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Math for Every Student

Cultivating Math Mindsets in Middle School

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Summary

Students in the United States often struggle with math. After repeated negative experiences, too many come to believe they are "not a math person" and withdraw from math learning. This problem predated COVID-19, although the acute impacts and lingering effects of school closures have made the need for change impossible to ignore. Research converges on a clear finding: Classroom learning environments strongly influence student math outcomes, particularly for students of color and those from low-income families. Instructional quality matters greatly, but evidence also shows that students' classroom relationships, sense of belonging, and mindset toward learning shape their math outcomes. Drawing on case studies of 10 middle school math teachers across five California schools, this brief illustrates how teachers cultivated these research-aligned conditions for learning in their math classrooms. It also identifies implications for teachers and the instructional coaches and leaders who support them. Together, these findings offer practical guidance for creating math classrooms where each and every student has a greater opportunity to succeed.

The report on which this brief is based can be found here.

Introduction

Students in the United States often struggle with math. The United States has long lagged behind international peers in math achievement, falling well below the international average score on the Programme for International Student Assessment (PISA). Racial and socioeconomic achievement gaps are long-standing and persistent, as are the systemic issues that contribute to them. Furthermore, a 2024 nationwide survey found that nearly half of students report losing interest or being disengaged in their math classes most of the time and nearly a third do not identify as a "math person."

What teachers do in their classrooms makes a meaningful difference in students' math engagement and achievement. Classroom conditions matter for all students during the middle school years and especially for students from historically marginalized groups. Middle school is a time when students' general school motivation and math engagement can sharply decline.

This brief describes the important classroom conditions that can support middle grade students' engagement with math and then documents how 10 math teachers in five California middle schools promoted these positive conditions in their classrooms. Building from these findings, we offer concrete, evidence-grounded insights for practitioners, specifically teachers and the math instructional coaches and instructional leaders who support their professional practice.

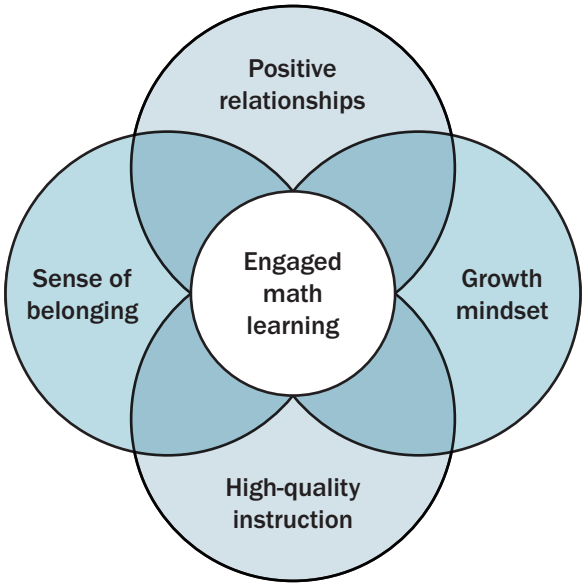
Conditions That Enable Math Learning

Evidence suggests there are interrelated conditions that support students' engagement with and success in math (see Figure 1). Students best learn math when teachers:

- foster positive relationships,
- develop students' sense of belonging,
- encourage a growth mindset, and
- deliver high-quality instruction.

These positive conditions show promise for helping all students achieve their full potential in math, likely because they attune the learning environment to students' developmental needs for safety, secure relationships, and affirming and purposeful environments. Research shows that all students benefit from these conditions, especially groups historically marginalized from math education (e.g., female students, students of color, students from low-income families, and English learners). These conditions are not merely "nice to have" in the classroom—they are central for full engagement in learning math.

Figure 1. Classroom Conditions That Support Students' Math Learning



Source: Learning Policy Institute. (2025).

