Cultivating Math Mindsets

Teaching Practices That Enable Equitable Classroom Learning

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Executive Summary

As a result of schooling disruptions related to the COVID-19 pandemic, students in the United States experienced significant declines in their math learning outcomes. This steep decline in math achievement has renewed attention on how to improve math instruction. Reducing math anxiety, improving students' general interest in math, and addressing persistent racial and socioeconomic achievement gaps are each important components of this work. Research indicates that improving math classroom learning conditions is a promising avenue for addressing each of these goals.

Rethinking how to design a classroom learning environment in ways that better enable math learning is a complex task. Recent syntheses of research from the fields of neuroscience, psychology, and other developmental and learning sciences (often referred to as the science of learning and development) emphasize the impact of the classroom learning environment on students' cognition and learning. Research also indicates that data on students' perceptions about their classroom learning environment as well as school and district practices can further enable teachers to improve the classroom learning environment.

In particular, there is evidence that students learn math best when they experience these classroom conditions:

- positive relationships with teachers and peers,
- a strong sense of classroom and mathematics belonging,
- support in adopting a growth mindset, and
- opportunities to engage with high-quality instruction.

These positive classroom conditions particularly matter for students from historically marginalized groups and for all students during the middle school years, which is a time when students' general school motivation and math engagement can sharply decline. Taken together, the evidence suggests that teachers can provide all students greater opportunities to thrive as math learners by cultivating positive learning conditions in math classrooms.

This study documents how 10 math teachers in five California middle schools promoted positive conditions for math learning. It provides examples of how teachers fostered positive relationships in the classroom, developed students' sense of classroom and mathematics belonging, encouraged growth mindsets, and delivered high-quality instruction. In addition, this report discusses the extent to which data on students' perceptions about their classroom learning environment and school and district practices enabled these teachers to foster a positive math classroom learning environment. These teachers' experiences yield insights and practices that can inform how other teachers, school and district leaders, and policymakers might improve classroom conditions for all students.

Cultivating Positive Classroom Conditions for Learning Math

Drawing on teachers' perspectives from interviews and classroom observations, the report begins by documenting how teachers cultivated each of the four positive classroom conditions in their middle school math classroom.

Fostering Positive Relationships

Positive relationships are developmentally important for student learning, and they help establish the classroom as a safe environment for intellectual exploration and growth. In their math classrooms, teachers in this study prioritized the development of positive relationships with students and between students. Teachers acknowledged that some students entered middle school with negative attitudes toward math due to their previous classroom experiences. The teachers viewed the relationships they cultivated with students as essential for helping students develop a more positive attitude toward math and aimed to establish the classroom as a safe, kind environment for learning. They also emphasized the importance of positive peer relationships for learning and engagement and worked to channel their students' sociality into learning-focused collaboration, in part because they viewed student peers as coeducators who could help translate academic content. Classroom routines and norms helped sustain positive teacher–student relationships and peer relationships by making the classroom a welcoming, predictable environment. Some common examples included welcoming students at the door, structuring daily group work, and creating a space of learning without fear of ridicule or shame.

Developing Students' Sense of Classroom and Mathematics Belonging

When students feel a sense of social belonging in their school or classroom community, they tend to experience more positive social-emotional and academic outcomes. This study illustrates how teachers made every student feel like they belonged as part of the classroom and mathematics community. Teachers gained and demonstrated knowledge of each student as an individual, created activities for students to connect on a personal level with their peers, established behavioral expectations that allowed students to feel safe to be themselves, and designed opportunities so that every student could contribute to the classroom math community.

In addition to general social belonging in school, it is important for students to feel a sense of "mathematics belonging." To cultivate their sense of mathematics belonging, teachers explicitly communicated to their students that each and every student could be successful at math, routinely recognized students' abilities as mathematical thinkers in front of their peers, and looked for opportunities to highlight the learning and success of students who doubted their abilities to succeed mathematically.

Encouraging Growth Mindsets

Students' beliefs about their ability to learn and succeed in math matter for their learning. Those who embrace a growth mindset tend to have better learning outcomes in math than those who think that ability and intelligence are static and innate.

In their classrooms, the teachers in this study adopted different strategies to encourage and reinforce growth mindsets. One strategy was to repeatedly communicate to their students the conviction that each and every student can grow their mathematical abilities. Teachers also described regularly reminding students that learning math is a *process* and that it is typical not to experience success right away. At the same time, nearly half of the teachers described emphasizing to their students that learning does not happen automatically—it requires them to take risks, try new approaches, and exert sustained effort. In addition to explicitly communicating ideas related to growth mindset, teachers implemented classroom practices that implicitly reinforced a growth mindset toward math learning, including through their approach to collaborative work, praise of students' problem-solving processes, and use of mastery-oriented assessments.

Delivering High-Quality Instruction

High-quality math instruction is essential for creating a classroom environment in which students can fully engage in learning math. Teachers' instructional approaches integrate research-based strategies to learn math content by incorporating students' relationships, sense of belonging, and mindset. Together, students can fully engage with, make meaning of, and benefit from well-designed math learning experiences.

When asked to share which of their instructional practices they believed matter most for students' math learning, teachers in our study often pointed to similar practices. These practices included designing direct instruction in short, manageable chunks; developing students' conceptual understanding; activating students' prior knowledge when introducing new concepts; providing ongoing feedback as students practice skills and solidify their knowledge; and supporting math language development through discussion of mathematical ideas and problem-solving strategies.

Using Data to Understand Student Perceptions About Learning Math

Research also suggests that monitoring how students *perceive* their classroom learning environment may be an important component to optimizing their experiences. The majority of teachers in this study indicated that their most important data sources for understanding students' feelings about math and their classroom learning conditions were based on their own observations—by noticing and interpreting student behavior and engagement. Some teachers also mentioned how their direct conversations with students offer another important data source. All teachers supplemented this informal data with more formal, recorded student survey data. Access to timely, disaggregated data remained rare, limiting teachers' ability to identify instructional inequities that may occur between different groups of students.

Teachers discussed using formal and informal data on their students' perceptions of classroom conditions to shift lesson design, modify classroom norms and practices, and identify students for personalized intervention. Teachers also identified a number of challenges that inhibited their integration of data, most notably their already heavy workload. For formal survey data, teachers shared that the practice of reporting student responses at the school or grade level made it difficult to use these data to inform improvement for the specific students they taught.

School- and District-Level Conditions Supporting Math Teachers

School and district conditions influence teachers' abilities to establish positive classroom learning conditions. At the district level, teachers highlighted that resources supporting their math teaching practices included professional development, instructional materials, and math coaches. Teachers viewed some district-level structures, such as pacing calendars and standardized assessments, as impediments to establishing positive classroom learning conditions when these structures pressured them to rush through material with little regard for student mastery. At the school level, teachers appreciated in-classroom support staff to help personalize instruction to individual student needs. Teachers also valued collaboration with colleagues and noted the impact when leaders set strong norms around collaboration time and developed structures to guide improvement-focused conversations between teachers.

Conclusions and Policy Considerations

This study shows how fostering positive relationships, developing students' sense of belonging, and encouraging growth mindsets can occur simultaneously with and reinforce high-quality instruction. This study highlights how teacher training, collaborative opportunities, and support from school leadership and other instructional staff further enable teachers to cultivate positive classroom conditions for students to engage with and learn math. The findings also underscore the need for practical, teacher-driven data tools and professional supports to enhance teachers' math teaching practices.

The findings from this report point to ways that state policymakers can support teachers in cultivating classroom conditions that are more conducive to math learning. They can:

- issue curriculum and instructional guidance for educators that articulates the importance of positive classroom conditions for students' math learning,
- ensure that teacher education programs instruct future teachers about the importance of positive classroom conditions for students' math learning so they can create these conditions in their own classrooms, and
- allocate funds at the state level for professional learning to support in-service math teachers.

District and school leaders seeking to support improvements in math learning have opportunities to:

- establish a shared vision for excellent math instruction that includes positive classroom conditions for math learning as an essential feature and
- support data-informed reflection on classroom learning conditions.

Introduction

As a result of schooling disruptions related to the COVID-19 pandemic, students in the United States experienced significant declines in their math learning outcomes. The National Assessment of Educational Progress (NAEP) documented that, between 2019 and 2022, 49 states experienced significant decreases in 8th-grade public school students' math performance. Data from the 2024 NAEP reveals that average student math achievement has not fully rebounded. Between 2022 and 2024, numerous states began to see improvements to 4th-grade average scores, yet no state's 8th-grade average scores significantly increased. In fact, 8th-grade average math scores significantly *decreased* in four states.[1]

Although this steep decline in student outcomes has drawn renewed attention to how to support students' math learning, the need to rethink how to teach math in the United States has been long-standing. The United States continues to lag behind international peers on student math outcomes: Out of the 80 jurisdictions worldwide that participated in the 2022 Program in International Student Assessment (PISA), the United States ranked below more than 30 other nations and fell well below in the international average score.[2] Math performance outcomes in the United States have long featured significant racial and socioeconomic gaps in student achievement, which result from a confluence of factors impacting students' opportunities to learn.[3] These outcome differences contribute to disparities in science, technology, engineering, and math (STEM) degree attainment—particularly in physical science and engineering—and subsequent entry into associated career fields.[4] While these trends have shown gradual improvement, women and Black, American Indian, Alaska Native, and Hispanic persons continue to be severely underrepresented both in terms of degree attainment and workforce representation within most STEM fields.

Systemic barriers contribute to disparate outcomes in math achievement. In particular, students experience inequitable access to well-prepared math teachers and advanced coursework.[5] Only 47% of U.S. 8th-grade math teachers majored in mathematics, compared to 78% internationally.[6] Nationally, more than 6% of math teachers do not yet hold full credentials from their state to teach math for their grade level.[7] The persistent tracking of students into different levels of math courses based on their perceived ability—a practice that can be subject to unconscious racial biases[8]—further expands the gap between the learning opportunities available to different student groups. Taken together, these barriers exacerbate gaps in the measured achievement outcomes and attitudes toward math between groups that have greater or fewer opportunities.[9] Resolving systemic disparities in access will be essential to improving U.S. learning outcomes in math and will require the careful design and implementation of policies that address these barriers.

While these systemic barriers persist, many educators work on a daily basis to create more equitable learning opportunities within their own classrooms, and their efforts make a difference in students' math outcomes. A significant and growing body of research suggests that what happens in the classroom greatly influences student achievement in math. Classroom learning conditions appear to particularly matter for students from historically marginalized groups and for all students during the middle school years,[10] which is a time when students' general school motivation and math engagement can sharply decline.[11]

Classroom learning conditions appear to particularly matter for students from historically marginalized groups and all students during the middle school years.

This report explores how 10 California teachers cultivate positive classroom conditions for learning math and catalogs their practices as a resource for other math teachers who are interested in ways to widen success in math. In addition to the practices that are discussed, this report discusses system factors that can support teachers in this work: first, data on students' perceptions about their classroom learning environment and, second, school and district practices that enable teachers to develop and improve their classroom learning environment.

Why Classroom Conditions Matter

Rethinking how to design a classroom learning environment in ways that better enable math learning is a complex task. Recent syntheses of research from the fields of neuroscience, psychology, and other developmental and learning sciences emphasize the impact of the classroom environment on student learning.[12] Commonly referred to as the science of learning and development (SoLD), this body of research provides evidence that, across subject areas, students are better able to engage cognitively with learning in environments where they feel a sense of physical, emotional, and identity safety; hold positive relationships with adults and peers; and experience belonging, purpose, and affirmation.[13] The SoLD research explains that coupling these factors with productive instruction that prioritizes curiosity, inquiry, and engagement with meaningful problems can build students' academic capacity and motivation for learning.[14] Together, these positive conditions promote healthy development, supporting students' cognitive growth and their physical, psychological, social, and emotional development.[15] These conditions can also help counter the negative effects of stress and trauma, which impact the brain in ways that biologically impair learning.[16]

Studies that focus specifically on math reinforce these findings. In the report *Positive Conditions for Mathematics Learning: An Overview of the Research*, we summarize the existing evidence base and find that students learn math best when they experience:

- **positive relationships** in their classroom community,
- a **sense of belonging** in the classroom and mathematics community,
- support in adopting a **growth mindset**, and
- opportunities to engage with **high-quality instruction.**[17]

These positive classroom learning conditions show promise for helping all students achieve their full potential in math. Notably, student groups that have been historically marginalized from math education or positioned as having deficient mathematical ability—namely, female students,[18] students of color,[19] students experiencing poverty,[20] and English learners[21]—stand to experience the greatest gains from a transition toward more developmentally appropriate classroom learning environments.

Attending to learning conditions in math classrooms is particularly important given the prevalent psychological fear and anxiety that students—and adults, including many elementary math teachers[22]—experience in relation to math. This phenomenon is commonly referred to as "math anxiety."[23] Researchers have linked the experience of math anxiety with numerous negative outcomes, such as reduced math achievement and a tendency to avoid college math courses and majors or career paths that require math.[24]

Studies on the neural basis of math anxiety find that children with high math anxiety perceive math as threatening. Compared to peers who do not have high math anxiety, they respond to situations requiring math engagement with higher levels of neural activity in the areas of the brain that process emotions and fearful stimuli and lower levels of neural activity in the mathematical and numerical reasoning area of the brain.[25] Indeed, one study finds that, when anticipating a mathematical task, highly math-anxious individuals experience brain activity in areas typically involved in bodily threat detection and pain perception.[26] These types of responses can be further magnified when stereotypes threaten the feelings of competency in students who have been historically marginalized from math education or positioned as mathematically deficient.[27] In both instances, students expend valuable cognitive resources on responding to a perceived threat, which detracts from their ability to engage in mathematical thinking and can impede their learning.

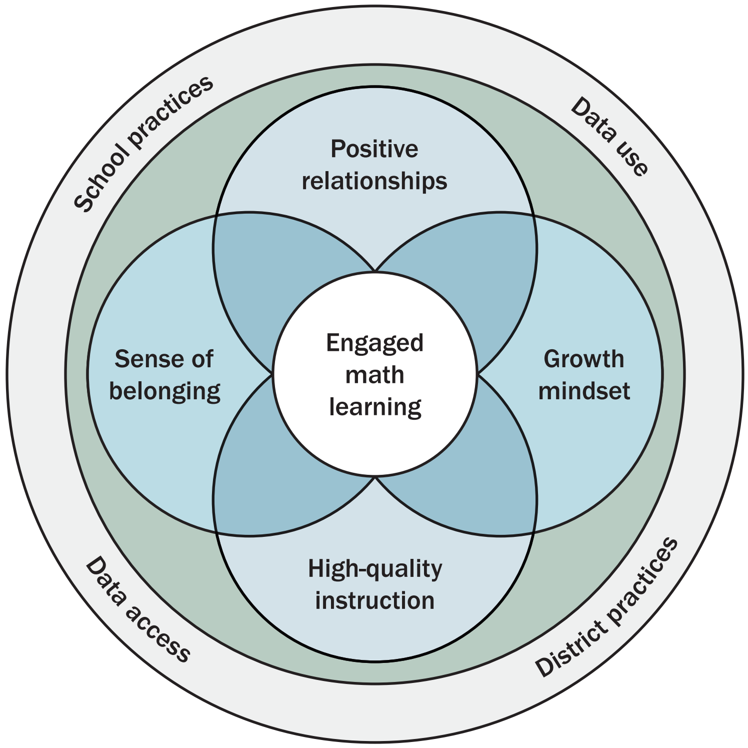
Many math anxiety researchers theorize that math anxiety can emerge from an accumulation of students' early struggles with math (possibly resulting from poor instruction), which then induces a cycle that impedes further math learning.[28] For this reason, any conversation about learning conditions in math classrooms needs to also include discussion of how to improve the quality of math instruction—in addition to the social and emotional experiences of students—since the quality of the instruction they receive can influence the emotional tenor of students' engagements with math.

A recent nationally representative survey of middle and high school students conducted by the RAND Corporation points to additional reasons to rethink classroom math instruction: Students are frequently bored with what they are learning. The study found that students express high levels of disinterest in the math instruction they receive in their schools: One half of middle and high school students reported losing interest in math class *half or more* of the time, and nearly 1 in 10 reported that they were rarely engaged at all.[29] Nearly one third of students shared that they did not identify as a "math person." It should therefore come as no surprise that math learning outcomes are generally poor when so many students report being uninterested and disengaged in what they are learning or view themselves as someone without a natural propensity for success in math. These findings on interest and boredom present additional reasons for focusing on improving the quality of classroom math instruction *and* the positive relationships, sense of belonging, and growth mindset that can promote student engagement and learning with math in the classroom.

System Factors Supporting Teachers' Classroom Conditions

Rethinking how to design a classroom learning environment in ways that better enable math learning is a complex task. Research indicates system factors can support teachers with their practice: first, data on students' perceptions about their classroom learning environment and, second, school and district practices that enable teachers to improve their classroom learning environment. These forms of support can inform and influence how teachers develop the types of classroom learning environments that advance students' engagement and learning in math (see Figure 1).

Figure 1. Classroom Conditions and System Factors That Support Students' Engagement in Learning Math



Source: Learning Policy Institute. (2025).

Access to and Use of Data

Teachers' access to and use of data about students varies by the type of information being collected. A recent national survey of teachers in the United States found that most teachers have ample access to student attendance data and most have access to skill-based data about their students.[30] At the same time, few teachers described having structured, paid time devoted to examining student data and using it to shape instructional decisions. Another nationally representative study reports that far fewer teachers have access to formal information on their students' perceptions of their learning, their teachers' demeanor, and their feelings about their classmate dynamics.[31]

The lack of information on student perceptions is notable. As teachers work to improve learning conditions within their math classrooms, research suggests that monitoring how students *perceive* these classroom learning conditions—for example, through student surveys that solicit their perceptions of the learning climate—may be an important component to optimizing the classroom learning environment. When available, these perception data can inform teachers' practices in important ways. First, teachers can gauge the extent to which students in the same classroom might perceive classroom conditions differently.[32] Second, data can reveal the extent to which teachers implicitly favor some students over others.[33] Third, formal data collection of this kind can give teachers a more accurate picture of how students perceive the quality of their relationship and interactions with their teacher than would be possible through classroom observation alone. Taken together, these findings suggest that teachers may benefit from access to more formalized data that can help bolster their ability to objectively examine how different students feel in their classroom.

The practice of regularly collecting and analyzing data on student perceptions of the classroom learning environment remains uncommon but appears to be gaining traction. In a national survey, 80% of math teachers reported reviewing information on how students viewed their instruction and learning climate at least annually, and over 30% of all math teachers did so at least weekly.[34] The current study examined the extent to which focal teachers—those recommended for the quality of their math teaching—integrated data to inform their practices to develop positive math mindsets in their classrooms.

School and District Supports

Teachers implement instruction in the context of the schools and districts in which they work. The instructional priorities set at these different organizational levels can influence, enable, or constrain teachers' practices. The staffing capacity and other resources allocated to support organizational priorities mediate teachers' abilities to integrate organizational priorities. Prior research evidence suggests that the following school and district practices can contribute to teachers' instructional improvement:

- allocating time for collaborative learning (e.g., professional learning communities, shared planning time, peer observation and feedback structures) among math teachers during the school day, which can help build teachers' efficacy and confidence as they work to adopt new strategies;[35]
- enabling access to well-designed professional learning opportunities,[36] particularly when these opportunities align with school goals and involve sustained engagement over an extended period of time;[37] and
- providing coaching or expert support focused on addressing teachers' contextual needs.[38]

This study aims to understand the district and school practices that math teachers themselves identify as the most important organizational supports as they work to create positive conditions for math learning. Describing teachers' viewpoints yields insights that can help districts and schools strengthen the supports teachers express they need to cultivate positive classroom conditions for math learning.

