Jo, and Megan E. Staples. 2014. “Creating Mathematical Futures through an Equitable Teaching Approach: The Case of Railside School.” In *Mathematics for Equity: A Framework for Successful Practice*, edited by Na’ilah Suad Nasir, Carlos Cabana, Barbara Shreve, Estelle Woodbury, and Nicole Louie, pp. 11–34. New York: Teachers College Press.
- Burris, Carol Corbett, and Kevin G. Welner. 2005. “Closing the Achievement Gap by Detracking.” *Phi Delta Kappan* 86, no. 8 (April): 594–98.
- Bybee, Roger W. 2010. “Advancing STEM Education: A 2020 Vision.” *Technology and Engineering Teacher* 70, no. 1 (2010): 30–35.
- Darling-Hammond, Linda. 2007. “The Flat Earth and Education: How America’s Commitment to Equity Will Determine Our Future.” *Educational Researcher* 36, no. 6 (August): 318–34.
- Gutiérrez, Rochelle. 2002. “Beyond Essentialism: The Complexity of Language in Teaching Mathematics to Latina/o Students.” *American Educational Research Journal* 39, no. 4 (Winter): 1047–88.
- Karp, Karen S., Sarah B. Bush, and Barbara J. Dougherty. 2015. “12 Math Rules That Expire in the Middle Grades.” *Mathematics Teaching in the Middle School* 21, no. 4 (November): 208–15.
- . 2016. “Establishing a Mathematics Whole-School Agreement.” *Mathematics Teaching in the Middle School* 23, no. 2 (September): 61–63.
- Mohr-Schroeder, Margaret, Sarah B. Bush, and Christa Jackson. 2018. “K12 STEM Education: Why Does It Matter and Where Are We Now?” *Teachers College Record* (February 26). <http://www.tcrecord.org>. ID no. 22288. Accessed March 3, 2018.
- National Council of Teachers of Mathematics (NCTM). 2014. *Principles to Actions: Ensuring Mathematical Success for All*. Reston, VA: NCTM.
- . 2016. *Providing Opportunities for Students with Exceptional Promise*. NCTM Position Statement. Reston, VA: NCTM. <http://www.nctm.org/Standards-and-Positions/Position-Statements/Providing-Opportunities-for-Students-with-Exceptional-Promise/>
- . 2018. *Catalyzing Change in High School Mathematics: Initiating Critical Conversations*. Reston, VA: NCTM.
- Stein, Mary Kay, Margaret Schwan Smith, Marjorie A. Henningsen, and Edward A. Silver. 2000. *Implementing Standards-Based Mathematics Instruction: A Casebook for Professional Development*. New York: Teachers College Press.
- Stiff, Lee V., and Janet L. Johnson. 2011. “Mathematical Reasoning and Sense Making Begins with the Opportunity to Learn.” In *Focus in High School Mathematics: Fostering Reasoning and Sense Making for All Students*, edited by Marilyn E. Strutchens and Judith R. Quander, pp. 85–100. Reston, VA: National Council of Teachers of Mathematics.
- Strutchens, Marilyn E., Judith R. Quander, and Rochelle Gutiérrez. 2011. “Mathematics Learning Communities That Foster Reasoning and Sense Making for All High School Students.” In *Focus in High School Mathematics: Fostering Reasoning and Sense Making for All Students*, edited by Marilyn E. Strutchens and Judith R. Quander, pp. 101–13. Reston, VA: National Council of Teachers of Mathematics.
- Tate, William F., and Celia Rousseau Anderson. 2002. “Access and Opportunity: The Political and Social Context of Mathematics Education.” In *Handbook of International Research in Mathematics Education*, edited by Lyn D. English and David Kirshner, pp. 271–300. Mahwah, NJ: Lawrence Erlbaum Associates.



Sarah B. Bush,
Sarah.Bush@ucf.edu, is an associate professor of K–12 STEM Education at the University of Central

Florida in Orlando. She served as Program Chair for the 2017 NCTM Annual Meeting in San Antonio, Texas. Her current work focuses on deepening student and teacher understanding of mathematics through STEAM problem-based inquiry and teacher professional development effectiveness.