Table 1. Typical Daily Math Lesson in Observed Classrooms: Emphasizing Student Engagement

Warm-up with whole class	
Goal	Review prior learnings while building connections between students.
Structure	Question projected on the board that, in most cases, offers multiple points of entry for differently skilled students and does not have a single correct answer. Students first share with their "elbow neighbor" and then discuss as a whole class. Low stakes with no grade.
Teacher	Facilitates whole-class learning together; synthesizes student inputs.
Student	Contributes to whole-class share-out.
Direct instruction mini-lesson to whole class	
Goal	Conceptually introduce new mathematical content, engaging students' prior mathematical knowledge and learnings.
Structure	Teacher talks through and writes out new content at the front of the class with some student input in solving example problems.
Teacher	Holds information. Delivers information. Elicits select student contributions.
Student	Receives information at desk, with some students targeted by teacher to contribute.
Activity in small groups	
Goal	Students collaboratively apply the new information to solve problems.
Structure	Standing lab stations with whiteboards posted around the classroom walls. Random assignment to groups; not ability-based grouping. Socially engages students.
Teacher	Circulates among groups and provides individual support to groups. As needed, teacher pauses group work and huddles all students to address common misunderstandings.
Student	Contributes to group work. Collaborates on procedural and conceptual thinking and approaches to solve increasingly complex math practice problems.
Share-out from groups	
Goal	Celebrate multiple ways to represent and solve math problems. Identify underlying mathematical patterns and demonstrate how diverse approaches reach the same answer.
Structure	Sitting at their desks, group members share out the approaches they used to solve the practice problems.
Teacher	Coordinates which groups share out to highlight interesting or instructionally productive approaches and bolster mathematical self-efficacy of students.
Student	Verbally or visually shares group thinking and logic with the whole class.
Note-taking with deskmates	
Goal	Translate the day's lesson into the students' own words.
Structure	Sitting at their desks, students share and work with their deskmates to write notes in their own words about the procedures they learned that day.
Teacher	Reviews the steps involved in procedures as needed. Circulates to review individual students' understanding.
Student	Interprets the day's lesson into their own words for later reference and review.
Demonstration of understanding as individuals	
Goal	Gauge variation in students' understanding and level of mastery of the new concept.
Structure	As individuals, students solve one to three problems on paper or electronically. Low stakes with no grade.
Teacher	Reviews the formative math skills development of each student to understand common misunderstandings and individual challenges.
Student	Practices their group learnings as an individual student.

Source: Learning Policy Institute analysis of classroom observations. (2025).

Teachers' practices illustrate how these conditions both come to life in math classrooms and how they mutually reinforce each other. Relationship building establishes the safety students need to take intellectual risks. Creating a sense of belonging activates more authentic engagement. Growth-mindset messaging makes prolonged efforts stimulating rather than threatening. And high-quality instruction helps students reach their potential as math learners.

Table 1 above provides a composite sketch of how teachers in this study organized their class periods to cultivate these conditions in their daily lessons. While the structure of the period may be familiar, the activities within the period illustrate how teachers integrated the four classroom conditions to enhance the learning experience.

Foster Positive Relationships

What the Research Says

Decades of studies affirm that classroom relationships matter for student learning. Students who report warm, trusting relationships with their math teachers show higher achievement, greater classroom engagement, more enjoyment of math, and stronger self-efficacy. Positive relationships with peers also matter: When students feel physically and emotionally safe, they can direct their energy toward learning rather than self-protection.

What Teachers Do

Teachers maintain a steady, positive tone and affect with their students. Across all observed classrooms, teachers sustained a warm and even tone regardless of circumstances. When groups wandered off task or misbehaviors occurred, redirection was calm and matter-of-fact. This consistency established the teacher as a predictable and safe adult to engage with.

Teachers are sensitive to each individual student's emotional orientation toward math. Teachers in our study understood that many students arrived in middle school carrying residual stress from prior negative math experiences. With the goal of counteracting these experiences, teachers aimed to establish the classroom as a nonthreatening space, where students could trust that they would be safe from ridicule and shame. Common practices included:

- using warm-up activities that have no single correct answer (e.g., "Which One Doesn't Belong?") to make participation feel safe for everyone;
- protecting less-confident students from cold calling and strategically selecting them to respond to questions in moments when teachers believed their success was likely; and
- incorporating music, humor, and brain breaks to lower stress responses in the classroom.

Teachers attend to students' interests and cultural contexts. Teachers gathered information about students' personalities and lived experiences through icebreakers and individual conversations and then used these details to select or modify activities for greater engagement. Examples of adjustments included:

- rewriting textbook problems to feature members of the classroom community,
- integrating Spanish phrases into instruction, and
- displaying multilingual posters in classrooms (see Multilingualism and Teacher–Student Relationships).