The Current Study

The current study was guided by the following research questions:

1. What does math teaching look like in classrooms that are viewed by school leaders as supporting engaged math learning?
2. How do math teachers gather insights on their students' experience of the classroom learning environment? What are teachers' strategies to:
   a. Gather data on their students' classroom experiences?
   b. Use data about their students' classroom experiences?
3. How do math teachers alter practices to improve the students' classroom experiences? How do they assess the impact of these altered practices?
4. How do math teachers alter practices to improve the students' mindsets? How do they assess the impact of these altered practices?
5. What factors help math teachers improve their classroom learning conditions?

Using a case study design, researchers selected 10 math teachers from five middle schools across three California districts (see Appendix A). Districts and schools were chosen based on their reputation for leading improvements in middle school math achievement since the COVID-19 pandemic. We selected schools that enrolled a majority of students of color and students from low-income families because these groups of students are typically excluded from opportunities associated with high mathematical expectations (see Table 1).[39]

Middle schools were the study's specific focus because research shows the middle school years to be critical junctures to developing students' mindsets and feelings about math.[40] In California, 14% of middle school teachers are only 1–2 years into the teaching profession, including the subset of math teachers.[41] All 10 teachers in this study had more than 2 years of teaching experience.

This study required that all selected teachers had access to some type of formal student perception data at the classroom level so we could learn about their use of these data. Principals nominated teachers who were early adopters and leaders among their colleagues in innovative and inclusive math practices. (See Appendix B for profile descriptions of each teacher in this study.) All teacher names are pseudonyms, and all school and district names have been used with permission.

Table 1. Description of Schools, 2024–25

School	Marshall Academy of the Arts	Stephens Middle School	Tincher K–8 Preparatory	Knox Middle School	National City Middle School
District	Long Beach Unified School District	Long Beach Unified School District	Long Beach Unified School District	San Diego Unified School District	Sweetwater Union High School District
Grades	6–8	6–8	K–8	6–8	7–8
Enrollment	~900 students	~700 students	~800 students	~500 students	~700 students
Ethno-racial composition	• 51% Latino • 21% White • 11% African American • 9% Multiracial • 5% Asian	• 66% Latino • 11% African American • 10% Filipino • 4% Asian • 4% Hawaiian or Pacific Islander • 3% Multiracial	• 38% Latino • 29% White • 11% Asian • 10% Multiracial • 7% African American • 4% Filipino	• 75% Latino • 15% African American • 4% Asian • 3% Multiracial • 2% White	• 87% Latino • 5% Filipino • 4% White • 2% Multiracial
Socioeconomic disadvantage	50%	83%	34%	96%	76%
Classified as English learners	5%	18%	5%	30%	36%
Students with disabilities	16%	18%	13%	21%	13%
Class schedule	45- to 50-minute periods; 2 electives daily	85-minute blocks	46-minute periods; times differ for K–5 and 6–8	85-minute blocks; weekly Zoom advisory	50-minute periods; blocks used for support classes
School highlights	STEAM focus; strong arts electives; wellness assemblies; strong and diverse student support team	California Distinguished School (2024); equity-focused; writing integration; strong leadership	Multiple award-winning school; Cognitively Guided Instruction framework; strong PLC collaboration	Level 4 Marzano Certified; student-led conferences; CARE Network math educators; strong advisory culture	College prep Wednesdays; restorative Saturday school; CARE Network math educators; strong literacy culture
Math initiatives	On-site math coach who was a longtime Marshall classroom teacher; BTC framework; Accelerated Math for all; additional math support elective; i-Ready diagnostics 3 times/year	On-site math coach; grade-level administrator teams; classroom skills data visually displayed in all classrooms; BTC framework; Accelerated Math for all; i-Ready diagnostics	Coordinated math dept. meetings; BTC framework; Cognitively Guided Instruction; Quality Core Instruction; Accelerated Math for all; additional math support elective	Marzano improvement-based strategic planning framework; teacher autonomy; visible data displays	High school math courses offered; literacy integration in math

Notes: BTC = Building Thinking Classrooms; PLC = professional learning community; STEAM = science, technology, engineering, the arts, and math.

Sources: California Department of Education. School Accountability Report Card data, 2023–24 (accessed 01/15/2025); Knox Middle School. (2025); Marshall Academy of the Arts (accessed 01/15/2025); National City Middle School (accessed 01/15/2025); Stephens Middle School (accessed 01/15/2025); Tincher K–8 Preparatory (accessed 01/15/2025).

Collected data included interviews with teachers and principals, single-day classroom observations, and a teacher intake questionnaire. Researchers triangulated these data with school field notes, artifacts, publicly available information, and students' survey responses on their feelings about math (see Appendix A for more information).

Researchers spent approximately 1 day observing each teacher's classroom and attended 2 to 4 class periods for each teacher. Periods varied in length from 45 to 85 minutes. Two researchers attended each class period and used two separate classroom observation protocols: one focused on the classroom learning environment and the other focused on math pedagogy. Importantly, neither observation protocol was designed as a teacher evaluation (i.e., the intention was not to rate the teacher on their application of professional standards to their daily lesson). Instead, the purpose was to describe the teacher's practices and classroom dynamics with particular attention to topics identified in the literature as important for students' math engagement and learning (see Why Classroom Conditions Matter for an overview of focal areas). The researchers alternated note-taking for each protocol between class periods in order to capture observations in both areas that would not be delimited by the predispositions or biases of a single researcher.

Data were analyzed for characteristics that research has deemed to be important concepts (*a priori*) and also for ideas that were unique to these teachers (*in vivo*). (See Appendix A for complete description.)

This study provides examples of how teachers shape learning conditions in classrooms where students meaningfully engage with math learning. These findings offer ideas for how district and school administrators and state policymakers can provide and allocate funds to support teachers in improving mathematics classroom learning conditions for each and every student.

Cultivating Positive Classroom Conditions for Learning Math

Both developmentally and cognitively, students benefit from learning math in classrooms that provide them with supportive relationships, a strong sense of classroom and mathematics belonging, and a firm conviction in their capacity to grow their mathematical abilities through experience and practice.[42] In classrooms with these characteristics, students are better situated to benefit from high-quality math instruction, which is also tremendously important for their learning.[43] When experienced together, as Figure 1 illustrates, these positive classroom conditions can enable students to experience the excitement of discovering mathematical relationships and grappling with challenging and meaningful problems. These conditions can also help cultivate positive mindsets toward highly engaged math learning.

This section presents the findings from interviews with and classroom observations of 10 middle school math teachers. It describes how they fostered positive relationships, developed belonging, encouraged growth mindsets, and delivered high-quality instruction. Table 2 provides a composite sketch of the structure of the observed lessons. Teachers' lessons shared common components: a warm-up, direct instruction, group activity, share-out, note-taking, and demonstration of understanding. Each teacher integrated at least five of these six components at some point in their lesson, whether their class period was 45 or 90 minutes.

When interviewed, teachers emphasized the importance of structuring the class time so that students could move around and socially interact with a variety of classmates. Teachers shared that they intentionally structured their activities to avoid student cliques based on mathematical ability or social status and to foster students' beliefs that each of them had something valuable to contribute to the classroom community while learning math. While these commonalities existed across all classrooms, variations between teachers occurred in the content of and approach to each lesson component. For example, some teachers' warm-up activity purely gauged the emotional pulse of the students rather than reviewed math content. Some teachers used whole-class choral call-outs for the warm-up instead of a hand-raised tally. Throughout the report, these variations in content and structure will be described.

Table 2. Typical Daily Math Lesson in Observed Middle School 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).

Fostering Positive Relationships

Research has established that relationships matter for student learning.[44] Positive relationships in the classroom, both between a student and their teacher and with their peers, can help establish the classroom space as a physically, emotionally, and identity-safe and unthreatening environment. This type of classroom space then enables students to focus their cognitive resources on the task of learning.[45]

Positive relationships especially matter for students during the middle and high school years.[46] During the transition to middle school, students experience significant social, psychological, and cognitive changes that couple with changes in how they experience school.[47] This idea was confirmed by one of the teachers in this study, when Ms. Ozark noted:

> At the beginning of the year, they're panicked because they're switching from elementary to middle, so it's a total new thing, going from one teacher to seven. So they're just trying to cope with the change, and we do have to start teaching very quick.

The Centrality of Teacher–Student Relationships

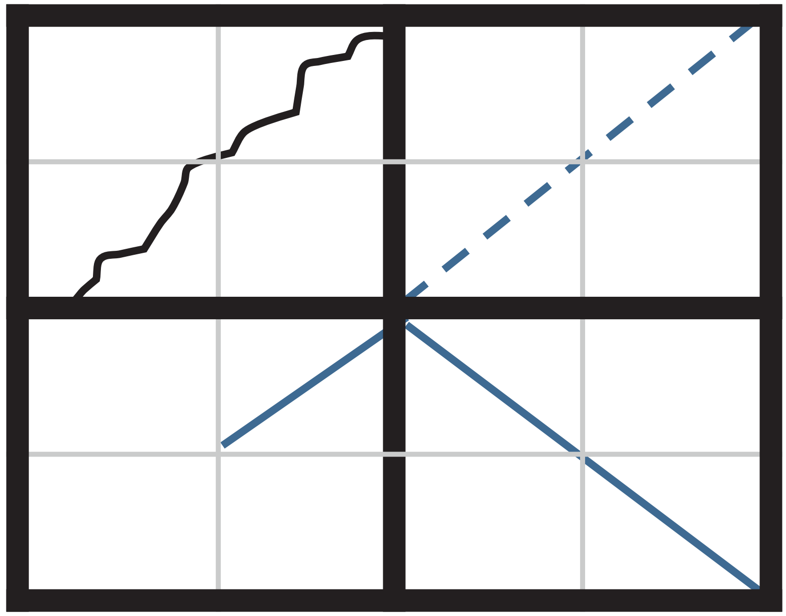
Teacher–student relationships have attracted the attention of researchers for decades. A large body of research finds that students who report positive relationships with their math teachers tend to experience other positive academic outcomes, including higher math achievement, greater classroom engagement, increased enjoyment of math, and increased self-efficacy and motivation toward math learning.[48] The research underscores that positive teacher–student relationships serve multiple pedagogical and emotional functions, particularly in reducing anxiety and creating safe spaces for learning.[49]

As the research shows, this study's teachers viewed the relationships they cultivated with students as essential for establishing a positive attitude toward math that would ultimately support their learning. These teachers worked to build positive relationships with students in a number of ways, most notably by fostering interpersonal trust and emotional safety, curating activities that they believed would interest and engage students, individualizing their attention to students based on what they knew about their personalities and learning needs, and striving to be authentic in their interactions with students.

Teachers reported that many students entered middle school with residual stress from prior negative experiences in math classrooms. Teachers described how fostering interpersonal trust and emotional safety helped students reframe their relationship with math, and the researchers observed teachers working to cultivate teacher–student trust and emotional safety in different ways. For instance, some teachers intentionally shielded shy students from cold-call questioning, while others strategically selected less confident students to answer low-stakes questions where they had a high potential for success. A warm-up activity such as "Which One Doesn't Belong?," which prompted students to identify similarities and differences between mathematical items, allowed students to provide valid answers with varying levels of mathematical sophistication (see Figure 2).

Across multiple classrooms, students' eagerness to participate in this activity suggests that it may reduce the anxiety that their peers will judge them if they share a wrong answer, since there is not just one "correct" answer. Other teachers, such as Ms. Birch, incorporated "brain breaks" with snacks to ease cognitive load and foster comfort. In some classrooms, teachers played music to lighten the atmosphere of individual work. Together, these examples show a range of practices that personalize a safe, reduced-stress classroom learning environment.

Figure 2. “Which One Doesn’t Belong?” Warm-Up



Source: Learning Policy Institute rendition of daily warm-up activity. (2025).

Teachers also drew upon their knowledge of students’ interests and personalities to curate activities that would be more interesting and engaging for them. Ms. Bristlecone, for example, responded to a student’s comment about a “boring lesson yesterday” by rewording the textbook activity to be more relatable for students. Her goal was to “make it more fun” and “tell more of a story” for the students, which she did by modifying the day’s tasks to include the teacher and coteacher as characters and the local pizza business as a setting. Unlike the textbook materials, which she felt students viewed as “just numbers,” Ms. Bristlecone believed that incorporating familiar people and contexts would make the day’s tasks more interesting to her students. Other teachers similarly modified word problems to include character names or geographic locations that reflected the various cultural contexts and backgrounds of their students.

Adopting different tactics, Ms. Pepper used videos with jingles and mnemonics to support memory and engagement, while Ms. Cypress designed a “Grinch”-themed warm-up specifically to reach a disengaged student who loved the Grinch character. Several teachers warmed up their classes with “getting to know you” questions so everyone could learn about each other, alongside incorporating some mathematical concepts such as proportional representation from students’ responses to whether they prefer Coke or Dr Pepper.

Across contexts, these student-centered approaches reflected how teachers used their relational knowledge of students to inform instructional design and foster inclusive classroom learning environments so that students of differing abilities and with different educational needs can learn together in one classroom. Research on culturally relevant teaching finds that these student-centered practices are highly effective at engaging students in math.[50] Teachers’ integration of multilingualism into classroom instruction also appeared to affirm students’ cultural backgrounds and contribute to positive teacher–student relationships (see Multilingualism and Teacher–Student Relationships).

Multilingualism and Teacher–Student Relationships

Knowledge and understanding of their students' home language 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/or their caregivers in their home language. In other instances, teachers incorporated phrases in languages other than English into their whole-class instruction. Six out of the 10 teachers commonly integrated Spanish phrases, such as "Está bien!" ("Alright!"; Ms. Cedar) and "Por qué?" ("Why?"), during whole-class share-outs. Three of the teachers also displayed classroom inspirational posters published in languages other than English. Research finds that these approaches improve students' feelings of trust with their teachers and bolster emerging multilingual students' contributions to classroom discourse. 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.

Sources: Feinauer, E., & Freire, J. A. (2024, April 13). *Sociocultural competence in dual language bilingual education: What the research says about student outcomes*. Paper presented at the American Educational Research Association Annual Meeting; Feinauer, E., Freire, J., Willardson, K., & Earl, M. (2023). Sociocultural competence in dual language bilingual education: A literature review of student outcomes. In J. A. Freire, C. Alfaro, & E. J. De Jong (Eds.), *The handbook of dual language bilingual education*, (pp. 194–212); Routledge; Learning Policy Institute analysis of teacher interviews and classroom observations. (2025).

Teachers' relationships with students also enabled them to identify and address individual students' needs. By attending to students' nonverbal cues and comparing them to typical behavioral patterns, teachers believed they could discern when a student was struggling emotionally or cognitively. Ms. Pepper was particularly attuned to students with behavioral needs, while Ms. Cypress used her knowledge of which students' focus could be improved with phone calls home. Ms. Ozark discussed how she used socioemotional learning-based warm-ups to gauge students' emotional states at the start of class, allowing her to tailor instruction accordingly. Ms. Pine noted, "How I'm asking the questions may be different to certain students. … It's about knowing them. But that's all with building relationships." In a few instances, teachers also mentioned how other schooltime interactions reinforced relationships with some students (see School Structures to Support Relationship Building). These practices underscore how understanding the whole child—their interests, family life, friend circles, and personality—informs how to academically support students.[51]

Understanding the whole child—their interests, family life, friend circles, and personality—informs how to academically support students.

School Structures to Support Relationship Building

In several cases, teachers described how building relationships with students in contexts outside of their math class period positively influenced their interactions with students in their math classroom. The few teachers with daily or weekly advisories discussed how those periods gave them additional opportunities to interact with their students. Two other teachers discussed how their extracurricular activity clubs supported stronger relationships with the students who participated. Teachers from two schools shared that their school's emphasis on social-emotional development offered opportunities to build stronger relationships with their students since they otherwise found it somewhat difficult to integrate social-emotional development into their math lesson. These additional touchpoints structured during the school day provided more time to build relationships with students.

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

Teachers stressed the importance of authenticity in their interactions with students, noting that students quickly detected superficiality and responded negatively to insincere efforts. The two most veteran teachers in this study, Ms. Cedar and Mr. Sycamore, both emphasized the importance of being genuine, noting that students are more likely to engage when they feel the teacher is being real with them. Ms. Cedar shared the strategy of "finding something to celebrate, but in a way that is authentic, that is not fake. 'You can do it'—no, that doesn't cut it with them because they've been hearing that, but they have not felt that before."

Overwhelmingly, all teachers maintained a positive tone and affect with the students. Tone and affect were steady whether the teachers were circling around to explain ideas to groups, checking desk work, or granting hallway passes to the bathroom. Even when a few groups became frustrated or lost focus, teachers' steady, positive tone and affect remained. Ms. Cypress, for example, redirected a squirrely group, telling them to copy down the problem from other students after they accidentally erased their problem, drew a cartoon, and then wandered away from their whiteboard. Ms. Cypress kept her voice even while reminding them that their grade depends on their ability to complete these types of problems. The warm demeanor of many of the teachers sustained a classroom atmosphere in which students appeared comfortable asking for support and participating in class.

Teachers also used humor to build rapport. Ms. Cedar often used "kid lingo" to humorously connect with students, while Ms. Cypress embraced her own teaching mishaps as opportunities for shared laughter and learning. For example, when she made a mistake writing an equation, she joked, "It was a test to see if you would find my mistake." (See Encouraging Growth Mindsets for more on teachers' approaches to mistakes.) Ms. Oak celebrated students' creative answers, such as when one student said, "That's not going to work because it's going to mess up the flow," reinforcing a classroom culture of intellectual playfulness.

In all classrooms, teachers used music, game-based activities, and/or humor to connect with their students and strengthen relationships. For example, in one of Ms. Cypress's classes, a student commented that the teacher's choice in music reminded her of what her mom listened to. Teachers also notably adapted their choices to the unique personalities and interests of each class. For example, one teacher played different music in each class period based on the personality of each class. This adaptability fosters authentic connections with students, compared to a teacher-centric music choice that generically spans all class periods. These practices highlight the central role of positive teacher–student relationships in fostering mathematical engagement through emotional safety and trust in middle school classrooms.

The Role of Classroom-Based Peer Relationships

In addition to their teacher–student relationships, all of the teachers in the study emphasized the importance of peer relationships in supporting math learning and classroom engagement. Teachers structured collaborative work in various ways and found it supported concept translation, belonging, and adolescent social needs.

Value of Peer Relationships to Support Engagement

Teachers expressed a shared value for peer interactions because they viewed student peers as co-educators who could help translate academic content. Encouraging peer interactions gave students opportunities to see how their peers used different representations to solve problems. In Ms. Ozark's classroom, for example, students were allowed to select their own strategies for solving programs while working in groups. As a result, some groups of students ended up solving integer problems using tactile counting chips while other groups used visual number lines or wrote algebraic long-form expressions. (See Delivering High-Quality Instruction for more about the importance of multiple representations as a math instructional approach.) Students' group work collaborations, deskwork conversations, whole-class share-outs, and multilingual translations all helped them understand how mathematical concepts and problems could be modeled using different tools.

Peers could translate math concepts and content into "kid language." Ms. Sequoia noted that students often explained concepts to one another in ways that are more accessible than teacher-led instruction, which prompted her to design lessons that intentionally fostered collaborative learning. Ms. Pepper shared, "I told them the best way to learn math is to teach it to somebody else, so I want them to help each other because I feel like both kids win that way."

Peers could translate math concepts and content into "kid language."

The use of kid language extended to include linguistic accessibility, particularly for bilingual and emerging bilingual students. Five teachers relied on peer translation to support comprehension of math content, recognizing that students often feel more comfortable asking questions and receiving explanations from classmates. These peer-mediated interactions enhanced understanding and also fostered a sense of belonging and mutual support within the classroom.

Peer relationships also contributed to and reinforced the maintenance of classroom norms around physical and emotional safety. Ms. Birch recounted an incident when a student alerted her to a peer's distress, demonstrating how students actively uphold the ethos of a community that genuinely cares for one another. In Ms. Sequoia's class, when a student self-deprecatingly said to his groupmates, "I'm dumb at this," his peers immediately rebuked the comment, saying, "No you're not" and then promptly giving him the marker to lead the problem-solving task.

