

How Belonging and Productive Struggle Can Motivate Students in Math

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While parts of the education system have incorporated tailored methods to keep students engaged, mathematics is often still taught in traditional, non-differentiated ways. For example, many math lessons focus on teaching the one correct path to reach the one right answer to a problem. Memorizing formulas and drilling in the “proper” approach through repetition too often take precedence over conceptual understanding and experiencing multiple strategies, both of which are important according to research.

In school systems where a one-size-fits-all approach continues to be the norm, it’s no wonder many students are turned off by math and begin to believe, “I’m just not a math person.” In addition, being the “only” in higher level math classes—the only girl in advanced algebra, the only black or brown boy in AP calculus—can also limit students’ ability to perform to their full potential. [Stereotype threat](#) can affect performance on tests and lead to a sinking feeling that they do not belong in that math class.

A growing body of research has revealed the diversity of student strengths and challenges and a wide variety of pathways there are to effective learning. Given the latest evidence, it is increasingly clear that a cookie-cutter approach to education does

not regularly engage many students and leaves behind far too many disconnected learners.

Incorporate Productive Struggle and a Sense of Belonging to Improve Math Learning

How can educators transform their approach and teach math in a way that effectively addresses learner variability? In recent edWeb webinars, Digital Promise's Learner Variability Project explored two important strategies for helping every student meet high expectations in math: enabling productive struggle and creating a sense of belonging. Both of these approaches allow students to actively participate in math learning and feel more connected to math.

Productive Struggle

Productive struggle focuses on the math journey instead of simply the destination. It recognizes that there are multiple ways to tackle a problem and views mistakes as opportunities for learning rather than failures. It encourages students to actively experiment and to participate in discussions about how to approach problems. All of this creates space for students to find the approaches that are most effective for them and engage in active learning.

Hear from Dr. Gerardo Ramirez on How to Help Students Build Positive Mindsets Around Math.

During our webinar on productive struggle, middle school math teacher and former National Council for Teachers of Mathematics (NCTM) board member Kevin Dykema explained his philosophy on the topic: "The thinking goes, if you were good at memorizing, you'd be good at math. And if not, you were told to work harder, pay more attention, do your homework." Instead, he proposes we empower students to truly understand math, instead of simply becoming "rule memorizers." To get there, Dykema said, "Students will be required to struggle, and I'll need to help them discover how to struggle productively."

Dykema shared several strategies that he has successfully used to help students become "schoolhouse" mathematicians, including error analysis, math talks, and worked examples. Our own expert advisors for Digital Promise's Learner Variability Project suggest that these and similar strategies can effectively motivate students to productively struggle in math and gain a deeper understanding of the concepts.

“At its core, mathematics is problem solving, and solving problems involves uncertainty and struggle at times,” said Dr. Bethany Rittle-Johnson, Anita S. and Antonio M. Gotto Chair in Child Development and professor of psychology and human development at Peabody College, Vanderbilt University. “Students need to search for appropriate solution strategies and flexibly choose among multiple strategies for solving a particular problem.” She added that “having students compare and discuss multiple strategies with their peers is one effective form of productive struggle, which leads to greater flexibility and understanding.”

Belonging

How can we make students feel like they belong in the math classroom? Dr. Jamaal Matthews, a former math teacher turned researcher and professor at Montclair State University, recommends that teachers elicit information from their students on the “4 Hs” to build student-centered instruction: home, hobbies, hopes, and heritage. By personalizing learning to incorporate these four elements of students’ lives, teachers can help students feel like they are just as much a “math person” as anyone else.

During [our webinar](#) on belonging, Dr. Matthews discussed the importance of expanding how we think about creating a sense of belonging in the classroom. Many teachers have been trained to think of belonging as only a product of classroom culture and student social relationships, that ultimately students have to learn to negotiate and navigate. However, Dr. Matthews’s research highlights how belonging extends to the instructional choices and curricula used by teachers, a theme that often comes up in research on culturally responsive pedagogy. What you teach and how you teach it plays a strong role in whether students feel like they belong, particularly in math classrooms.

“Teachers may understand the importance of belonging for building positive relationships with students or comfortable class communities,” explained Dr. Matthews. “However, many may not recognize the power they have to promote belonging through instructional choices, what we call belonging-centered instruction, which gives students the opportunity to see themselves reflected in the content they are learning.”

When students don’t feel a sense of belonging, this may create opportunities for disengagement from the material or even for them to “act out” in class. Many webinar participants shared that they had not previously considered the connection between

belonging and behavioral issues, motivation, and engagement. As one webinar participant wrote, quoting Dr. Matthews: “Disruptive, distracted, or disengaged behaviors can be indicators of lack of belonging not just behavior problems. A-ha!”

Tips for Promoting Math Engagement

Productive struggle and belonging represent two factors, supported by research, that help students more actively engage in math learning by teaching to the whole child. Both approaches emphasize the importance of context and communication. As students participate in productive struggle, they have opportunities to discuss and analyze what they're doing and identify the approaches that work best for them. It's also important that they are presented with content that speaks to their identities and cultural contexts and makes them feel like they belong in the math classroom.

Dykema and Matthews concur that establishing authentic relationships with their students is an essential first step for educators and both take the time to get to know and understand their students. Matthews studies the use of math interest interviews to help personalize the math experience. These interviews ask learners to consider how math plays out in their family, hobbies, entertainment, workplace, and daily lives. Teachers can use these insights to create belonging-centered curricula and instructional strategies, such as word problems that relate math to students' lives outside the classroom. This strategy may be useful for any student, but particularly students of color, who may not see themselves represented in that specific class or even the school.

“Both ‘productive struggle’ and ‘belonging’ urge us to go beyond sugar-coating or watering down math to make it more palatable to students,” says Dr. Jeremy Roschelle, executive director of learning sciences research at Digital Promise. “The real rewards of mathematics are connected to feelings of insight and power that are achieved through working hard at a challenge; further, by sincerely caring about and respecting what each student uniquely brings to a challenge (and not just right or wrong answers), we can cultivate their mathematical identity.”

Explore these topics and strategies in the Learner Variability Project's Navigator web app by clicking on Models and selecting a grade range. You can also learn more about learner variability as a part of Powerful Learning experiences.