Multilingualism and Teacher–Student Relationships

Knowledge and understanding of their students' home languages supported teachers' connections with their students. Teachers had varying familiarity with languages other than English. In some instances, teachers shared how they could directly communicate with multilingual students and their caregivers in their home language. In other instances, teachers incorporated phrases in languages other than English into their whole-class instruction. Six of the 10 teachers commonly integrated Spanish phrases, such as "Está bien!" ("Alright!") and "Por qué?" ("Why?"), during whole-class share-outs. Three of the teachers also displayed classroom inspirational posters published in languages other than English. Whether small or substantial, the integration of multilingualism yielded deeper connections between teachers and students and facilitated more accessible communication between them regarding the math material.

Source: Learning Policy Institute analysis of teacher interviews and classroom observations. (2025).

Teachers facilitate structured peer collaborations. The teachers we spoke with recognized that middle schoolers are deeply social and leveraged this to enhance engagement by providing ample opportunities for peer collaboration (see Table 1). As one teacher put it, "They are social people … and we need to incorporate that into instruction rather than correcting it out of them." Teachers also emphasized how students often explained concepts in more accessible "kid language."

To enable peer collaboration, teachers did the following:

- arranged desks in either pairs or pods to allow for conversation,
- prompted brief "turn and talk" exchanges between students and their desk partners, and
- facilitated problem-solving activities involving randomized student groups.

To keep group work positive and productive, teachers established and reinforced norms and expectations. For example, one teacher posted expectations that students "Collaborate, Persevere, Take Risks" by including every group member, sharing writing tasks, and asking permission before erasing a peer's work.

Develop Students' Sense of Belonging

What the Research Says

In the math classroom, two distinct types of belonging come into play. **Social belonging** is a student's general sense of being accepted, respected, and included in the classroom community. A stronger sense of social belonging is associated with better social-emotional and academic outcomes. **Mathematics belonging** is a student's sense of being recognized as a capable math learner—as someone who has a place in the world of mathematics.

Research finds that female students and non-Asian racial and ethnic minority groups report a lower sense of mathematics belonging than their peers with similar prior math knowledge, which may come from messages from classrooms, media, and culture about who is stereotypically "good at math." These disparities have tangible consequences: Students' sense of mathematics belonging has been found to be a predictor of their algebra learning, which can shape their long-term math trajectories. Communicating to all students that they are seen as capable can shift beliefs to directly support their math learning.

What Teachers Do

Teachers explicitly notice and interact with each student on a personal basis. For example, the teachers in this study shared that greeting students at the door and circulating systematically during student work time enabled them to interact with each student (see Table 1). Some incorporated getting-to-know-you activities so students could share their personalities and get comfortable with their peers. Large class sizes made personalized interactions challenging, but teachers with support staff could coordinate to increase individualized attention.

Teachers create opportunities for every student to contribute. Teachers we observed incorporated "low floor, high ceiling" tasks—activities accessible to students with limited prior knowledge that were also rich enough to engage advanced students. One widely used task type was the "Notice and Wonder" problem, in which students observed a mathematically rich image and were asked to share what they noticed and wondered. Teachers found that the absence of a single correct answer appeared to reduce anxiety about participating in whole-class discussion.

Teachers publicly recognize competence. The practice of publicly recognizing students' mathematical thinking—sometimes called "assigning competence"—can be a powerful tool for building mathematics belonging. Teachers implemented this tool in varied ways:

- One teacher instructed a group not to erase their work because he wanted to bring other students over to learn from it.
- Another took photos of group work and projected it during whole-class note-taking.
- Yet another teacher asked a student to explain his approach to the class during the lesson debrief.

Teachers shared that recognizing students in this manner built their sense of mathematical belonging.

Teachers praise concrete successes for all students. The teachers we spoke with described watching carefully for moments of genuine mathematical success so they could draw the students' attention to this evidence of their learning and growth. As one teacher shared, "As often as possible, I try to point out [their growth by telling them things like,] 'Look where you were at before. You didn't know what an *x* was. You didn't know what a *y* was. And now you can fill a table in. You can graph.'" This math-specific, authentic praise was viewed as more effective at building students' sense of competency than generic praise of their classroom work or behavior—particularly since teachers believed students could readily distinguish genuine affirmations from pro forma ones.