Coordination of Peer Collaboration

Collaborative peer interaction occurred in all classrooms in various styles. It ranged from one student simply explaining math to their deskmate to more structured, teacher-designed group activities. All of the teachers in the study coordinated group work at tables or lab-style configurations to encourage peer-to-peer interaction in efforts to enhance uptake of mathematical learning. Ms. Ozark shared that the group table configurations especially helped them to “share with one another, because I can’t call on every single one of them. And I want them to feel included, so that’s just kind of my technique.”

To facilitate peer interactions, no teacher used single-desk rows. Mr. Sycamore and Ms. Oak arranged desks in forward-facing pairs to facilitate focused collaboration, while all other teachers used pod designs to promote inclusive discussion (see Figure 3). Nine of the 10 teachers grouped three to six students per table (and, when there were no tables, teachers clustered desks to form a “table” design).

Teachers used different criteria to select tablemates, ranging from random alphabetical order to mixed skill levels to compatible personalities. Sometimes the criteria depended on their instructional goals. For example, Ms. Cedar’s goal at the start of the year was to get to know the students’ personalities and needs. Once she familiarized herself with them, she rearranged students so that those students with complex needs (including newcomers to U.S. schools with limited formal education and beginning English skills, as well as English-speaking students with socioemotional needs or learning disabilities) were seated closest to her at the front of the classroom. Depending on the students’ abilities to self-manage social urges during lessons, she also rearranged some of her 6th-grade students to be at homogeneous-gender tables.

Figure 3. Examples of Desk Pod Arrangements

Source: Learning Policy Institute photos of pod arrangements. (2025).

To encourage cross-peer relationships rather than social cliques, all teachers used random-draw configurations for their group work. Several teachers used name generators to configure groups, while others used matching cards to group students. Due to her short class periods, Ms. Oak randomly assigned student groups on a weekly basis so she could balance the efficiency of getting to the math task with opportunities for students to work with a variety of peers. This approach appeared to have the desired effect, because observations of hierarchies in which the socially popular students ruled in the peer-led group interactions were sparse.

Establishing norms for peers to build relationships with each other required deliberate effort from teachers to incorporate collaborative activities into their lessons. Ms. Cedar, for example, projected a group work slide that listed the "Skills Needed to Be Successful" with the statement: "As you can see, none of us possess all of these skills *yet.* But we have something to contribute to the group." At each group work station around the classroom, Ms. Sequoia posted "Whiteboard Moves" that explained how to "Collaborate, Persevere, Take Risks" by working together, sharing the writing tasks, including every group member, and asking permission to erase another group member's work. By reminding students of group work norms, teachers helped to facilitate positive, productive, and learning-focused collaborations.

While most classrooms operated smoothly on the day of the researchers' observations, teachers acknowledged occasional interpersonal challenges. Ms. Ozark shared that some students needed to work apart from each other until their other social dramas settled down so as not to disrupt the classroom flow. She also observed that students were initially shy during first-quarter interactive group work but gradually became more comfortable as safe collaborations became reliable occurrences.

Social Developmental Needs of Middle School Students

Collaborating with other students and engaging in peer-to-peer interaction also engaged students' social selves in the learning process. Teachers recognized that middle school tweens and teens are deeply social beings, and they leveraged this developmental stage to enhance classroom engagement. As Ms. Oak shared, "They are social people. They're 6th-graders. They're full of energy, and 'full of social,' and we need to incorporate that into instruction rather than correcting it out of them, I think." Ms. Bristlecone said, "If they're chatting with each other, that's a good sign for me." Ms. Pine began each class with 5 minutes of social time to help students settle in, and Ms. Cypress allowed students to switch groups and sit with friends.

Teachers recognized that middle school tweens and teens are deeply social beings, and they leveraged this developmental stage to enhance classroom engagement.

Several teachers incorporated game-based activities into their instruction, blending play-based social interaction with mathematical thinking. All of the teachers who used game-based activities displayed each student's answer next to a randomly generated name. Combined, these two strategies produced a competitive energy while also protecting students who answered incorrectly from ridicule. Allowing students to interact with each other during class around a shared math topic attended to the social developmental needs of students—especially middle school students.

The sentiment was clear in all classrooms: Students valued learning from one another. No classrooms rejected or rebuked group activity directions to learn math with and from their peers, even when they were randomly assigned to work with classmates who they did not know well. A few individual students in 5 of the 20 classrooms did decline *optional* opportunities to work with peers. These opt-outs typically occurred among the students with severe math knowledge deficits or social-behavioral special needs.

Routines and Classroom Norms Ensuring Safety and Kindness

Classroom norms around peer interaction were closely connected to the broader sense of safety and belonging. Across these classrooms, kindness was the norm; name-calling and put-downs were virtually nonexistent. Students did not ridicule or shame their fellow classmates for voicing an incorrect answer or doing something socially awkward. In most of the instances in which a classmate acted out, students appeared to understand to ignore the act, and the classmate would be expected to self-correct. When one of Ms. Pepper's classrooms watched a hip-hop video on integers, for example, one student loudly sang along with mumbled words. This form of engagement disrupted some students' concentration on the video content, but classmates simply did not react to this behavior.

Students were also observed enforcing their own classroom norms.[52] During a Kahoot! game in Ms. Cypress's class, for example, when some students called out a single student for the only incorrect answer in the whole class, they quickly corrected their rudeness and praised their classmate when he got the answer correct in the next round of the game. Students palpably felt safe sharing incorrect answers or tentative ideas. In Ms. Ozark's class, a student began a share-out with "I think I'm wrong, but …" and multiple peers verbally encouraged her to continue.

From observations, it was evident that teachers had worked to establish classroom learning environments that precluded shame or ridicule. In Ms. Oak's class, for example, when a student answered a question incorrectly in whole-class discussion, Ms. Oak noted that it was a mistake many students would likely make. She gave the student a chance to try again, and the student provided the correct answer.

Routines provided necessary structures to build trusting relationships between teachers and students as well as among student peers. These routines—such as greetings at the door, open access to supplies, warm-up activities, random assignment groupings, and group-based deskwork—provided structure and predictability, which in turn supported focus. Other routines—such as the use of timers, bells, and signals—provided rhythm to transitions to help maintain the learning flow.

While most teachers did not necessarily mention routines in their interviews, routines were regularly seen across the classrooms. Importantly, routines were not just about following classroom rules—routines inspired a classroom ethos of trust and care for one another. As Ms. Cedar explained, "The way that I care for them is by creating consistency, predictability, and strong and high expectations." The importance of norms and routines for creating a positive and cooperative classroom learning environment has been well documented in the research literature, and they can be an important part of establishing the classroom as a safe space for engagement.[53]

The strength of teacher–student relationships also influenced students' adherence to classroom norms, time on task, and engagement with activities. Seven of the 10 teachers noted in their interviews that students were more likely to follow routines and participate meaningfully when they felt safe with a trusted teacher. As Ms. Cedar shared, "Once I build that trust, once I build that environment, that caring environment, the sky's the limit."

Developing Students' Sense of Classroom and Mathematics Belonging

Numerous studies provide evidence that students who feel a sense of social belonging in their school or classroom community tend to experience more positive social-emotional and academic outcomes.[54] For students, the feeling that they are a part of the school community helps to establish the classroom as a space for social and cognitive inquiry, experimentation, and growth.[55] Developmentally, this perception of fitting in with others is very important, particularly during adolescence.[56]

In addition to general social belonging in school, it is important for students to feel a sense of mathematics belonging. Mathematics belonging, as a concept, particularly focuses on whether students feel accepted as part of the group of people who learn and excel in math and can be socially recognized as having the ability to be mathematically successful (see Table 3). Due to its social dimension, this perception of fitting in is distinct from math *identity*—i.e., the "ability to participate and perform effectively in mathematical contexts."[57] Research links students' gender and ethno-racial identity with their perceptions of mathematics belonging, which may be due to internalized gender- and race-based stereotypes regarding innate mathematical ability. One study of middle school students found that female students and students from non-Asian minoritized racial and ethnic groups reported a lower sense of mathematics belonging than their male or White and Asian peers, even after controlling for differences in their prior mathematical knowledge and self-concept.[58] A previous study by the same research team found that students' sense of mathematics belonging predicted their algebra learning, which suggests that differences in mathematics belonging may contribute to math performance disparities.[59] Working with students to develop a sense of mathematics belonging may offer an additional approach that teachers can use to support improved math learning for all students.

In addition to general social belonging in school, it is important for students to feel a sense of mathematics belonging.

Table 3. Definitions of Social Belonging and Mathematics Belonging

Social belonging	Mathematics belonging
A student's feeling that they are "personally accepted, respected, included by others in the school social environment."	A student's feeling that they are a member of the community of individuals who learn and excel in math and are socially recognized as having the ability to be mathematically successful.

Sources: Barbieri, C. A., & Miller-Cotto, D. (2021). The importance of adolescents' sense of belonging to mathematics for algebra learning. *Learning and Individual Differences*, *87*, 1–11; Good, C., Rattan, A., & Dweck, C. S. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *Journal of Personality and Social Psychology*, *102*(4), 700–717; Goodenow, C., & Grady, K. E. (1993). The relationship of school belonging and friends' values to academic motivation among urban adolescent students. *Journal of Experimental Education*, *62*(1), 61.

Social Belonging

Prior research finds that teachers can facilitate social belonging in their classrooms by demonstrating a caring affect toward each and every student, promoting positive classroom interactions, affirming students' unique identities, and building bridges between school and out-of-school contexts.[60] Teachers in this study demonstrated various ways to make every student feel that they belong as part of the classroom community—feeling personally seen by the teacher, recognized by their peers as unique individuals, safe to be themselves, and part of the functioning of the classroom community. As Ms. Sequoia explained:

> I think if they feel like they belong in here, they're going to do way better. So it is something that I think about. Even when I have kids talk at tables, I always try and encourage them not to leave anybody out. I don't want anybody to feel … like [they] can't share. That needs to be a mutual thing. If someone feels like they're going to shut you down, they're not going to speak up.

A few teachers also mentioned that they pay more attention to belonging now that their school district (Long Beach Unified) formally surveys students about their feelings of belonging and the welcoming atmosphere of their school (see Using Data to Understand Student Engagement With Learning Math for more information).

To signal belonging, teachers enacted practices to explicitly notice each and every student in the classroom. Some teachers greeted students individually at the classroom door. As Ms. Bristlecone explained, "I think that [it] just starts at the beginning with having a warm welcome. If you [as a teacher] are coming in with an attitude that is not welcoming, they're not going to be confident that they can learn the material." Other teachers explained that they used direct electronic comments via school portals to personalize communication with students. Ms. Pine, for example, begins each year by having students electronically submit to her an account of their "math story":

> [And] I judge, is it a positive math story? Or is it them being like, "This teacher ruined my life in 5th grade." And then once I do that, I take all their stories, [and] I respond to each and every one of them. So every single story, I write a little message back, and they have that. So that's their first connection with me.

During the classroom observations, all teachers circulated through the classroom to interact with all students, either individually or in small groups. Large classrooms, Ms. Oak noted, limited her ability to connect with students individually in each class period, but additional in-class support staff helped increase the frequency of individualized interactions (see School-Level Supports for more information).

Some of the teachers bolstered social belonging by integrating "get to know you" activities into their classrooms that affirmed students' identities, often weaving mathematical concepts or socioemotional guidance into the activities. For example, Ms. Ozark began her class periods with a warm-up activity asking if they'd prefer tacos or pizza to eat as their only meal for the rest of their life. This activity allowed students to learn about each other, and it also reinforced their understanding of fractions with their tally of tacos or pizza and their practice to provide the rationale for their choice. Ms. Ozark shared that these types of activities are foundational for learning:

> [They get students to] feel comfortable around each other, so it's basically cultivating that safe environment … just getting to know each other. … At the beginning of the year, that's the most important thing: having them understand the norms and expectations and feeling comfortable around each other. And that's the base of everything, because if they're not willing to work with each other, it's going to be really hard to just share any thought process.

Nearly all of the teachers explained how they structured their classroom to ensure that all students had active opportunities to contribute to the functioning of the classroom community. Some teachers incorporated traditional activities such as rotating classroom tidiness duties among the students or engaging students' voice to contribute to the classroom rules. Two teachers filled their walls with students' math work or artwork, affirming many ways that students and their unique identities contribute to the classroom community.

In some classrooms, support staff provided additional attention in ways that strengthened students' feelings of belonging with their classroom community. For example, some focused on accommodating students with special education needs so they could be fully integrated into classroom activities. Others provided language translation to support students who were still acquiring English communication skills, ensuring they could fully participate in learning math. In larger classrooms, support staff circulated among work groups to provide adequate scaffolding as students worked through complex math tasks.

Mathematics Belonging

In the classrooms observed for this study, teachers worked to cultivate students' sense of mathematics belonging in a number of ways. In nearly all classrooms, teachers explicitly communicated to their students the belief that each and every one of them could be successful at math. Ms. Pine, for example, incorporated a series of math-related affirmations, such as "I can do math." Every day, before a student entered the classroom, she stood next to them as they looked into a mirror on the door and chose an affirmation to say aloud. She acknowledged that this practice might feel a bit "elementary school" to some students, but she nonetheless valued it as a practice that could help students rewrite their mental scripts about their math abilities.

Teachers explicitly communicated to their students the belief that each and every one of them could be successful at math.

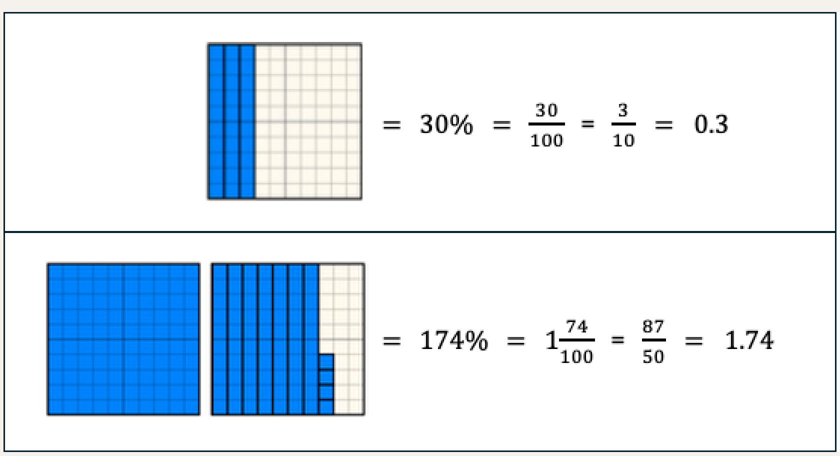
Teachers also worked to create a classroom culture that affirmed each student's ability to participate meaningfully in the classroom learning environment. For example, in multiple classrooms, teachers incorporated "low-floor, high-ceiling" mathematical tasks into whole-class instruction, which allowed students with varying degrees of mathematical knowledge to contribute to classroom discussion and be recognized and affirmed by their mathematics community of teacher and peers (see Low-Floor, High-Ceiling Math Tasks). These types of tasks—coupled with teachers' verbal coaching—also helped to expand students' sense of what it means to be a math learner. Ms. Oak shared her observation that some students enter middle school as "quick calculators [who] think they're [math] superstars, and the slower ones think they're horrible at math." One of her goals in her classroom was to decouple speediness from math learning so students could understand that "neither one of these things is necessarily true."

Low-Floor, High-Ceiling Math Tasks

With the goal of establishing a "low floor" and "high ceiling" for math engagement, teachers implemented math activities that allowed all students to offer meaningful contributions, regardless of their level of math proficiency. The teachers in this study expressed the belief that getting students—particularly those who had negative past math experiences—to experience success was important for their mathematical confidence and ongoing engagement. For example, Ms. Bristlecone believed that giving less confident students opportunities to contribute and experience success, particularly earlier in the year, could be tremendously reassuring for them. She hoped that, as a result of early successes, students might think, "Oh, if this is the way that this math class is going to be, then I can still participate." Establishing a low floor for engagement provided more students with opportunities to experience some success on grade-level tasks during the class period.

One example of a low-floor, high-ceiling task was the "Notice and Wonder" problems that were a fixture in Long Beach Unified School District classrooms. In a Notice and Wonder problem, students received a prompt or image. They then discussed what they observed and articulated any mathematical questions from the prompt. For example, in Ms. Sequoia's classroom, students were presented with an image containing multiple representations of 30% and 174%.

"Notice and Wonder" Task in Ms. Sequoia's Classroom



Source: Provided by teacher. (2025).

After giving students a minute to share with a small group of peers what they noticed and wondered about the image, Ms. Sequoia solicited volunteers to share their thoughts with the whole class. In the absence of a single "correct answer," students noticed and wondered about different things, including:

Noticing: that both percents are even; that each box in the visual representations represents 1%; that the bottom row percentage is greater than 100; that the fraction in the bottom row contains 1 whole; and that the numbers in the top row are all the same, though in different forms.

Wondering: how many times 30% can go into 174%; why the bottom equation includes the fraction $^{87}/_{50}$.

In each case, the teacher affirmed students' contributions. In some cases, she commented on a student's observation to draw attention to the core insight that each column contains different equivalent representations of the same number. For example, when a student noted that the numbers on the top were "all the same, just different forms," the teacher affirmed this, saying, "Yeah, they're all equivalent. I like that you're noticing all those equal signs." When a student asked, referring to the bottom row, "Why does it say $^{87}/_{50}$?" she responded by saying, "I don't know, what do you think?" One student volunteered that $^{87}/_{50}$ was equivalent to $^{174}/_{100}$, and the teacher prompted them to articulate how they would go about simplifying $^{174}/_{100}$ to get $^{87}/_{50}$, which they did. Regardless of the level of insight that any given student brought to the activity, they appeared to benefit from hearing their classmates' insights and the teacher's narration connecting their observations with mathematical ideas that were relevant to the day's lesson.

Another low-floor, high-ceiling task design strategy, adopted by multiple teachers, gave students options to complete problems at different levels of difficulty. In multiple classrooms, students could choose from "mild, medium, or spicy" problems, which allowed them to select a problem that would be accessible yet challenging. Then, if they experienced success, they could continue scaling up their level of difficulty.

Across classrooms, low-floor, high-ceiling tasks allowed all students to engage in the community of mathematical learners by contributing to group- or classroom-level conversations in their own authentic voice. These types of activities helped students recognize their mathematical ideas as valued by the group and broadened the group's understanding of what it means to be competent in math. In contrast to traditional math tasks that ask students to "solve" by applying an algorithmic procedure, tasks like the one recreated in the figure above prompted students to reflect on mathematical patterns and consider the relationships between different ways of writing numbers. This different focus encouraged and lauded various ways of thinking about numbers.

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

Teachers also routinely recognized students' abilities as mathematical thinkers in a public fashion by showcasing their approach to a problem in front of their peers. Previous research elevates the importance of this type of recognition—sometimes referred to as "assigning competence."[61] How teachers assigned competence looked different depending on the teacher. For example, Mr. Sycamore, after reviewing the work of a group of students, instructed them not to erase their work because he wanted to bring another group of students over to learn from it. Ms. Cypress took pictures of student work samples during collaborative work time and, after recalling students to their desk for note-taking, projected these work samples onto the screen as exemplars for the whole class to record in their notes. Ms. Oak, after having a discussion with a particular student during collaborative work time, returned to this student during the note-taking so he could explain his thinking on one of the day's problems to the rest of the class.

In addition to these generalized affirmations of student mathematics belonging, multiple teachers described providing individualized support for students who entered their classroom with internalized negative narratives about their math abilities. With the goal of countering these internalized narratives, the teachers shared that they looked for instances in which these students experienced genuine mathematical success in order to point them out to the student. Ms. Cedar described being very mindful when reviewing the work of these students and explained that she was always looking for evidence of their learning and growth that she could authentically celebrate with them. For this teacher, it was important to move beyond simply encouraging students with a "You can do it!" and to instead point to a concrete example in which they succeeded so that she could tell them, "This is you right here. Look how amazing you did." Mr. Sycamore adopted a similar approach, aiming to point out to low-confidence students the progress they made over time:

> 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."