Encourage a Growth Mindset

What the Research Says

Mindset theory distinguishes between learners who believe intelligence and math ability are static and innate ("fixed mindset") and those who believe ability can be developed over time ("growth mindset"). These beliefs shape how students engage with learning. When students hold a fixed mindset, their struggle and failure can feel like evidence of a permanent limitation; a growth mindset reframes both as expected and productive parts of the learning process. Students with growth mindsets consistently show better math learning outcomes. Teachers influence students' mindsets both through explicit messaging and through the implicit signals embedded in their instructional choices of words and practices.

What Teachers Do

Teachers explicitly communicate growth mindset ideas. All teachers in the study expressed the genuine belief that their students could improve their math abilities through effort. They communicated this conviction repeatedly and specifically through the following examples:

- Classroom walls in nearly every room displayed multilingual growth-oriented messages (e.g., "Mistakes are expected, inspected, and respected" and "Progress, not perfection").
- Teachers regularly narrated for students that math learning is a process and that early difficulty is typical and expected—not a sign of inability.
- Several teachers explicitly framed the start of a new unit as a fresh beginning ("No one is expecting you to know this perfectly today.") and the end of a unit as an opportunity to observe growth.
- Teachers communicated that effort was essential for learning, reminded students that learning does not happen automatically, and set the expectation for students to actively seek further information when they were struggling to master a skill or concept.

Teachers reinforce growth-mindset messaging in their instructional choices. For example:

- All teachers assigned groups randomly, on a daily or weekly basis, and avoided grouping students by ability, which can implicitly communicate that math ability is a fixed trait.
- Teachers consistently praised students' thinking and problem-solving approaches rather than correct answers. "I love that you chose that strategy" was more characteristic of these classrooms than simply affirming correct answers.
- Nearly all teachers allowed students to revise or retake assessments, communicating that the goal is mastery over time rather than performance at a single moment.
- Teachers normalized and destigmatized mistakes. In multiple classrooms, teachers deliberately made and then corrected their own errors in front of students, modeling the practice of treating mistakes as information rather than failures.

Deliver High-Quality Instruction

What the Research Says

Classroom learning environments that allow students to feel emotionally safe, supported, challenged, and able to succeed provide the conditions necessary for deep engagement in math learning opportunities—but these conditions must be coupled with high-quality math instruction for students to reach their potential as math learners. Research finds that teachers' instructional practices influence student math achievement. Students show greater growth when they view their teacher as academically challenging, with that relationship being especially strong in classrooms with more African American students.

Multiple sources of guidance on high-quality math instructional practices exist (e.g., from the National Council of Teachers of Mathematics and the National Research Council). Each speaks to the importance of moving beyond the memorization and reproduction of algorithmic problem-solving methods. Rather, they emphasize the importance of developing students' conceptual understanding and building their ability to reason and engage strategically in mathematical problem-solving.

What Teachers Do

Teachers deliver direct instruction in short, manageable chunks and integrate active learning. All teachers delivered direct instruction in short "mini-lessons" of 5–15 minutes—a practice well-supported by cognitive science research on working memory—that were followed by substantial time for collaborative student practice (see Table 1). Several teachers used a "double mini-lesson" structure by reconvening for a second segment of direct instruction based on observed needs. This practice reflects research showing how direct instruction after an active learning experience can help students consolidate and extend what they have discovered.

Teachers activate students' prior knowledge when introducing new material. Teachers built deliberate review into their lessons as a strategic tool for filling knowledge gaps and building confidence. Several teachers noted that reviewing skills tied to the day's lesson ensured that students had the prerequisites needed to approach grade-level content.

Teachers explain the "why" behind mathematical procedures, not just the "how." The teachers in our study believed that students who understand the conceptual basis of a procedure are better positioned to apply their knowledge flexibly, retain it, and generalize to new situations. For example, one teacher explained what the solution to a system of equations *represents* (the intersection point of two lines), not just how to find it. Another teacher had students discover a pattern for multiplying exponents by first expanding the expressions and talking through what was happening mathematically, so students could then use the rule for subsequent problems.

Teachers provide students with ongoing feedback as they practice new skills. Extensive collaborative work time allowed teachers to circulate; observe student thinking as it happened; and deliver immediate, targeted feedback. They did not have to wait for homework or tests to discover misconceptions. In minutes, as one teacher moved among four groups tackling the same problem, she reminded one to complete a neglected final step, prompted another to self-correct an error, walked a third through a prerequisite skill they had gotten stuck on, and pushed a fourth to use precise mathematical vocabulary in describing their correct answer.