Research explains that math-specific, authentic praise is more effective at building up students' feelings of competency than generic praise focused on procedural fluency or good behavior.[62]

Teachers also aimed to create opportunities for low-confidence students to feel a sense of competence in front of their peers. Ms. Bristlecone was particularly intentional in this area. One strategy she adopted was to amplify these students' contributions in front of their peers. She found that doing things like announcing to the class, "Oh, did you guys hear what John said for this answer? He just gave a really good answer. John, can you say it again? I don't think the whole class heard you" could help students see themselves as competent and successful.

Another strategy, noted by several teachers, was to call on these students when the teacher was confident they could provide a correct answer. For example, Ms. Bristlecone said that if she noticed when she's circulating during student work time that a student who regularly struggles got a problem correct, she'd make sure to call on that student to share their solution with the class. In doing this, she obtained her goal to "set them up for success in little ways." She contrasted this approach with the more common practice of cold calling, which can publicly embarrass students who do not have an answer to share.

For many students, gaps in math skills and knowledge from prior grades can act as a real barrier to their sense of mathematics belonging. With a mind toward addressing this challenge, two teachers noted the importance of providing and encouraging the use of resources that would support student recall of vocabulary and procedures (e.g., anchor charts, note sheets) or execution of basic calculations (e.g., multiplication tables, calculators). These resources ameliorated anxiety and facilitated access to grade-level content for students with gaps from prior years. By promoting the use of these resources to all students in the classroom, rather than singling out certain students, teachers avoided stigmatizing these students and enabled them to participate more fully in the classroom math learning community.

Research also promotes incorporating cultural references and culturally relatable content as approaches to affirm students' feelings that they belong in mathematical spaces.[63] On the days the researchers observed classes, none of the teachers incorporated content including cultural references. Only Ms. Oak's classroom had posters commemorating mathematicians from diverse backgrounds.

Encouraging Growth Mindsets

Students' beliefs about their ability to learn and succeed in math matter for their learning. In recent years, neuroscientific research shows that all students, including those with math learning disability diagnoses, have the ability to build the brain pathways that support math learning and that children's brains respond with "remarkable plasticity" to math learning opportunities.[64] That is, brains continually forge new connections based on math experiences, which means all students can build their capacity to learn math throughout their lives.

Researchers and practitioners alike commonly discuss students' beliefs about their ability to learn and succeed through the lens of mindset theory. Mindset theory posits that learners tend to fall into one of two categories: They either have a fixed mindset whereby they view ability and intelligence as static and innate (e.g., you either *are* or *are not* a math person), or they have a growth mindset whereby they view ability and intelligence as malleable and able to be developed over time.[65] The latter stance aligns with contemporary scientific understandings of how the brain works and, in numerous studies, associates with positive math learning outcomes.[66]

Students' mindsets can be shaped by experiences, and research suggests that teachers can play a role in developing or supporting students' growth mindset beliefs.[67] A teacher can influence students' mindsets through explicit messaging about the brain's ability to grow and learn. Teachers can also influence student mindsets through their instructional practices, which can implicitly reinforce or contradict growth mindset messaging (see Delivering High-Quality Instruction for more on this topic).[68]

This section describes teachers' beliefs about the importance of cultivating growth mindsets in their math classroom and the explicit and implicit ways that they encouraged students' growth mindsets and mathematical mindsets.

Practices to Promote a Growth Mindset

In this study, all teachers expressed a growth mindset toward their students' abilities: That is, they all believed that their students' math abilities were *not* innate and could be grown through effort.[69] They also shared that most of their students were familiar with growth mindset ideas, having been exposed to growth mindset messaging throughout their school careers. At the same time, teachers recognized that many students entered the math classroom with negative dispositions toward math as a result of prior experiences. Teachers worked to counteract the influence of these predispositions by encouraging and reinforcing a growth mindset orientation in a variety of ways.

Explicit Mindset Messaging

One strategy teachers used was communicating to their students, repeatedly, the conviction that each and every one of them can grow their math abilities. Posters adorned the walls of nearly every teacher's classrooms, encouraging students to seek "Progress not perfection," and reminding them that "Mistakes are expected, inspected, and respected," or endorsing similar perspectives.

Teachers also described regularly reminding students that learning math is a *process* and that it is typical not to experience success right away. As Ms. Cedar explained, "Kids historically have seen math as either you're right or [you're] wrong." She aimed to destabilize this perspective and instead help students interpret mistakes and errors as part of their ongoing learning rather than as evidence of failure. She communicated this idea through both verbal messaging and the design of classroom activities. For example, she coordinated a group work activity in which students completed problems and then received immediate feedback from her student teacher via a software platform. In response to this feedback, groups corrected errors or discussed how they could revise and improve their solution or explanation.

By having all students respond to improvement-oriented feedback, Ms. Cedar normalized and destigmatized the practices of correcting mistakes and revising one's work. From classroom observations, it was clear that her students had internalized this message. At one point during the observation, Ms. Cedar accidentally wrote an inequality sign facing the wrong direction. She quickly noticed it and corrected it. A student chimed in with what appeared to be a common classroom reframe: "Mistakes happen!" Ms. Cedar smiled, repeating back to the student, "Mistakes happen."

Multiple teachers shared Ms. Cedar's perspective on mistakes and errors. "Making mistakes is important, and it's part of the learning process," said Ms. Ozark. She explained how she tends to respond when a student shares an incorrect answer:

> I just show the problem and ask, "Did anybody else have a different answer?" We start comparing [different answers] and we start talking about it. After our discussion, I tie it up [by saying], "OK, well we did get some incorrect answers, but that led to this discussion and it helped us understand the concept better."… And I always tell them, "Thank you. This is what I wanted to see. This mistake happens often, and I'm very happy you shared it because now we can talk about it."

Through this approach, she aimed to destigmatize incorrect answers and used mistakes as opportunities for students to deepen their learning by discussing different approaches to problem-solving. Notably, the practice of having students critically analyze mistakes communicates to students that the learning goal is to understand math concepts—rather than just getting correct answers—which can reinforce a growth mindset orientation toward math learning.[70]

Ms. Bristlecone, too, described efforts to emphasize how math learning unfolds over time. She shared how she narrates this for students when starting a new unit: "Today we're starting brand new. So today's the first day we're doing it. No one is expecting you to know it perfectly today. No one's expecting you to know it perfectly by the end of the week." She explained that later, when closing the same unit, she makes a point of directing students' attention to their growth over the unit's arc, saying things such as:

> Do you guys remember at the beginning of the unit when we knew none of this? And now you guys are getting 3's and 4's on your test. … You came into this year with none of this knowledge. Look how much you've grown."

At the same time, nearly half of teachers described emphasizing to their students that learning does not happen automatically—it requires them to take risks, try new approaches, and exert effort. Several teachers communicated to their students that while it *is* OK not to know something or to get an answer wrong, it *is not* OK to not be willing to try a problem due to fear of failure. Multiple teachers communicated to students the expectation that they take an active role in their learning, particularly when struggling to master a skill or concept. Ms. Sequoia explained how she framed this idea:

> When we do group work, I always tell them, "If you don't know what you're doing, that's fine, but I also need you to say 'Hey, I need to figure out what I'm doing. Someone help me!'" That's part of having a growth mindset, too. I might not know what I'm doing, but I can still get there—but I've got to ask for help or have somebody explain things. It's OK not to know. But how are you going to get [from there] to knowing?

Implicit Mindset Messaging

In addition to the ways in which they explicitly communicated ideas related to a growth mindset, teachers implemented classroom practices that implicitly reinforced a growth mindset toward math learning.

Teachers approached collaborative group work in ways that reflected an understanding that students were always learning and growing. When assigning groups, nearly all teachers did so randomly on a daily or weekly basis, which resulted in students with different ability and skill levels working together. None of the teachers created classroom groups that clustered students according to their level of achievement (i.e., creating groups of exclusively "high" or "low" achievers), which is a practice that research suggests can reinforce a fixed mindset toward ability.[71]

Multiple teachers also reinforced to students that one of the major benefits of working collaboratively with peers was that they could lean on their peers to support their developing understandings. Ms. Sequoia touched on this idea in her earlier remarks about encouraging students to take an active role in their learning. Ms. Cedar, too, reminded her students, "Not everybody possesses all [the skills they need] yet. But that's why we need each other. Because two brains are better than one." Several teachers also designed their group work to offer problems at multiple difficulty levels to allow students to apply their learning in incrementally challenging situations. Ms. Sequoia, for example, organized word problem options on different tables across the room, allowing students to visit these tables to retrieve their next choice, whereas Ms. Pine used an online platform to offer students different challenge options.

Teachers praised students' thinking and mathematical processes rather than focusing on whether their answers were correct. For example, while observing a group work through a problem, Mr. Sycamore praised their approach, saying "I love that you chose that [strategy]." After talking through how their approach got them to the correct answer, he concluded with, "Nice work. You proved it!" In Ms. Oak's class, when a student answered a review question using a different strategy than other students had, she affirmed his approach by saying, "Way to mix it up!" (For more about teachers' encouragement of multiple methods for problem-solving, see Developing Conceptual Understanding.) Ms. Cedar approached correct answers that students shared in the same way that she approached incorrect answers, saying to them, "It could be right, it could be wrong. Let's convince each other." Rather than focusing on the outcome, she communicated that she valued students' efforts to explain their thinking and justify their mathematical approach.

Finally, teachers approached assessment in ways that conveyed a growth mindset. Multiple teachers allowed students to use their homework or classroom notes as a resource while completing an exit ticket, which allowed students to work toward mastery of a topic at their own pace. In addition, nearly all of the teachers in this study allowed students to revise or retake assessments, a practice that encourages students to work toward mastery of class content.

One challenge that several teachers experienced, however, was that they could not allow their students to retake the standardized district assessments that occurred periodically throughout the year. These teachers communicated that these assessments were disheartening for some students, since the score they received on them was final and precluded them from opportunities to continue working toward mastery.

Delivering High-Quality Instruction

Classroom learning environments that allow students to feel emotionally safe, supported, challenged, and able to succeed provide the conditions necessary for deep engagement in academic learning opportunities. However, these developmentally enabling classroom conditions must be coupled with high-quality math instruction in order for students to reach their potential as learners of math.[72] Indeed, the other positive classroom conditions discussed in the report appear to lay the groundwork for students to engage with, make meaning of, and benefit from well-designed math learning experiences.

The National Council of Teachers of Mathematics (NCTM) lays out a research-informed set of high-leverage math teaching practices in *Principles to Action: Ensuring Mathematical Success for All*. These practices include:

- establishing math goals to focus learning,
- implementing tasks that promote reasoning and problem-solving,
- using and connecting mathematical representations,
- facilitating meaningful mathematical discourse,
- posing purposeful questions,
- building procedural fluency from conceptual understanding,
- supporting productive struggle in learning mathematics, and
- eliciting and using evidence of student thinking.[73]

For more than 10 years, NCTM has stood behind this list. These teaching practices reflect the consensus first articulated in the National Research Council's seminal report *Adding It Up: Helping Children Learn Mathematics*: that learning math involves developing not only students' procedural fluency but also their conceptual understanding, strategic competence, adaptive reasoning, and a productive disposition toward learning.[74]

Researchers also examine the types of instructional practices that math teachers can adopt to cultivate students' growth mindset toward math. One broadly endorsed body of theory builds from the position that traditional approaches to math instruction—i.e., those characterized by the expectation that students will use a single, algorithmic method to get a correct answer—contribute to student frustration in ways that inhibit the development of a growth mindset.[75] In order to avoid this pitfall, proponents suggest that math teachers should both provide explicit growth messaging *and* present math as a more "open" subject—that is, one that involves thinking about patterns and ideas rather than simply producing correct answers.[76]

Redesigning math instruction using these approaches has the potential to help students develop a "mathematical mindset." A mathematical mindset is a belief that one's mathematical understanding and ability grows through engagement with the subject, and that math classrooms provide spaces to think about and make sense of new ideas.[77] These perspectives highlight how the way teachers deliver instruction can shape students' relationships, sense of belonging, and mindset toward math learning,[78] much like other classroom conditions influence how students engage with their instruction.

In the present study, researchers observed teachers delivering instruction on different topics and to different grade levels. When asked to share which of their instructional practices they believed matter most for students' math learning, teachers tended to point to similar practices, specifically designing instruction in short, manageable chunks; developing conceptual understanding; activating students' prior knowledge; providing ongoing feedback to students as they develop skills; and supporting mathematical language development. Each of these practices is discussed in greater detail below.

Importantly, none of the teachers included in this study approached these instructional practices in a sit-and-get lecture style, nor did any of them approach students' learning of math through pure inquiry-driven, discovery-based laboratory activities. All teachers used a combination of direct instruction and various forms of peer-to-peer interactions as the way to support students' internalization of the day's lesson.

Designing Direct Instruction in Short, Manageable Chunks

Across classrooms, teachers delivered direct instruction in short, manageable chunks, which they often referred to as mini-lessons. In their mini-lessons, which lasted from 5 to 15 minutes, teachers introduced new concepts or procedures and, in some cases, reviewed previous material that continued to be relevant. Decades of research in learning science lend credence to the practice of "chunking" information to aid learning: Breaking down complex information sequences (mathematical or otherwise) into smaller segments can help overcome the limitations of working memory, supporting retention and later recall.[79]

Teachers said mini-lessons allowed them to scaffold students' understanding while also reserving time for students to make sense of new information through practice and conversation with peers. Notably, research evidence consistently finds that this type of systematic instruction, which incrementally builds student knowledge toward learning objectives, supports students' mathematical understanding, with particular benefits for students with previous struggles in math.[80]

Teachers said mini-lessons allowed them to scaffold students' understanding while also reserving time for students to make sense of new information through practice and conversation with peers.

Mr. Sycamore explained that he aimed to gradually teach students the elements of a new mathematical process “piece by piece,” while offering them opportunities to practice in between new additions. Ms. Pine said she drew on her years of accumulated knowledge as a math teacher to segment instruction based on “how much [new information students] can take at once without it getting muddled all together.” Ms. Oak similarly described the delicate work of right-sizing her instructional development, saying that she was “always trying to think of what’s the right appropriate step, not a crazy step or too small that it doesn’t feel challenging enough.”

While many of the observed mini-lessons were didactic—i.e., the teacher explained and modeled mathematical procedures to the whole class—a small number of lessons introduced a new procedure in which teachers prompted students to develop a “rule” for how to go about problem-solving (see Developing Conceptual Understanding for an example of this). In adopting this more exploratory lesson structure, Ms. Sequoia shared that her goal was to get the students to do more of the mathematical thinking. She contrasted this approach with her own experience as a young math student, explaining, “When I was a kid, math was basically a lecture, where [the teacher said] ‘Here’s what you do. Repeat it.’” She aimed to help her students move beyond this type of mimicry and instead become competent at analyzing mathematical patterns and processes.

In nearly all cases, mini-lessons occurred near the start of the class, before students began engaging in their major tasks of collaborative student group work for the period. The collaborative work time offered students opportunities to make sense of the mini-lesson with their peers. As they worked together to solve problems, students deployed various mathematical representations, questioned each other, explained their thinking, and struggled productively, all with loose oversight from their teacher (see Providing Ongoing Feedback on Student Work).

Although this study’s research design did not allow for in-depth analysis of students’ mathematical discourse during their working times, readers are cautioned not to interpret the omission of these interactions as an endorsement of exclusively teacher-centered instructional practices. The teachers observed in this study intentionally allocated sizeable time during their class period for students to grapple with their mathematical understanding alongside their peers, within the scaffolds provided by their direct instruction.

In several cases, teachers called students back together for a second mini-lesson after a segment of collaborative work time. In these second mini-lessons, teachers continued developing the day’s content, typically in response to tendencies that the teacher observed in the students’ collaborative work. Referring to the double mini-lesson structure, Ms. Pepper expressed her belief that “it really helps, because they’re getting two lessons in one day and they’re getting to talk to each other about it twice in one [class].” This strategy is also well grounded in cognitive science: Direct instruction, when delivered after an active learning experience, can introduce principles that help students make sense of previously observed patterns, thereby solidifying and extending insights gained during their active learning experience.[81]

Developing Conceptual Understanding

Contemporary research suggests the importance of teaching math with an emphasis on conceptual understanding—i.e., emphasizing the "why" rather than just the "how" of mathematical content and making connections between different areas of math and problem-solving procedures.[82] Conceptual understanding can promote greater mathematical fluency, support the retention of new facts and methods, and enhance students' ability to apply their math learning to novel situations.[83]

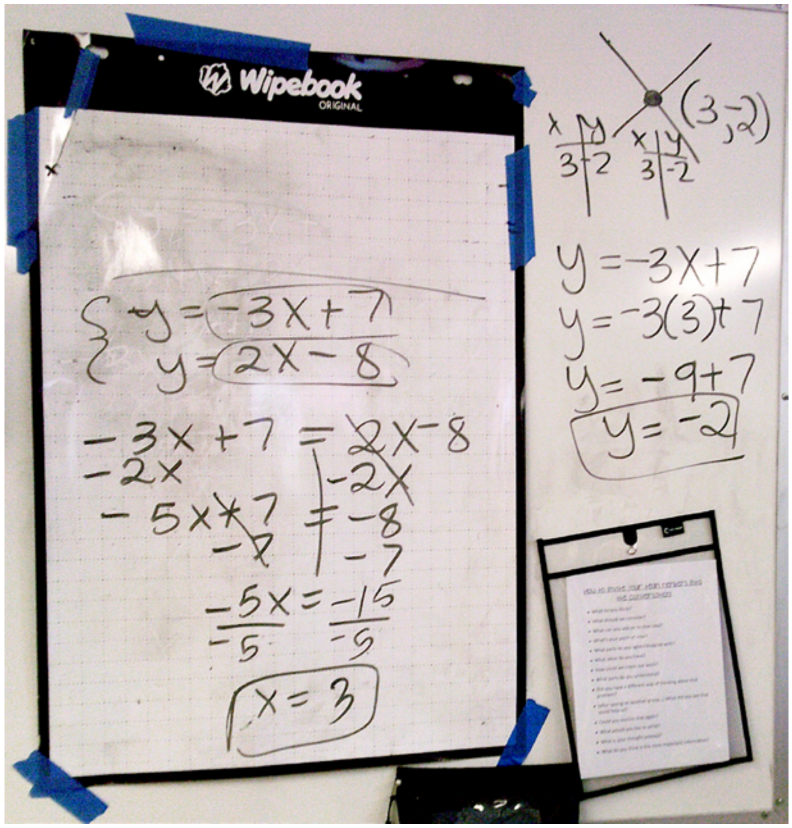
Several teachers communicated the priority of developing students' conceptual understanding of the math because it would help students make sense of current and future mathematical ideas and procedures. Teachers recognized that, in their previous years of math classes, students often learned to execute mathematical algorithms without understanding what they were doing or why it worked.

In several cases, these teachers worked to undergird procedural knowledge with conceptual understanding. For example, one lesson focused on solving systems of equations using the substitution method. The teacher explained the standard procedure while also emphasizing the conceptual meaning—that the solution of a system of equations represented the point where the equations intersect when graphed. In another case, Ms. Pine began a mini-lesson on multiplying exponents by reminding students of the conceptual meaning of an exponent—that it indicates repeated multiplication. She then modeled how to rewrite the expression $x^3 * x^3 * x^7$ in its expanded form—$(x * x * x) * (x * x * x * x * x * x * x)$—and made the connection for students that, due to the commutative property of multiplication, this expanded expression is equivalent to x^{10}. Thus, she concluded: $x^3 * x^7 = x^{10}$.