Teachers support mathematical language development. All the observed teachers modeled precise mathematical vocabulary. When students used informal or imprecise language, teachers affirmed the conceptual understanding the student was communicating but also gently provided or elicited the correct terminology. The framing was always that mathematical vocabulary takes practice: It is not expected to come easily at first and is itself a learning target.

Teachers' emphasis on precise mathematical vocabulary often served a dual purpose, reinforcing conceptual understanding alongside language development. For example, when a student in one class read x^3 aloud as "x 3," the teacher corrected the language—"x to the power of 3" or "x cubed"—and used the moment to clarify the conceptual difference between x^3 and $3x$.

Teachers collaborate with other math-focused colleagues. Within their own schools, nearly all teachers described relationships with their colleagues as their main source of professional learning about instructional innovations. Teachers deepened their practice by exchanging ideas with other teachers, district and school coaches, and math-focused school leaders.

Implications for Educators

The four classroom conditions described above—positive relationships, a sense of belonging, growth mindset, and high-quality instruction—are cultivated through deliberate, learnable practices. The learnings from the teachers observed in this study and evidence from the broader research base suggest the following implications.

For Teachers

Treat relationship building as a foundation for learning. The teachers in this study viewed time spent establishing emotionally unthreatening classroom environments and building connections with and between their students as foundational to unlocking students' math mindsets. Investing in relationship building at the start of the year—and sustaining it throughout—can help establish spaces in which students feel safe to take intellectual risks while learning.

Nurture both social belonging and mathematics belonging. Feeling a part of the classroom community is distinct from feeling recognized as a mathematical thinker. Both forms of belonging matter, and both require active cultivation. Integrating personalized details into lessons can make students feel known and valued. Teachers can also regularly publicly affirm students' mathematical thinking. Assigning competence through specific, genuine praise of students' mathematical reasoning (not just correct answers) can build mathematics belonging.

Align instructional choices with growth mindset goals. Teachers who cultivate growth mindsets examine how their instructional practices propagate it. Key questions to consider include:

- Are students grouped randomly or by perceived ability level?
- How much praise and feedback focuses on thinking and process compared to correct answers?
- How do the assessment policies communicate that mastery takes time and revision?

Prioritize conceptual understanding in addition to procedural fluency. When students understand the "why" behind a mathematical procedure, they are better positioned to retain the knowledge, apply it flexibly in new situations, and see themselves as genuine mathematical thinkers rather than algorithm followers. The teachers in this study consistently paired procedure with explanation of meaning, and they allocated substantial class time for students to make sense of new content through peer collaboration rather than passive reception.

Use collaborative work time to offer differentiated learning and real-time feedback. Structuring lessons so that students spend substantial time working together in groups frees teachers to circulate, observe student thinking as it unfolds, and deliver targeted feedback. Students also support each other when they translate content into "kid language."

For Instructional Coaches and Instructional Leaders

Expand the coaching lens beyond instructional content to include classroom conditions. Instructional coaching conversations frequently focus on content delivery, pacing, and assessment. These are important. This brief also highlights the importance of attending to the relational and social-emotional

dimensions of the classroom environment. Observation tools and coaching conversations that attend to teacher–student interactions, peer collaboration, and classroom norms can help teachers develop a more complete picture of the learning conditions they create.

Support teachers in creating classroom conditions that help all students engage in mathematics. The classroom conditions described in this brief have the potential to strengthen engagement and learning across a wide range of learners, including students who have historically had less access to high-quality math learning opportunities. Coaches and leaders are well-positioned to help teachers build classroom environments that support student success and advance equity through strong instruction.

Model mathematical classroom activities that engage all students. The teachers in this study demonstrated how to design a class period with integrated activities that included all students at all times, no matter their differing levels of mathematical skills. Working with teachers to share activities among each other can enrich individual lessons and increase teacher collaboration.

Conclusion

As practitioners work to improve student math outcomes, a focus on students' experiences in math classrooms is an essential part of the equation. The teachers in this study cultivated positive classroom relationships, encouraged students' sense of belonging, reinforced growth mindsets, and delivered high-quality instruction. The students who have the most to gain from a greater focus on these classroom conditions are those who have historically been most underserved by math education. For these and all students, these mutually reinforcing conditions enable students to more freely and productively engage in math learning.

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