After modeling a similar problem, she prompted students to identify a "rule" for multiplying exponents for variables with the same base, at which point students intuited the standard procedure for doing so: Keep the base the same and add the exponents. In this instance, the conceptual development preceded and contributed to students' procedural knowledge, while also clarifying for them why the standard procedure worked. This practice was observed in multiple classrooms, while other classrooms developed conceptual understanding in tandem with procedural knowledge.

Across classrooms, teachers taught students multiple means of representing different mathematical procedures. Importantly, when doing so, they helped their students understand the connections between the features of different representational models. For example, in a lesson focused on solving systems of equations algebraically using the substitution method, Ms. Cypress demonstrated finding the solution. She then narrated for students how this solution related to what they would see when solving systems of equations using different methods: She reminded them that if they were to graph the lines, this solution would be the same as the point of intersection between the two lines. If they were to instead create a function table, the solution would occur where both equations produced the same output for a given input (see Figure 4). By drawing these connections, Ms. Cypress reinforced students' prior learning and continued to develop their conceptual understanding of what it means to solve a system of equations.

Figure 4. Solving Systems of Equations in Ms. Cypress's Classroom



Source: Learning Policy Institute photo of classroom activity. (2025).

After students were introduced to multiple methods of approaching a problem, several of the observed teachers encouraged them to select the method they found most comfortable when solving subsequent problems of the same type. This practice can help students view math as more "open" and creative than if they have to rely on a single prescribed algorithm.[84] During lessons, teachers affirmed the different methods students chose to use and, in several cases, discussed these strategies with the whole class or even projected examples of groups' approaches on the board.

In other instances, teachers also provided students with feedback about the relative efficiency (or inefficiency) of different methods, particularly when they observed students selecting a more labor-intensive or time-consuming representational method. For example, in the lesson on multiplying exponents described briefly above, several students opted to write each expression they approached in expanded form, as their teacher had modeled initially. When circulating, the teacher (Ms. Pine) affirmed their answer while also engaging them in a quick conversation about how long it took to solve each problem using the expanded form, validating that "it's annoying" to write the expression out in this way. She reminded that group about the shorthand strategy of adding the exponents as a more efficient route to the same answer, and the students subsequently adopted this method. Ms. Ozark also acknowledged that, although she valued and celebrated the different methods students learned and adopted, she ultimately tended to direct students toward more time-efficient algorithms that would be "the most beneficial strategy to use ... when taking a test."

Activating Prior Knowledge

Teachers repeatedly referenced the importance of activating students' prior knowledge when introducing new content or when approaching the end of an instructional unit. Some teachers built regular review into their lesson structure, for instance by starting the period with an activity designed to prompt recall of past vocabulary or procedures. "I want them to connect to what they already know so they recognize that [what they're learning that day] is not entirely new material," explained Ms. Oak. Starting with something familiar, she continued, also gave students the opportunity for the "repeated practice that helps their brains to learn and hold onto" different mathematical concepts and procedures. She also noted that review helps build student confidence when using vocabulary and when approaching specific problem types. Beginning a lesson with review can help students feel successful from the start. Over time, it can also reduce the distress students experience when they encounter related problem-solving scenarios.

As Ms. Cedar noted, reviewing skills involved in the day's lesson can help fill gaps that may exist in a student's mathematical knowledge and equip them with the tools they need to approach grade-level content. When planning a lesson on dividing fractions with common denominators, Ms. Cedar recognized that students would benefit from a review of how to convert mixed numbers into improper fractions—an often-necessary step to take before beginning to divide. In this case, as well as others, the need for review sometimes became apparent during the lesson itself, when students struggled to apply skills from past lessons to the present work. As her first-period lesson unfolded, Ms. Cedar realized that quite a few students struggled to identify the least common multiple of two fractions, a skill needed to rewrite both fractions with a common denominator. In subsequent periods, she used this observation data from the first period to build in additional review to address this observed skills gap (see How Teachers Used Data to Improve Classroom Conditions).

The practice of building in time to review skills relevant to the day's lesson was observed in many classrooms. In some cases, reviews were a planned part of the lesson; in other cases, teachers added in review in response to observed student uncertainty when recalling past concepts, skills, and procedures. Teachers' emphasis on collaborative group work helped address gaps in student skills and conceptual knowledge: When working together, students with spotty prior knowledge could learn from or have their recall prompted by observing how a peer executed a mathematical procedure.

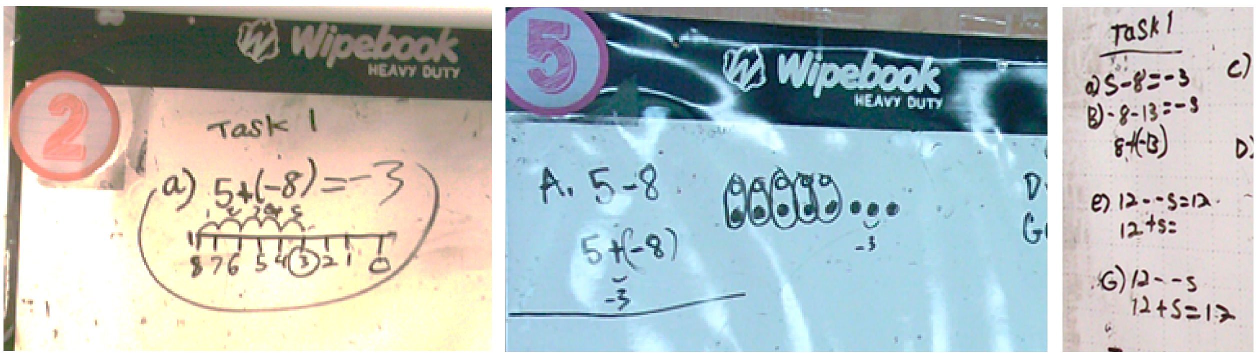
Teachers' emphasis on collaborative group work helped address gaps in student skills and conceptual knowledge.

Teachers also acknowledged that incorporating regular review served the pragmatic purpose of preparing students for end-of-year cumulative standardized assessments. By reviewing skills and concepts learned earlier in the year, teachers hoped to keep the skills fresh and readily accessible to students. In one case, a teacher used these review problems instead as an opportunity to incorporate older material, unrelated to the day's lesson, so that students would be accustomed to the random nature of the ordering of questions on state tests. In all other cases, teachers selectively reviewed past content that related to the topic at hand.

Providing Ongoing Feedback on Student Work

Multiple teachers noted that one major benefit of extensive, in-class student work time was that it allowed them to observe students' problem-solving procedures, provide feedback on student work, and address emerging misconceptions, all during the same class period. Ms. Ozark explained that getting students up and working at their vertical whiteboards allowed her to overhear and see the variations in students' verbal and written thought processes (see Figure 5). When they're up at the whiteboards, she shared, "That is when the thought process starts to come out."

Figure 5. Vertical Whiteboards Group Work Station Examples, Ms. Ozark's Class



Source: Learning Policy Institute photo of classroom activity. (2025).

Another teacher, Ms. Sequoia, explained that having students work together in small groups allowed her to individualize her support to each group. "I am able to work in small groups in a different way," she said. "I'm able to interact with students a lot more and have conversations with them." This individualized support was precisely what the researchers observed during their observations of this teacher's classroom: Within the span of just a few minutes during group work time, the teacher circulated among four different student groups, each working to convert 26% into its equivalent and fully simplified fraction. With each group, she paused for a few moments of interaction and provided guidance that responded to their group's need. Examples included the following:

- **Prompting Continued Engagement.** One group, moving quickly through the problems, rewrote 26% and several subsequent percentages as an equivalent fraction with a denominator of 100 but had not reduced these fractions to their simplest form. The teacher prompted this group to revisit their work, saying, "You're not quite done. You're going to want to go back and ask yourself, 'Can I simplify?'"
- **Identifying Student Errors.** Another group wrote the incorrect answer of 12/50. The teacher noticed the error and paused, saying, "You're going to want to check this." Suspecting that the students had made a mistake when simplifying their fraction, she asked, "How did you get one hundredths to fiftieths?" The students answered that they had divided the numerator and denominator of the fraction by 2. As her group mates were explaining this, one student caught the error they had made when dividing the numerator, saying, "Ohhh. It should be 13/50!"

- **Addressing Skill Gaps.** Yet another group seemed to be stuck when it came to reducing fractions into their most simplified form. The teacher paused with this group for a few moments longer than with other groups, patiently reminding them of the steps in this process and helping them think through how to identify common factors of the numerator and denominator.
- **Extending Student Learning.** A final group got the correct answer, 13/50. Without acknowledging their answer's correctness, she asked them if the fraction was fully simplified, prompting them to think if there are any numbers that 13 is divisible by. When, after a moment of thought, the students affirmed that 13 isn't divisible by anything other than itself and 1, the teacher pushed them to use the vocabulary word that describes it, resulting in students identifying 13 as a prime number.

By circulating to each group and observing their work, the teacher delivered brief, targeted interventions that met each student group where they were in terms of their procedural or conceptual understanding. Teachers could also tailor support based on students' learning needs and assets, for example by delivering short Spanish-language explanations to a group that had one or more English learners or by issuing reminders to stay on task to groups with students who tended to get distracted. Several other teachers engaged with student groups in similar ways during their work time. Most of these teachers also consciously aimed to avoid giving, as Ms. Sequoia put it, "too much" feedback while still giving enough that they're "not just floundering."

Teachers' observations of student work helped them understand when misconceptions or procedural struggles were common across groups. When this happened, several teachers paused students' collaborative work to provide a brief mini-lesson focused on the observed point of friction. For example, Ms. Ozark paused student collaborative work time and called all students together into a huddle in front of one of the classroom's several vertical whiteboards. On the board, she wrote a problem that she observed several student groups struggling with and provided the first step toward solving it. She then asked students to speak with a "shoulder partner"—the student sitting next to them—about how they would continue solving the expression, which spurred active discussion. Subsequently, she selected a student to talk the whole class through the rest of the process for solving, and she affirmed his explanation, adding narration to explain the conceptual basis of the student's process. In other cases, a teacher's mini-lesson might spotlight different problem-solving methods observed across student groups and identify efficiencies, with the goal of providing other students with ideas about how they might approach problems.

Supporting Mathematical Language Development

In several instances, teachers noted in their interviews the importance of supporting students in developing habits of precision in their mathematical vocabulary use. In their classroom instruction, the majority of teachers consistently emphasized precise mathematical language use throughout their lesson and student work time.

Teachers modeled the use of mathematical vocabulary, often reminding students of the meaning of specific terms when introducing new content or reviewing processes addressed in past lessons. When students used imprecise language in their contributions to whole-class discussion, teachers commonly affirmed their conceptual understanding while simultaneously either revoicing their contribution using mathematical language or prompting students to themselves reframe their contribution using the mathematical language that was available to them. Mr. Sycamore expressed a noted emphasis on vocabulary development in his interview. In his classrooms, he emphasized to students that new mathematical vocabulary takes practice: “It doesn’t always come easily at first.” This messaging normalized the difficult transition between intuitive language and mathematical language, while still holding students accountable for working toward precise mathematical language use.

Often, teachers’ emphasis on using mathematical vocabulary also aimed to support students’ developing conceptual understanding. For instance, during a class period taught by Ms. Cedar, students were learning to divide fractions. During the teacher-led demonstration of the strategy students would be applying that day, dividing the fractions resulted in a quotient of $^4/_1$, and Ms. Cedar asked the class how to proceed when encountering this type of fraction. A student responded that “the 1 goes away,” meaning that they should rewrite the answer as the number 4. Ms. Cedar quickly stepped in to clarify the “why” behind this procedural answer, affirming the student’s contribution while explaining that $^4/_1$ “can be rewritten as a whole number since the denominator is 1.”

In another instance, a student in Ms. Pine’s class incorrectly read the term x^3 aloud as “X 3.” She quickly provided the more accurate mathematical language: “X to the power of 3” or “X cubed.” Ms. Pine used this moment to remind students of the mathematical meaning of the exponent, clarifying the difference between x^3 and the expression $3x$. In doing so, she linked the mathematical language with its conceptual meaning.

Using Data to Understand Student Engagement With Learning Math

Data on students' experiences in their classroom learning environment can support teachers' efforts to improve student engagement. Prior research on how math teachers, in particular, use this type of student perception data is severely limited. Broader research on data use suggests that certain factors make the collection and use of data more or less likely, finding that:

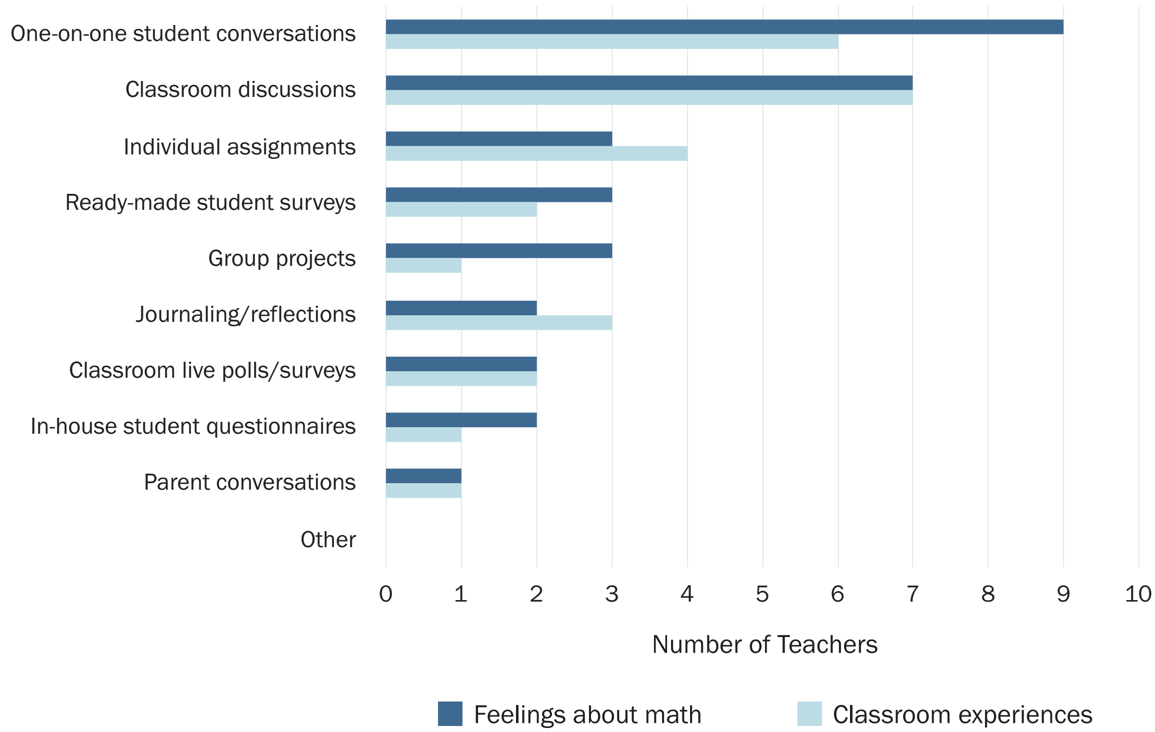
- teachers' uptake improves when data collection tools can be initiated by teachers, are easy to use, address teachers' questions, allow teachers to customize questions, focus on their classroom of students, and feature automated and visual outputs;[85]
- teachers become frustrated when new schoolwide data collection systems are implemented without training teachers on their use;[86]
- training helps teachers make sense of and act upon the data outputs;[87] and
- support from school principals[88] and alignment with school and/or district goals[89] are crucial for impactful data use.

All teachers selected for this study specifically had access to some type of student perception data: Their district had adopted a formal student perception data collection system or they participated in a professional learning network that provided them with a tool to collect their own classroom data. All the teachers in this study worked diligently to create classroom conditions that would support the math learning of their students and continuously monitored multiple data sources about their students' math learning and classroom experiences to further support and improve the conditions. This section summarizes how these teachers collected, accessed, and used their students' perceptions of classroom conditions to improve the learning environment.

Types of Data Collection on Student Perspectives

Teachers reported using a variety of data sources to understand students' experiences in their classrooms. On their pre-observation surveys (see Figure 6), one-on-one conversations and classroom discussions were the most commonly noted strategies for collecting information from their students about their feelings about math and their experiences in the classroom. Some teachers used electronic data collection sources, such as a ready-made student survey (e.g., PERTS Elevate, Panorama, Kelvin), classroom polls (e.g., Mentimeter, Poll Everywhere), or custom in-house student questionnaires created by the teacher or school staff. In interviews, teachers also noted their classroom observations of student behavior and engagement and teachers' personal interactions with students as important data sources. Teachers also leveraged more formalized and recorded data, to varying degrees, from student surveys that were developed and administered by their district, a professional learning community, or by teachers themselves.

Figure 6. Data Sources Teachers Used to Understand Student Experiences



Notes: *n* = 9. (One teacher did not complete the questionnaire.) The question asked: "Which ways do you collect information from your students to understand their classroom experiences? Please check all that apply. Which ways do you collect information from your students to understand their feelings about learning math? Please check all that apply." Feelings about math can include their emotional reactions to the day's lesson or math in general; their prior experiences learning math; and/or their aspirations, hopes, and dreams for their future learning of mathematics.

Source: Learning Policy Institute analysis of teacher background questionnaire. (2025).

Data From Classroom Observation and Interaction

In interviews, the majority of teachers identified that their most important data source for understanding students' feelings about math and their perceptions of classroom learning conditions came from in-person observations of student behavior and engagement and their interactions with students. Due to the amount of time that they spent with students during daily class periods—and, in some cases, drawing on many years of experience working with children—teachers described feeling confident in their ability to assess student feelings about math by observing their classroom behaviors or by soliciting information directly from students.

It is important to note that prior research has shown that what and who teachers notice in the classrooms has social, cultural, and ideological dimensions shaped by teachers' own beliefs and experiences.[90] These dimensions can bias how teachers see, hear, and understand students' actions, speech, and nonverbal cues.[91] It takes training and practice for teachers to refine their noticing practices to nurture equitable mathematical classroom experiences and promote positive mindsets for all students.[92] This caveat does not dispute teachers' claims that they could understand their students' experiences through observations—indeed, the examples below suggest that their observations yielded important insights. Instead, the intention of the caveat is to note that teachers' observations can be prone to subjective creep and thus may be incomplete.

In multiple instances, teachers described noticing subtle behavior cues that they believed to indicate student attitudes toward math. For Ms. Cedar, informal data collection began the moment that students stepped into the classroom. From her perspective, students' emotional affect could be an indicator of their attitude toward the class: "I can see so much at the door," Ms. Cedar said. "You can tell who's excited about coming into this room and who's not." In other cases, teachers described carefully observing the way that students engaged during the class period, both in relation to the math content and with their peers.

Lack of engagement or participation was described as a red flag that could trigger more focused teacher attention on a student. "If they're not engaging, I look deeper to figure out why," said Ms. Oak. "Generally, it has to do with their [ability to access the material]." Ms. Birch shared this sense that disengagement could indicate that students were "just completely lost." Teachers shared that behavior changes—for instance, when a normally vibrant student begins acting listless—served as a flag for teachers that something might need attention.

A few teachers acknowledged that it could be challenging to interpret student behavioral cues to understand their underlying cause. For instance, Ms. Birch described how students might disengage because they feel utterly lost in relation to the math, but they also might be reluctant to engage if they feel like a social outsider to the classroom community. Disengagement could also be driven by circumstances entirely separate from the classroom, which was something acknowledged by several teachers. Regardless of the cause, several teachers spoke about the importance of understanding the underlying issues that motivated student disengagement. "That's where the relationship building comes into play," said Ms. Birch.

During class periods, teachers also solicited information directly from students about how they felt in relation to their math learning. At the beginning of the school year, several teachers had students complete a "mathography"—a math biography—that tells the story of their math journey,[93] which teachers felt helped them understand students' past experiences with math and their current feelings about the subject. Another technique, used by four of the teachers, was to check in with students about their level of comfort with the day's lesson. For example, some teachers asked students to report whether a task felt "easy, medium, or hard" or indicate their level of comfort by holding up anywhere from five fingers (meaning "I could teach this") to one finger (meaning "I'm totally lost"). Research underscores how this type of student self-assessment furthers learning.[94]

A few teachers also described conversations with students as important sources of information about students' feelings toward math and the classroom context in general. In some cases, teachers gauged feelings via conversations between the teacher and a student, and other teachers gleaned insights from conversations they overheard between students.

Teachers shared that, for the most part, they did not systematically record or reflect on their classroom observations. The one exception was Ms. Cedar, who implemented a formalized system for tracking how students engaged in group work. On a clipboard, Ms. Cedar evaluated how each student enacted classroom norms around collaborative group work, specifically how they participated, shared airtime with their collaborators, stayed together on a specific problem, listened to others' contributions, adhered to team roles, and asked clarifying questions of one another.

While this data collection served as a form of assessment, Ms. Cedar also used the information to inform when and how she chose to reinforce classroom norms and support students in developing more productive approaches to collaboration. Ms. Cedar's clipboard, as a written artifact, provided the most detailed insight into the many factors that teachers in the study reported monitoring throughout their instruction. In all other cases, teachers described either episodically recording notes on their observations and interactions with students or relying on their accumulated impressions of student behavior. In the latter case, teachers cited time limitations as inhibiting more formalized or comprehensive reflection on observational data.

Data From Surveys

In all cases, teachers supplemented informal data from classroom observation and interactions with more formal, recorded data from student surveys. It is important to note that the teachers included in this study may be atypical in terms of their access to student data, as they were specifically selected because they had access to some form of student perception survey to understand student attitudes in their math classrooms. In some cases, the formal surveys were administered by their district or school and, in other cases, they were voluntarily administered by teachers as part of their participation in a professional learning network. Some teachers also supplemented these data with surveys they developed themselves to better understand student experiences in their math classrooms.

District Surveys

Teachers were often able to access student perception data through general schoolwide datasets, such as the California Healthy Kids Survey used by San Diego Unified and Sweetwater Union school districts or the Panorama used by Long Beach Unified School District. These surveys offered valuable information on how to compare students' perceptions between schools or districts. Some districts, such as Long Beach Unified, created additional in-house surveys for their specific schools.

In Long Beach Unified, all schools administered a Wellness Pulse Survey at the beginning of the second semester to collect data on student perceptions of their personal identity, belonging, and agency (see Table 4). Schools used data from these surveys to inform improvements in different focus areas and added questions to probe for more information in focus areas. For instance, Tincher Preparatory School adopted a school-level emphasis on student belonging, while Stephens Middle School focused on the engagement aspect of student agency. To better understand student engagement, the Stephens administration supplemented the standard set of questions included in the survey, adding questions for students to self-assess their level of engagement on a scale of 1 to 5 for each of their class periods. Students were also prompted to identify the class where they felt most engaged and explain why.

Using these supplemental data, the school administration could report each teacher's average engagement scores and analyze qualitative data on students' thoughts about what makes a classroom engaging. Teachers were also notified of individual students in their classes who reported exceptionally low levels of engagement, which enabled targeted interventions. The school administration also disaggregated students' responses demographically, which allowed for analysis of variation between student groups. Administrators noted a particular focus on the engagement of Black students and English learners, and the data they collected allowed them to monitor changes in student groups' levels of engagement over time.

Table 4. Long Beach Unified School District Wellness Pulse Survey: Topic Descriptions

Agency	Agency refers to students' opportunities to take ownership of their learning, including the degree of choice they are able to exert and how engaged and empowered they feel in their learning opportunities.
Belonging	Belonging refers to students' sense of social connectedness and trust in peers and adults within the school community.
Identity	Identity refers to students' sense of self and feelings or pride with regard to their age, gender, religious or spiritual affiliation, sexual orientation, race, ethnicity, and socioeconomic status.

Source: Adapted from Long Beach Unified School District. (2022). *Student Wellness Pulse Survey: Fall 2022 survey results*.

At each Long Beach Unified school, teachers described having opportunities during staff meetings to examine and reflect on the data from these surveys. At one of these schools, for example, a teacher described a staff meeting in which she and her colleagues collaboratively reviewed survey data, discussed strategies for improving student perceptions, and set improvement goals (e.g., to improve students' feelings of belonging by 10 percentage points on the next survey). She shared that despite the existence of this process, "It's not really talked about after that," an admission that suggests an opportunity for better integration of student perception survey data with other school improvement efforts and initiatives.

Professional Learning Network Surveys

As might be true in other districts across the country, four of the teachers in this study participated in a learning community that was external to their district—coming together with teachers from other schools and districts to collect, understand, and use a set of data. Some of the teachers in this study were selected because they participated in the CARE Network, a professional learning network that "focuses on creating [middle school] systems that support student belonging and engagement," particularly for the most underserved students.[95] It brings together teachers in middle schools in San Diego County to work toward increasing "the number of students who are Black, Latinx, Indigenous or from low-income backgrounds who have a strong academic identity and are on-track in 8th grade to graduate high school and successfully enter college and career."[96]

One strand of the CARE Network's work is to build math teachers' capacity to develop and refine "culturally responsive approaches to math instruction" and facilitate lesson study with this focus in mind with teams of teachers at their school sites.[97] As part of their learning process, participating teachers are expected to regularly administer surveys to their students focused on their feelings about math: how they feel connected to the content, sharing in class, receiving feedback from their teacher, motivated to work, heard by others, and cared for by their math teacher.[98]

This study sought to understand teachers' experiences in this type of external professional learning community (PLC) to identify the benefits and potential challenges as they relate to using data collected on their students' math experiences. The teachers believed that understanding their students' feelings about math could usefully inform their teaching practice, and they greatly appreciated the professional support they received through membership in the learning network. However, several reported issues accessing, interpreting, or responding to the prepackaged data they collected with these surveys. Ms. Birch belatedly joined the network and, perhaps for this reason, had not seen her data and did not know where to access it. Another teacher dismissed the positive feedback she received from the survey, suggesting that students may give positive answers out of a desire to please their teacher, thus biasing their results.

Conversely, another teacher was surprised to receive negative feedback from her students on the survey, sharing that she initially believed the data to be a fluke. However, the second survey she administered returned similarly negative feedback. Curious to understand her students' feelings, she created a Google Form for them to share more information about their negative perceptions of the classroom. Her main takeaway from the survey was that students wanted her to incorporate more games, and she continued to harbor uncertainty about how to create a classroom environment that would positively influence students' math learning.

These issues point to the importance of robust professional supports around this type of data interpretation and use. Although the network's intention is to create school-based teams of educators who work together toward instructional improvement, each teacher described their engagement with the student survey data within their own school as a solo endeavor. Embedding supports within the school and district community rather than—or in addition to—housing them in an external and voluntary professional learning network has the potential to help teachers contextualize their interpretation of data and collaborate with colleagues (e.g., fellow math teachers and district math coaches) to workshop, implement, and assess instructional changes.

Personally Developed Surveys

Out of the 10 teachers included in this study, 3 teachers—one from each of the schools in Long Beach Unified—shared that they administered a survey they developed by themselves to understand students' feelings about their math classroom. They administered these surveys at different times in the year, with different intervals of frequency, and with a focus on different topics. Ms. Ozark gave students a survey at the beginning of the school year that asked them to rank their feelings about math on a scale from 1 to 5. This survey helped her get a sense of the attitudes of her incoming students. She noted, "Overall, I feel like a lot of them have mixed emotions about math." The same survey also asked students to share about their favorite teacher, which provided information about preferences that Ms. Ozark could use to tailor her approaches. Ms. Pepper administered a survey to her students at the end of the first semester, asking them to evaluate their experience in her classroom and identify the aspects of the class that they liked and disliked. Ms. Sequoia solicited student input more frequently by periodically including short surveys about classroom activities at the end of quizzes.

How Teachers Used Data to Improve Classroom Conditions

Teachers discussed using formal and informal data on their students' perceptions of classroom conditions to shift lesson design and modify classroom routines and expectations, both of which are described in this section. Teachers tended to describe making modifications guided by their sense of what they thought would generate a positive student response.

Formal and informal data on their students' feelings about math and general classroom conditions informed how teachers modified lesson design. As a part of their formative assessment of student interest and engagement, teachers used their noticing data from informal observations to make midstream adjustments during the class period. For these teachers, a shared strategy to bolster waning interest or engagement was to allow students to engage socially with their peers. For instance, in response to waning student attention or interest, teachers added "turn-and-talks" between students and their seat neighbors, had students stand up rather than sit down for the lesson launch, and/or paused a mini-lesson to call students up to the main whiteboard to complete a problem with the support of their peers. Both informal and formal data-informed planning for future lessons.

One example of how teachers used formal data to improve students' sense of belonging comes from a Long Beach Unified classroom. When the school's Wellness Pulse Survey revealed that students from historically minoritized racial and ethnic groups averaged a lower sense of belonging, the school administration established a school-level focus to improve these students' sense of belonging. This included holding teachers accountable for modifying their classroom practice in ways that would further this goal and provided time during faculty meetings for planning and discussion of how to accomplish it. One math teacher described working to build more representation for Black and Hispanic students into the lesson plans (e.g., by modifying problems to include culturally relevant names and activities) so that students could better see themselves as belonging in the classroom.

In response to data collected from their personally developed student surveys, a few teachers described modifying their instructional approach to improve engagement. To meet student requests for more "fun" instructional elements, teachers incorporated humorous yet informative math videos, game-based learning platforms (e.g., Kahoot!, Blooket), and playful learning activities that offered students multiple modes of engagement.[99]

Some results from teachers' self-developed student surveys proved complicated to integrate into classroom improvements. Ms. Cypress expressed that a downside of surveying student preferences in relation to classroom activities was a tension when students expressed a preference for activities that did not align with what the teacher knew to be pedagogically most beneficial for their learning. For example, when she asked students if they enjoyed the regular classroom activity of working in small groups at whiteboard work stations posted gallery-style around the classroom walls (see Figure 5), many students expressed a preference for independent work. Because she knew that the collaborative whiteboard work was more beneficial for their learning, she noted their preferences but maintained her emphasis on group work—with renewed attention to designing group work time in ways that would support more positive and productive experiences for her students.

Another way teachers mentioned using their data was to modify their classroom routines and expectations. Teachers said they primarily used informal data for this purpose. Based on their observations about how students interacted in the classroom, teachers described shifting their approaches to improve the focus and productivity of these interactions. Depending on the teacher, these adjustments took the form of experimenting with or adopting new systems for behavior management, restating classroom norms or providing students feedback on how they were enacting them, or openly discussing areas of conflict with an eye toward resolution. One example came from Ms. Cedar's use of a system that tracked how students engaged in group work. In response to this tracking data, Ms. Cedar reviewed classroom norms and expectations for collaborative learning time differently with each classroom.

It is worth noting that, in their interviews, teachers described much less frequent use of students' perceptions of the classroom learning environment data than their use of academic data. When asked to "select all that apply" regarding which types of information teachers had used in the previous month, all teachers reported using data on student performance on specific math skills, whereas fewer than half gathered information about students' needs or the classroom climate (see Table 5).

Table 5. Types of Data Math Teachers Reported Using

Data type	Number of teachers
Summative data about student performance on specific math skills	9
Formative data about student performance on specific math skills	9
Information from students about their math learning needs	6
Feedback from my students on my instruction	5
Skills assessment data that is built into curriculum software	4
Information from parents/guardians about students' needs, interests, and goals	3
Information from students about their identities	3
Information from students about how they best learn math	3
Feedback from my students on our classroom climate	3
Other	0

Note: n = 9. (One teacher did not complete the questionnaire.) The survey asked, "Which of the following resources have you used within the last month of teaching in your mathematics classroom? Please select all that apply."

Source: Learning Policy Institute analysis of teacher background questionnaire. (2025). Items adapted from Schweig, J., Pandey, R., Grant, D., Kaufman, J. H., Steiner, E. D., & Seaman, D. (2023). *American Mathematics Educator Survey: 2023 technical documentation and survey results*. RAND Corporation.

Among the academic data collected, teachers informally observed student work and checked for understanding during the class period, gathered exit tickets at the end of the class period, and used summative assessments (e.g., graded quizzes or district exams) and diagnostic or interim assessments (e.g., I-Ready) to chart student progress toward meeting grade-level standards.

School and district administrations made academic data tracking and monitoring a shared priority, providing teachers with regular time and space to reflect on these data and plan collaboratively for academically focused instructional improvement. One school even posted each classroom's aggregate state test scores prominently to keep attention firmly on academic progress, the administrators explained.

Structural Challenges to Teacher Data Use

Although teachers communicated the value of understanding students' perceptions of the classroom learning environment, they noted several barriers when using formally collected data. The most commonly cited barrier was their workload: Given the broad scope of their existing responsibilities and the rapidity of instructional pacing, teachers felt they had little time to engage with new types of data or to redesign their instructional approaches in response to student perceptions. At the same time, teachers noted that surveys were administered too infrequently to assess whether within-year improvements were making a difference. These challenges are not unique to these teachers: Lack of time and work overload are also cited as the main barriers in other research studies.[100]

Teachers noted that the presentations of school-administered district survey results often limited its usefulness. Because schools determined how to analyze their survey data, teachers in different schools received student perception data with various levels of specificity. At Marshall Academy of the Arts and Tincher Preparatory School, school data were only disaggregated by grade level, while the Stephens administration additionally collected student perception data that could be disaggregated by individual teachers. Teachers shared that it was difficult to assess how their practices related to their students' feelings toward math when they only had broad grade-level or school results.

Finally, when schools did not integrate student perception data into school-level instructional improvement efforts, teachers lacked the structure and feedback that might otherwise support their use of data to inform instructional modifications. As noted above, one school's student perception data discussions only occurred in a one-off fashion, which offered little to no encouragement for teachers to pursue sustained improvement. For teachers who participated in the CARE Network, their math instructional improvement priorities were not always shared by their school administration. This disconnect left multiple CARE Network teachers feeling like they were working on math instructional improvement independently, isolated from their broader school community.

Given the emerging research on the importance of classroom conditions for math learning,[101] these teachers' experiences suggest the importance of district- and school-level leadership in encouraging and scaffolding how teachers reflect on and use student perception data for instructional improvement, much as they already do for academic data.

School- and District-Level Conditions Supporting Math Teachers

Teachers exert a large influence over the experiences of students within their classrooms. At the same time, school and district conditions influence teachers' abilities to establish positive classroom learning conditions. The teachers included in this study spoke about several school- and district-level supports that enabled them to improve the learning conditions in their math classrooms.

District-Level Supports

Teachers highlighted their districts' professional development, instructional materials, and math coaches as resources that supported their math teaching practices.

Several teachers identified district-level professional learning opportunities as providing valuable engagement with new instructional ideas. For example, all six of the interviewed teachers in Long Beach Unified School District described significant district-level emphasis on the implementation of a framework for collaborative math learning and math routines, both of which aimed to make classroom learning more engaging and relevant. Over the course of each school year, the district funded teachers' participation in multiple days of training focused on the implementation of these practices, which helped teachers sustain their shifts in instructional practice. Teachers also appreciated the provision of resources that eased the burden of adopting new research-based practices in their classrooms. For instance, the district provided unit guides that included "Which One Doesn't Belong?" and "Notice and Wonder" tasks that teachers regularly wove into their lessons.

In some cases, districts supported teachers in pursuing their own professional learning or leading others in activities focused on math instructional improvement. Sweetwater Union School District provided one middle school and one high school math teacher with release time as a "teacher on special assignment" (TOSA) to provide professional learning to other district teachers that supported their adoption of a new instructional framework (the same used in Long Beach Unified).

Ms. Cypress shared that, in addition to benefiting the participating teachers, the opportunity for her to lead these sessions deepened her own learning. As part of this role, Ms. Cypress led a voluntary book club for the district's math teachers. Each month, the group read a couple of book chapters on the framework. They then met to discuss what they had read and to observe demonstrations, led by Ms. Cypress, showing how to put the book's ideas into practice. Teachers tried out new approaches to math tasks, group work, and asking questions to foster more inclusive and engaging math classrooms. The district also supported some of the book club teachers by funding their attendance at a professional learning session, offered by the district's curriculum provider, on integrating the framework into the math curriculum.

At Marshall Academy of the Arts in Long Beach Unified, the school's math coach ran a similar book club. One Marshall teacher expressed a strong preference for this kind of voluntary professional learning. While participating in required district professional development sessions felt, to her, like "box-checking," she valued voluntary learning communities, such as book clubs, that gave teachers opportunities to connect with and exchange ideas with teachers from other schools.

Although the majority of teachers valued district-provided learning opportunities, they noted that opportunities that focused on instructional improvement generally lacked consideration for classroom learning conditions. The exception, again within Long Beach Unified, was a district-level focus by the superintendent to cultivate students' sense of belonging within the school and classrooms' learning environments. The Wellness Pulse Survey enabled district- and school-level discussion, reflection, and improvement planning around students' perceptions of the classroom learning environment (see Data From Surveys for more information on this). One instructional initiative that emerged from this process at Tincher Preparatory School was an emphasis on having teachers design lessons that better represented students' racial and ethnic identities, with the goal of cultivating students' sense of belonging in the classroom.

District-Level Challenges

Teachers viewed some district-level structures, such as pacing calendars and standardized assessments, as impediments to establishing positive classroom learning conditions. Many expressed frustration that rigid pacing calendars pressured them to rush through material before the majority of their students mastered it. Teachers particularly felt this pressure when their district required them to administer a standardized district assessment that was linked to the pacing calendar at specific intervals during the school year. Teachers reported that these assessments often left their students feeling discouraged, especially because they were not allowed to retake or revise district tests. This "no retakes" policy for district testing stood in contrast to school- and district-level policies to allow students retakes and corrections on other forms of classroom assessment.

At the same time, the teachers understood that these practices were part of the districts' efforts to raise the level of instructional consistency across schools. They recognized the importance of this effort, noting that a major challenge in middle school was that students' background knowledge varied widely depending on which elementary school they had attended. This tension between district efforts to standardize and teachers' need to respond to the unique needs in their classroom contexts is not easily resolved, and it points to the need for further district-level supports for math teachers as they work to meet the ambitious learning targets set at the district level.

School-Level Supports

Teachers praised many of their school supports, including their colleagues, additional in-class support staff, shared teaching materials, and schedules that promoted coordinated teaching efforts. They also noted when they lacked any of these supports and expressed a desire for their schools to provide them.

Colleagues as a Source of Support for Improving Math Teaching

Within their own schools, nearly all teachers described relationships with their colleagues as their main source of support for instructional improvement. That said, it was uncommon for teachers to mention receiving support from colleagues on improving other aspects of their classroom learning environment (e.g., how to build better relationships with students). For example, one teacher described getting new ideas on things like modeling integer subtraction for students but did not discuss brainstorming with her fellow teachers about things like how she could improve students' growth mindsets toward math or enhance their sense of belonging in the math classroom.

In most cases, regular school-level math team meetings or grade-level or subject-area professional learning communities (PLCs) facilitated teachers' engagement with their colleagues. These gatherings provided teachers with opportunities to discuss new, research-aligned instructional practices—such as sharing CLEVR (Claim, Evidence, and Reasoning) prompts between grade-level teachers at Stephens Middle School math department meetings or sharing new curricular activities among 6th-grade teachers at Tincher Preparatory School. Teachers noted that they appreciated learning from early implementers with greater expertise in these areas.

At least one school benefited from a "train the trainer" model of math learning, in which early-implementing teachers attended a district-sponsored training on a new instructional method and then brought it back to teach to their colleagues within the school. The teachers included in this study highly valued these opportunities to learn from their colleagues, with one teacher even stating that she feels like she learns more from her fellow staff members than from professional learning sessions hosted by the district. She felt that her colleagues better understood the needs of students within their school, which made the information they shared more relevant and contextualized.

Not all teachers felt that they had adequate opportunities to collaborate with their colleagues. Some teachers expressed a desire for more subject-specific collaboration time (as opposed to time with grade-level teams). Another teacher explained regretfully that PLC meetings at her school, which were intended to occur on a weekly basis, were regularly supplanted by other community-building activities for school staff (e.g., baby showers or shared meals), leaving her feeling like "we never actually truly PLC together." Conversely, the teachers at a different school noted that the newly structured back-to-back department meetings functioned as an in-house PLC, where they could learn about a new practice and then try it in their classes and report back to their colleagues about how it worked.

The teachers who cited particularly robust collaborative cultures tended to work in schools where school or departmental leadership set strong norms around collaboration time and developed structures to guide improvement-focused conversation between teachers (see Math-Focused Leadership at Stephens Middle School).

Math-Focused Leadership at Stephens Middle School

Stephens Middle School, located in Long Beach Unified School District, provided a particularly strong example of how math-focused leadership can support teachers' instructional improvement. At Stephens, the school administration adopted a focus on improving student math outcomes and implemented several schoolwide instructional norms that shaped teachers' lesson design and delivery. One norm included the use of specific "math routines," or short, structured learning activities intended to improve student engagement. For example, across the math classrooms, teachers implemented a collaborative learning framework that involved students getting out of their desks to work in groups at vertical whiteboards (see Delivering High-Quality Instruction for more information) and closed each lesson with a "Prove It" activity that held students accountable for demonstrating their learning.

Other routines were normed schoolwide and used by teachers regardless of subject area, which allowed these practices to become routine for students. One example was the ClEvR model—which stands for Claim, Evidence, and Reasoning—which provided teachers with a shared model for teaching short response writing in a manner intended to develop students' ability to explain their thinking. The school administration held teachers accountable for implementing focal instructional routines throughout the school year by reserving time during staff meetings to discuss student outcomes and troubleshoot the implementation of these new practices to best meet their students' needs.

CIEvR Model Applied to Math

CIEvR in Math			
Cl	Claim: (the answer)	Yes	No
	Did you answer the question?		
	Is your answer/response clear and in a complete sentence?		
Ev	Evidence: (your math work)	Yes	No
	Did you use numbers, tables, diagrams, graphs, and other given information from the problem?		
	Did you show your work?		
R	Reasoning: (how do you know?)	Yes	No
	Did you explain how you know your answer is correct using math vocabulary?		
	Did you choose a math strategy?		
	Did you connect your reasoning with your evidence?		
	Did you make sense of why you believe your claim is correct?		
	Did you answer the question completely?		

Source: Provided by staff. (2025).

Furthermore, school leadership redesigned the master schedule to add an additional period of math, Math Development, for students who were performing below grade level. This course afforded students additional time to build their math skills, allowing them to develop missing skills from previous grade levels during one period and learn grade-level content in another. Importantly, they designed the schedule so that these students did not miss out on elective courses, and the course was taught by their same math teacher.

By establishing shared priorities for math instruction (e.g., implementing specific instructional routines) and reinforcing focus on them throughout the school year, school leaders gave teachers clear incentives and support for adopting new instructional approaches. At Stephens, leaders implemented a multipronged approach to math instructional improvement, providing teachers with resources for classroom instruction, time for personalized remediation to enable students' access to grade-level content, and support from colleagues as they implemented new practices.

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

Support Staff Increase Capacity for More Personalized Math Instruction

Teachers expressed strong appreciation for the support staff they had access to. The role of support staff varied by classroom. In some cases, an educational specialist co-taught or assisted students on an individual basis. One teacher hosted and co-taught with a preservice teacher candidate who was completing their student-teaching placement. These teachers stated that having another adult in the classroom allowed them to implement more ambitious activities and provide more personalized student feedback in their daily classes.

Teachers integrated their support staff in different ways depending on their role. In some cases, support staff specifically assisted students with special needs; in other cases, teachers operated on more of a co-teaching model. The role of the support staffer could even differ across periods, according to the needs of the students in each classroom. In one instance, Ms. Oak altered the level of personalization in the classroom depending on whether or not she had a support staff member during that class period. She had less time to work directly with individual students when she was the only adult in the classroom. All teachers with support staff expressed that they could only do this type of active math group learning with additional help in the classroom.

Conclusions and Policy Considerations

State education departments, school districts, schools, and individual teachers are undertaking considerable efforts to improve the math learning experiences and achievement of students across grade levels. Growing evidence suggests that the whole of the students' classroom learning environments—including the content being taught—influence their math learning and outcomes. Research also suggests that positive classroom conditions for learning math have a greater impact on learning outcomes among groups of students whose families earn a low income and students of color.[102] As such, there exists solid potential for classroom-level shifts that can create more equitable opportunities for student engagement with and success in mathematics.

Understanding how math teachers cultivate positive classroom conditions for their students can inform efforts to improve math experiences across classrooms. This study improves the evidence base by highlighting teacher practices through case studies of 10 California middle school math teachers. This study also shows how fostering positive relationships, developing students' sense of belonging, and encouraging growth mindsets can occur simultaneously with the delivery of high-quality instruction and reinforce it in important ways.

Cultivating Positive Classroom Conditions for Learning Math

Students benefit both developmentally and cognitively from learning math in classrooms that provide them with supportive relationships, a strong sense of classroom and mathematics belonging, a firm conviction in their capacity to grow their math abilities, and opportunities to fully engage with high-quality math instruction.[103] This report examines how a group of middle school teachers identified as effective math engagers cultivated these positive conditions for math learning in their classrooms.

Fostering Positive Relationships in the Classroom

In their math classrooms, teachers in this study prioritized the development of positive relationships with students and between students and their peers. Teachers acknowledged that some students entered middle school with negative attitudes toward math due to their previous classroom experiences. These teachers viewed the relationships they cultivated with students as essential for helping students develop a more positive attitude toward math. To do so, they aimed to establish the classroom as a safe and kind environment for math learning. They also emphasized the importance of positive peer relationships for learning and engagement and worked to channel their students' sociality into learning-focused collaboration. Relationships also enabled teachers to center the students' interests in their math lessons. Classroom routines and norms helped sustain positive teacher–student relationships and peer relationships by making the classroom a welcoming, predictable environment.

Teachers viewed the relationships they cultivated with students as essential for helping students develop a more positive attitude toward math.

Developing Students' Sense of Classroom and Mathematics Belonging

Teachers in this study used a variety of tactics to make every student feel like they belonged as part of the classroom and mathematics community. Teachers gained and demonstrated knowledge of each student as an individual, created opportunities for students to connect on a personal level with their peers, established behavioral expectations that allowed students to feel safe, and provided each student opportunities to contribute to the classroom community. To cultivate their sense of mathematics belonging, teachers explicitly communicated to their students that each and every student could be successful at math, routinely recognized students' abilities as mathematical thinkers in front of their peers, and looked for opportunities to highlight the learning and success of students who doubted their abilities to succeed mathematically.

Encouraging Growth Mindsets

In their classrooms, the teachers in this study adopted different strategies to encourage and reinforce growth mindsets. One strategy was to repeatedly communicate to their students the conviction that each and every student can grow their math abilities. Teachers also described regularly reminding students that learning math is a *process*—i.e., that they should expect to grapple with new material and not experience success right away. Their assessment practices tended to reflect this ethos, with multiple teachers encouraging or requiring students to revise or retake assessments as part of the process of working toward mastery. Nearly half of the teachers also emphasized to their students that learning does not happen automatically—it requires students to take risks, try new approaches, and exert sustained effort. To reinforce this idea, teachers provided ample time for students to practice new skills through structured collaborative and mixed-ability group work time, and they praised students' thinking and mathematical process rather than correct answers.

Delivering High-Quality Instruction

The above-mentioned practices occurred alongside high-quality instruction, which is necessary to fully support students' math success. When asked to share which of their instructional strategies they believed matter most for students' math learning, teachers often pointed to similar practices that are well supported in the learning sciences literature. These strategies included designing direct instruction in short, manageable chunks; working concertedly to develop students' conceptual understanding; activating students' prior knowledge when introducing new concepts; providing ongoing feedback to students as they develop skills and solidify their knowledge; and supporting mathematical language development through active discussion of mathematical ideas and problem-solving strategies. Despite the time teachers spent developing students' conceptual understanding and growing their ability to model math problems using different representations, multiple teachers acknowledged that they eventually guided students toward a single problem-solving algorithm that was best suited to timed, standardized tests.

Use of Data to Inform Practice

This study particularly focused on questions about how teachers gathered insights about their students' experiences and how they used those data to alter practices.

All the teachers in this study worked diligently to create classroom conditions that would support the math learning of their students and continuously monitored multiple data sources about their students' math learning and classroom experiences. They used classroom data to assess students' learning, students' learning experiences, their own teaching effectiveness, and progress on curricular and school goals. Teachers collected these data in a variety of ways, from students' in-class or homework exercises to skills-based test results, surveys of students' experiences, teachers' informal observations of students, and students' self-reflection assignments.[104] Teachers found survey data on their students' experiences in the classroom more challenging to use than their own observational data and survey questions they created for their classroom students.

Teachers gauged their students' feelings about their learning experiences mostly by noticing their behaviors. By attending to their students' behaviors, teachers believed that they were able to assess students' interest, confidence, anxieties, and engagement in the moments of learning.[105] Self-reflection assignments, such as student "mathographies" (math biographies), helped teachers put into context the other data that they collected about the students' skills, perceptions, and feelings about math.[106] Teachers took in all of these sources of data on students' uptake of and engagement with new content to assess their own effectiveness. Looking at all different types of data together—as many teachers in this study did—helped to inform a holistic understanding of students and their classroom needs.

The teachers in this study collaborated with their colleagues, but dedicated time to review data was sparse. Research shows that only about half of American math teachers agree that their work schedules include dedicated time to collaborate with colleagues to review student data.[107] When teachers have the time to use data to inform their practices,[108] they most commonly use it to inform curriculum changes, identify students' needs, and track students' progress.[109] These data can help teachers adjust pacing of teaching and identify strategies that are working more or less effectively within and between classrooms of students. The evidence from this study conforms to these established findings.

National studies show that teachers value data to inform their practice—when the data come in a timely manner and are disaggregated by various groupings of students.[110] Data that come months or even a year later are deemed relatively useless, since classroom contexts are dynamic and fluctuate between semesters and years.[111] Breaking down data by different student characteristics can uncover biases in teaching practices that may favor one group of students over others. Disaggregating results by different student characteristics can work to make the classroom experience more equitable for all students. In turn, this disaggregated data can reveal "instructional microclimates" between different groups of students in the same classroom,[112] which teachers can then use to improve the classroom experience for all students.[113] However, disaggregated data were not commonly available to teachers in this study, as it is not common more generally.[114]

School- and District-Level Conditions Supporting Math Teachers

Teachers exert a large influence over the experiences of students within their classrooms. At the same time, school and district conditions influence teachers' abilities to establish positive classroom learning conditions. The teachers included in this study referred to several school- and district-level supports that enabled them to improve the learning conditions in their math classrooms. At the district level, teachers highlighted their districts' professional development, instructional materials, and math coaches as resources that supported their math teaching practices. On the other hand, teachers viewed some district-level structures, such as pacing calendars and standardized assessments, as impediments to establishing positive classroom learning conditions when these structures pressured them to rush through material with little regard for student mastery.

At the school level, teachers highly valued opportunities to collaborate with and learn from colleagues. Regular math team meetings and professional learning communities helped to facilitate their engagement with colleagues. Teachers valued school or departmental leadership who set strong norms around collaboration time and developed structures to guide improvement-focused conversation between teachers. Teachers also expressed appreciation for the support staff in their classroom, valuing the way these staff members increased personalized instruction.

Policy and Practice Considerations

This study draws on teachers' reflections and perceptions shared in interviews and questionnaires, as well as observations from one day in each of their classrooms. From these findings, several practice implications arose that could be implemented in state, district, or school systems. The sections below identify which actions could most efficiently be applied at each level to have the greatest impact on classroom practice. That said, taking any of these actions at any level—at the state, district, or school level—has the potential to improve the classroom conditions for math teachers and students. For example, in the absence of state-level instructional guidance, district leaders can develop and issue their own instructional guidance.

State Policymakers

Spurred by COVID-19–era math learning loss and slower-than-expected student recovery, several states have passed and enacted legislation in recent years that focus on improving student learning outcomes in math.[115] The strategies by which these policies pursue improvement vary, yet one commonality encourages the adoption of high-quality instructional materials in math classrooms coupled with providing teachers with professional development to support their use of these materials. These approaches hold promise for improving the classroom experiences of many students who currently lack opportunities to engage with appropriately rigorous and well-scaffolded math content. At the same time, as the evidence recounted in this report suggests, attending to the other three classroom conditions can support the positive engagement of all students in classroom learning opportunities. The findings from this report point to the following ways that state policymakers can support teachers in creating classroom conditions more conducive to math learning:

- **Include the importance of creating positive classroom conditions in curriculum and instructional guidance for mathematics educators.** While teachers have received ample guidance on *what* to teach in their math classrooms, they have received considerably less guidance on *how* to teach their content. Emphasizing the importance of developing relationships with students, cultivating student belonging (including mathematics belonging), and encouraging a growth mindset alongside delivering high-quality instruction can benefit all students' learning. States can issue guidance that explains how to develop these elements, articulates their specific importance in math classrooms, and establishes them as core factors for students' engagement in learning in accordance with the evidence on what matters for students' math learning.

One example of state-level guidance is the 2023 California Mathematics Framework, which was "designed to help educators align classroom teaching with California's rigorous math learning standards."[116] The framework focuses on how to deliver high-quality instruction in ways that will help resolve persistent disparities in math outcomes by incorporating research-informed instructional components, including elements of supportive math classrooms known to promote positive outcomes for each and every student, coupled with practice-based examples.[117]

Maryland's PreK–12 Mathematics Policy presents another example. Maryland's new strategic initiative aims to transform mathematics teaching and learning in the state. One of its identified strategies is to promote the use of effective math teaching practices through job-embedded teacher professional learning. The policy's vision for effective math instruction elevates the importance of students' attitudes toward math and sense of belonging in the math classroom alongside other research-informed pedagogical practices.[118]

- **Ensure that teacher education programs instruct future teachers in how to establish positive classroom conditions for students' math learning in their own classrooms.** State policymakers can shape the instructional priorities and capacities of new teachers by updating accreditation and licensing requirements for teacher preparation providers and candidates. For example, states can create or update preparation standards for math teachers to integrate the new research on which positive classroom conditions support student math learning, along with techniques about how to establish those conditions in their classrooms. The recently updated California Standards for the Teaching Profession[119] brought together representatives from the Commission on Teacher Credentialing; university teacher preparation programs; county, regional, and district administrators; and the California Department of Education to update standards for teacher preparation and teacher induction. It incorporates many of these ideas that promote positive classroom conditions for learning in general that could transfer well into the math classroom specifically.
- **Allocate funds for professional learning to support in-service math teachers.** While many math teachers feel highly invested in improving the quality of their students' classroom learning experiences, they often lack access to high-quality professional learning opportunities that could help them do so.[120] Because research shows that teacher participation in in-service professional learning can positively affect K–12 student math outcomes,[121] state investments that increase teachers' access could meaningfully boost students' math learning. Many of the positive aspects of professional learning mentioned by teachers in this study align with known features of effective professional development.[122] These math teachers placed high value on learning from their colleagues, suggesting that a professional learning model in which expert teachers support their colleagues over time could be an effective way to maximize the impact of such investments. There appears to be room, for example, for teachers to learn more from each other about how to incorporate deeper, inquiry-based, and culturally affirming pedagogies.

  Providing or augmenting funds for training and hiring math coaches is another investment option. For example, Alabama's 2022 Numeracy Act allocated one to two math coaches (depending on school size) to all public K–5 schools and specified that these coaches would receive training and ongoing support on evidence-based coaching practices from the state's newly created Office of Mathematics Improvement.[123] As of the 2024–25 school year, Alabama supported 442 building-based math coaches,[124] and, in 2025, the Alabama legislature appropriated $27 million to continue and expand the coaching program.[125] In California, the state legislature has appropriated a total of $50 million for the Mathematics Professional Learning Partnership Grant Program, which funds the development and delivery of educator training for math coaches and teacher leaders in alignment with the state mathematics framework described above.[126]

District and School Leaders

District and school leaders are well positioned to advance their teachers' implementation and maintenance of key factors that support positive classroom conditions for math learning. Teachers from this study emphasized how coordination at the district or school level often supported their efforts. Based on these findings, key considerations for districts and school leaders include the following:

- **Establish a shared vision for excellent math instruction that includes positive classroom conditions for math learning as an essential feature.** By elevating classroom relationships, student belonging, and practices that promote growth mindsets alongside high-quality instruction in a vision statement and in vision-aligned messaging, districts can ensure that central administration, school leaders, teachers, and support staff share an understanding of the full set of factors that influence students' math learning. This shared vision can then inform the types of professional learning and collaboration opportunities made available for school leaders, teachers, and support staff as they work to improve instruction and deliver learning experiences that support the varied needs of all math learners.

  Furthermore, district leaders should consider the barriers that teachers face when implementing this vision (e.g., standardized pacing calendars or interim assessments that require superficial coverage rather than deep understanding) and problem-solve with faculty about how to find supportive alternatives. District and school leaders may also share strategies across district lines to expand ideas about how to manage the tension between advancing positive classroom conditions alongside pacing and assessment requirements.

- **Support data-informed reflection on classroom learning conditions.** Well-designed data systems can help teachers reflect upon students' perceptions of their classroom learning conditions and inform modifications to the classroom learning environment that improve students' experiences. School and district systems around data reporting and use can influence whether and how teachers understand, reflect on, and respond to student data.[127] As evidenced by the uniform encouragement to collect and use skills-based data, school- or district-level emphasis on data collection signals priority areas for teachers to focus their attention. The findings from this study suggest that district and school leaders can constructively shape teachers' engagement with student perception data by:

  - Developing data collection systems that provide teachers, at regular intervals, with timely information about how their students feel about the classroom learning environment and toward math more generally.

  - Including teachers in the development of data collection systems to improve the specificity of the data to their classroom context, the relevance of the data to their classroom concerns, the timeliness of its availability, and the supports necessary for effective data use.

- Reporting data in formats that provide teachers with information about the perceptions of the students they teach, for example, by disaggregating data to the classroom or teacher level and by different student groups rather than reporting it at the school level.
- Adopting processes in the school to support and hold time for teachers' analysis of data and collaborative planning for instructional improvement. Importantly, district and school leaders should remain mindful of the time burdens already faced by teachers when designing these processes and ensure that they are well integrated with existing processes for reflecting on academic data.

Conclusion

As policymakers and practitioners work to improve student math outcomes, a focus on students' experiences in math classrooms is an essential part of the equation. Students' math learning—like all learning—requires social engagement and safety. Classroom relationships and students' feelings about their ability to learn math can shape the ways in which they engage with classroom instruction, as can the ways that teachers present the subject matter and structure math learning activities. Research evidence suggests that creating positive classroom conditions that foster positive relationships, encourage a strong sense of belonging, provide growth mindset supports, and offer high-quality instruction can structure the space to set students up for success in math.

This study examined how middle school math teachers with a reputation for creating strong learning environments promote the evidence-based set of positive conditions for math learning. It also described how teachers used data to understand students' perceptions of their classroom learning environment as well as the school- and district-level conditions that supported teachers in creating positive classroom learning conditions. Taken together, these findings offer implications for policy and practice that can inform steps for state and local institutions to create conditions to support math learning experiences that meet the needs of all students and make success in math more widespread.

Appendix A: Methods

The research team completed data collection between October 2024 and January 2025, with the last site visit conducted on January 23, 2025. In total, the team conducted interviews with and observed the classrooms of 10 middle school math teachers from five different schools in three districts located in Southern California.

Given the focus on teachers' practices, the research design included three data collection methods from teachers: questionnaire, classroom observation, and interview. By combining these data collections, the research team aimed to supplement teachers' perceptions of their practices with direct observations of the learning conditions established in their classroom. The team also triangulated these data with schools' math achievement data from the California Assessment of Student Performance and Progress (CAASPP) and interviews with the principals. In some schools, the research team spoke with additional administrators, including math instructional coaches, and recorded their input in the field notes.

Sample Selection

The research team selected sites for this study based on three criteria determined by strategic foci of the Gates Foundation as well as theoretically motivated to inform policies for math teaching practice. The following criteria were used for sample selection:

1. Districts of the teachers must have supported a data collection tool that assessed students' perceptions of their school and classroom learning environment. Some districts (Long Beach Unified) directly supported the data collection through the Panorama and Wellness Pulse Surveys, and other districts (San Diego Unified, Sweetwater Union) directly supported their teachers via financial or time-effort resources to independently collect data through the High Tech High College of Education.

2. To align with the strategic focus of the Gates Foundation, site selection was narrowed to California schools serving predominantly students of color or students from low-income families.

3. Teacher selection was narrowed to math teachers in grades 6–8 due to the pivotal role of middle schools in shaping students' access to advanced math courses in high school and beyond.

District and school selection was informed by conversations with math-focused academics and education professionals about districts and schools with reputations for leading improvements in middle school math achievement since the pandemic.

Once the research team identified appropriate sites, the team received permission to conduct research with each district, contacted superintendents and principals, and requested their recommendations for math teachers who cultivate classroom environments that promote math learning. The team selected these teachers because they stood out among their colleagues. While researchers did not select teachers on any objective measure of positive math mindsets in their classrooms, this study confirmed that their schools were showing progress in math achievement and the teachers were recognized for using pedagogies that promote positive math mindsets. Additional student surveys from some of the teachers' classrooms (see Data Collection Protocols) triangulated the data, confirming the elements of positive classroom conditions for learning math in which these teachers stood above the national average. According to these surveys, all teachers exceeded the national average on multiple survey items, confirming their expertise in cultivating positive learning environments.

The research team contacted all teachers via a shared email exchange with their principal or instructional coach as the point of contact.

Schools received compensation for their participation in the study, and the five teachers who administered the student survey also received compensation.

The research team obtained institutional review board approval through Salus IRB, as well as from each school district.

Data Collection Protocols

When teachers agreed to participate, researchers emailed a link to a 10-minute intake questionnaire. Teachers were asked to provide an inventory of their data collection efforts and uses, their perceptions of their students' math abilities and mindset, and their own self-efficacy in teaching math. These questions were derived from previously validated questions from the Mathematics Teaching Efficacy Beliefs instrument and the RAND American Mathematics Educator Survey.[128]

Interview questions for teachers included pre-lesson questions about the intentions of their lesson; their educational philosophy; and their perspectives on students' math mindsets, confidence, feelings, and effort. Interview questions post-lesson observation reflected on how teachers made in-time decisions, attended to student needs, collected data from students, and felt the lesson unfolded more generally. In two instances, the pre-lesson interview occurred as part of the post-lesson interview.

There were two classroom observation instruments. The first observation instrument chronicled the classroom learning environment, focusing mostly on the students' reactions and behaviors during the class period. Broad areas of interest included students' sense of belonging, equitable opportunities to learn, and growth mindset orientation. The second observation instrument chronicled the pedagogical techniques of the teacher. Broad areas of interest included instructional practices, instructional tasks and assessment, and relational interactions related to learning. The design and contents of the instruments were informed by other research.[129]

Interviews with principals gathered information on the school and district resources available to their math teachers. Interviews occurred with four of the five principals.

In addition, researchers took field notes on the school climate and teacher planning times, collected artifacts at the school sites via physical objects (e.g., worksheets), and photographed objects (e.g., wall decorations, student work products).

Lastly, some teachers opted to administer and share anonymous student data with the research team from a survey adapted from the nationally normed Youth & Teen Math Mindset Study questionnaire.[130] These data were used to triangulate other data confirming teachers' cultivation of positive learning environments for their students.

Validation Methods

To prepare for accurate use of classroom observation instruments, the researchers trained on video excerpts of math classroom lessons publicly available on YouTube. To ensure coverage and reduction of bias, the researchers additionally switched who used the classroom learning environment instrument or the pedagogy observation instrument; all instruments used a double-coder technique.

Each of the three coders for the research wrote positionality statements before coding began. This activity worked to elucidate lived experiences that could potentially bias the researcher in their coding lens.

Interrater consensus was established on a set of codes before applying them. All three researchers coded the same two interviews and two observation protocols and then reviewed the consistency of the code tags throughout. A codebook was developed from the interrater discussions that defined which aspects of the concept were included or excluded, including naming elements that relate to the concepts. From then on, each theme had two coders: a lead coder and a support coder. The support coder checked the lead coder's codes and identified any extraneous or missed passages for the domain.

Authors conducted additional member-checking review with the study's participants (teachers and principals) to ensure accuracy and provide the opportunity for study participants to contribute additional contextual information as needed.

Analytic Methods

A first round of coding for the observation instruments was conducted immediately after the observation day. Researchers summarized their broad observation field notes into elements related to key concepts. Key concepts of belongingness, equitable opportunities to learn, growth mindset orientation, math mindset practices, math effort, and conceptual math teaching practices were all informed by the literature reviewed for this study.[131]

For the classroom learning environment protocol, researchers also rated the observed level of equity across student groups. For instance, relational interaction element was coded overall in general terms as well as additionally coded on how relational interactions embraced research-aligned practices for promoting equity and access in mathematics. The equity framework considered the extent to which all students were attended to, positioned as competent, expected to perform the tasks, attended to by language, and the like.[132]

Data were analyzed using both *a priori* and *in vivo* coding using Dedoose software following interrater consensus techniques.[133] Using a narrative cross-teacher case study design, researchers analyzed within-element and between-element intersections. Certain aspects of the teaching practices evidenced as universal across these 10 teachers. Other aspects associated only with some teachers and/or teaching characteristics regarding classroom learning conditions.

After coding, the research team produced analytic memos for each of the main areas of interest of classroom learning environment, mindset, pedagogical approach, data collection, data use, professional support, and teaching philosophy. The authors divided up leading the memoing for each of these areas and then reviewed each other's memos. These memos revealed themes among our teachers: how these teachers felt, thought, and practiced in their classrooms in relation to the key concepts. For each section of the report, the authors highlight the quotes and examples from the teachers who scored above the national average on the survey item associated with the section topic.

Data from the teacher and student surveys were descriptively analyzed using Stata statistical software. Scales on teachers' self-efficacy and belief in students' growth mindset were simple scales of averaged Likert-type scores on six items for each concept.

Teacher profiles (see Appendix B) were generated from field notes, teacher interviews, principal interviews, and observational protocol data. All teachers were provided with opportunities to review for comprehensiveness and accuracy.

Appendix B: Teacher Profiles

Ms. Birch

Ms. Birch is a 7th-grade general-track Math 7 teacher. She brings a bilingual, relational, and affirming approach to her teaching, grounded in the belief that all students can grow mathematically through reflection, discussion, and persistence. Currently pursuing her dissertation on mathematics identity, Ms. Birch centers student voice and risk-taking in her classroom, aligning with the school's emphasis on social-emotional learning (SEL) and belonging. She expresses strong confidence in motivating students, adapting instruction, and fostering a sense of academic agency. Her bilingualism allows her to connect deeply with students and families, and her teaching celebrates effort, reasoning, and participation. She recently joined the High Tech High Graduate School CARE professional learning network.

Classroom Setting

Ms. Birch's classroom follows a consistent routine that includes SEL-based check-ins, collaborative problem-solving, mind breaks with music and snacks, and group-developed notes. Instruction emphasizes vocabulary support, bilingual prompts, and real-world contexts. Students work in groups at tables, using sentence frames and visual references to explain their reasoning. The physical space is flexible and responsive, with anchor charts, student work, and accessible supplies that support independence and well-being. The atmosphere is calm and welcoming—students engage actively, shift between English and Spanish, and treat mistakes as learning opportunities. Ms. Birch uses humor, soft verbal cues, and consistent praise to maintain a positive and focused environment.

Math Class

Ms. Birch teaches Math 7, covering full 7th-grade standards with a focus on conceptual understanding, fluency, and communication. Her students reflect the diversity the school, including many multilingual learners and a wide range of academic readiness levels. In her interview, Ms. Birch described how her instruction is designed to build mathematics identity and affirm student thinking through collaborative work, discussion, and multiple representations of math. She integrates Spanish and English throughout instruction and feedback, ensuring access and engagement for all learners.

To assess understanding, Ms. Birch relies on formative data from classroom discussions, group projects, entrance tickets, and partner talk. She observes student work during collaborative tasks and uses reflections to adjust pacing and guide groupings. Her classroom highlights include SEL mood check-ins, bilingual scaffolds, and a strong focus on mathematics identity. Students revise their thinking, explain strategies, and persist through challenges. Ms. Birch's teaching reflects her belief that math learning is deeply connected to belonging, resilience, and student voice.

Ms. Bristlecone

Ms. Bristlecone is a mid-career 6th-grade math teacher. She teaches Math 6 Accelerated high-track course. She is known for her upbeat, student-centered approach that fosters care, structure, and belonging. Her classroom culture encourages humor, perseverance, and academic risk-taking. Ms. Bristlecone integrates culturally relevant examples and emphasizes reasoning, process, and multiple solution paths. With a background in economics and experience teaching high school, she has found her stride in middle school math. She expresses strong confidence in motivating students and adapting instruction based on formative feedback, always aiming to connect math to students' lived experiences and promote growth through discussion and strategy. This year, she joined the High Tech High Graduate School CARE professional learning network.

Classroom Setting

Ms. Bristlecone's classroom is structured yet flexible, beginning with warm-ups that use familiar contexts and progressing through collaborative board work and practice. Students work at their own pace with support from circulating teachers and prompts to explain their reasoning. The physical space is spacious and organized, with desks grouped for collaboration, anchor charts reinforcing math and SEL strategies, and materials easily accessible. The atmosphere is warm and relational—Ms. Bristlecone greets students at the door, uses humor and encouragement, and treats mistakes as learning opportunities. Students feel supported and engaged, with clear expectations and praise focused on effort and persistence.

Math Class

Ms. Bristlecone teaches Math 6 Accelerated, which includes 6th-grade content and parts of 7th-grade standards. All 6th-grade students in the school are enrolled in Math 6 Accelerated. Her students reflect the school's diverse population, including predominantly Latino and African American students, multilingual learners, and those receiving special education services. She employs a co-teaching model with her support staff to support a wide range of learners. She uses scaffolds like Spanish translation, modeling, and visual aids. Instruction is designed to maintain engagement across varied readiness levels through flexible grouping and structured discourse.

Despite short class periods and large, mixed-readiness rosters, Ms. Bristlecone maintains a steady pace focused on conceptual understanding and student agency. She collects formative data through warm-ups, collaborative work, and verbal explanations, adjusting instruction in real time. While she expressed slightly less confidence in consistently gauging understanding, her strengths in relationship building and persistence support a responsive classroom learning environment. Her classroom highlights include relatable contexts, student discourse, and a belief in every student's capacity to think mathematically when given the right tools and encouragement.

Ms. Cedar

Ms. Cedar is a 6th-grade teacher and math lead at her school. With 6 years at the school and deep personal ties to the community, she brings both professional expertise and personal investment to her teaching. Ms. Cedar is a second-career teacher who previously worked in the semiconductor industry. She blends analytical precision with trauma-informed practices, drawing from her dissertation work to support student well-being. Her classroom is built on trust, care, and academic rigor, and she mentors preservice teachers while integrating SEL into daily routines. She expresses strong confidence in adapting instruction, motivating students, and fostering mathematical identity through structured reflection and encouragement. She is an active participant in the High Tech High Graduate School CARE professional learning network.

Classroom Setting

Ms. Cedar's classroom follows a consistent and predictable structure, beginning with warm-ups and progressing through direct modeling, partner-based problem-solving, and independent or small-group work. Students use visual models, sentence frames, and anchor charts to support reasoning and autonomy. The physical space resembles a science lab, with counters, cabinets, and desk pods arranged for collaboration. Whiteboards display norms and problem-solving supports, and a resource table provides access to materials and technology. The atmosphere is calm, focused, and welcoming, with smooth transitions, positive reinforcement, and high expectations. Mistakes are treated as learning opportunities, and rigor is maintained through deliberate pacing and structured engagement.

Math Class

Ms. Cedar teaches multiple sections of Math 6 Accelerated to 6th-grade students, a course that compresses 6th-grade and parts of 7th-grade standards. Her students represent a wide range of readiness levels and learning needs. Instruction includes procedural fluency, reasoning development, and self-reflection through journals and mathographies. She uses consistent routines and scaffolded supports to ensure access and challenge for all learners. Large class sizes and short periods present challenges, but Ms. Cedar addresses these through flexible pacing, targeted standards, and embedded time for catch-up or extension. There are also one to two additional staff supporting Ms. Cedar in these large classes.

Formative data collection is central to Ms. Cedar's practice. She uses warm-ups, collaborative board work, notebooks, and quick checks like thumbs-up/thumbs-down and partner summaries to monitor understanding. Student dialogue and work products guide her decisions on pacing and differentiation. Her classroom highlights include bilingual and SEL scaffolds, collaborative tasks, and math identity work. Students actively reflect, support one another, and engage with visuals in a space that exemplifies structured care and the belief that all students can succeed in math.

Ms. Cypress

Ms. Cypress is an 8th-grade math teacher and instructional coach. With 9 years of prior experience at another school in the district and recognition as "Teacher of the Year," Ms. Cypress brings a relational, student-centered, and innovative approach to her classroom. Her teaching is shaped by her connection to the High Tech High CARE network and her use of Building Thinking Classrooms (BTC) practices. She integrates movement, choice, and identity-affirming routines, creating a space where students take ownership of their math learning. Ms. Cypress is known for her ability to elevate student engagement and agency, and she expresses strong confidence in motivating learners, adapting instruction, and fostering belonging.

Classroom Setting

Ms. Cypress's classroom began with SEL mood check-ins and call-and-response vocabulary practice, followed by collaborative vertical whiteboard work and independent note-taking. Students rotate leadership roles, explain strategies, and record key ideas in structured notebooks. The physical space includes desk pods, accessible materials, and whiteboard stations around the room. Decor is minimal, emphasizing student-created content and functional resources. The atmosphere is upbeat and responsive—Ms. Cypress uses humor, music, and bilingual communication to maintain engagement, while reinforcing expectations through verbal cues and tangible rewards. It is evident that students feel safe to take academic risks and collaborate meaningfully.

Math Class

Ms. Cypress teaches Math 8, a class that develops 8th-grade standards and conceptual fluency through graphing, algebraic reasoning, and contextual problem-solving. Her students are predominantly Latino/a, including multilingual learners and those receiving special education support. She uses bilingual prompts, peer scaffolding, and culturally relevant examples to ensure full participation. Instructional design includes direct modeling, collaborative tasks, and independent practice, all aimed at helping students make sense of math in multiple forms.

To monitor learning, Ms. Cypress collects formative data through group observations, notebook checks, whiteboard responses, and exit tickets. She uses student work to guide mini-reteaches and highlights effective strategies for peer learning. Activities like Kahoot! include visible thinking routines to discourage guessing. Her classroom highlights include SEL routines, real-world math contexts, and student-centered note-taking. Ms. Cypress's teaching reflects a belief in student agency, identity, and intellectual challenge, showcasing students as capable mathematical thinkers.

Ms. Oak

Ms. Oak is a math educator currently in her third year. She teaches 6th-grade Accelerated Math, including a co-taught section with a high concentration of students with individualized education programs (IEPs). With rare exception, Accelerated Math is the default general math class for all students in this school. Known for her calm presence and inclusive practices, Ms. Oak creates a structured and equitable classroom learning environment where student discourse and confidence are central. Her classroom features consistent routines, visual learning tools, and scaffolds such as sentence frames and number lines. She is certified in Gifted and Talented Education (GATE) and brings over a decade of educator experience in middle school and adult education. Ms. Oak is deeply committed to helping all students reconnect with math, emphasizing effort, adaptability, and meaningful engagement.

Classroom Setting

Ms. Oak's classroom is designed for collaboration and clarity. Lessons begin with warm-ups and progress through vertical board work and whole-class reflection. Students work in small groups using visual aids and sentence starters to support participation and reasoning. The physical space includes desk pods surrounded by vertical whiteboards, posters of diverse mathematicians, and organized supplies for smooth transitions. The atmosphere is calm, respectful, and structured, with students confidently following routines and engaging in learning through praise, humor, and quiet redirection.

Math Class

Ms. Oak's math classes include all 6th-grade students, with rosters of 30–35 students representing a wide range of academic backgrounds, including GATE and special education students. One section is co-taught with a paraeducator and case specialist to support students with cognitive, behavioral, and social needs. She differentiates instruction through scaffolds and routines that promote both access and challenge. The accelerated curriculum compresses 1.5 years of content into a year of 45–50 minute periods, requiring careful pacing and structured support.

Ms. Oak uses a variety of formative assessment tools—such as board work, exit tickets, and informal checks—to monitor understanding and adjust instruction. Students are encouraged to reflect, correct, and retake assessments using notes. Her classroom highlights include vertical board stations, sentence frames, and visuals that support mathematical reasoning and identity. The classroom learning environment is relational and engaging, fostering confidence and a sense of possibility in math for all students.

Ms. Ozark

Ms. Ozark is a third-year teacher in her second year at this school, where she teaches 6th-grade Accelerated Math. With rare exception, Accelerated Math is the default general math class for all students in this school. Calm, relational, and highly structured, Ms. Ozark uses routines and collaboration to foster student engagement and confidence. She transitioned from her first year teaching high school so she could focus on relationship building and early academic support. Her principal describes her as thoughtful and quietly influential, bringing warmth and consistency to her teaching. With a recent MS in Mathematics and a math-specific certification, Ms. Ozark expresses strong confidence in motivating and supporting students across readiness levels. She maintains strong professional networking ties to the other mathematics teachers from her MS cohort. Her instruction centers students' thinking, modeling how to evaluate strategies and learn from mistakes.

Classroom Setting

Ms. Ozark's classroom follows a consistent routine: warm-ups, problem launches or videos, collaborative board work, and whole-class huddles. Students work in trios to solve problems, compare strategies, and reflect on clarity and efficiency. The physical space is designed for movement and collaboration, with desk pods, vertical boards, and accessible materials like sentence frames and visuals. The atmosphere is warm and focused: Students warmly converse during transitions, take academic risks, and follow clear expectations. Ms. Ozark uses visual and verbal cues to maintain a calm pace and strong classroom relationships.

Math Class

Ms. Ozark teaches multiple sections of Math 6 Accelerated, a required course for all 6th-grade students at this school. Her students reflect the school's diverse demographics, including many multilingual learners and students with IEPs. Instruction is scaffolded with visuals, modeling, and structured talk to support access and challenge. Short class periods and accelerated pacing present challenges, but Ms. Ozark adapts by prioritizing key standards and condensing lower-priority content. She builds a culture of persistence and access, especially for students with math anxiety or limited prior success.

To monitor learning, Ms. Ozark uses warm-ups, board work, exit tickets, and "check-your-understanding" sheets, which are open-note and non-graded. She adjusts instruction based on observations during group work, huddles, and student questions. Journaling and SEL check-ins help her gauge confidence and misconceptions. Classroom highlights include BTC-aligned problem-solving, vertical whiteboard use, strategy huddles, and prompts that connect math to students' lived experiences. Her teaching blends clarity, care, and critical thinking, with the aim of helping all students grow into confident math learners.

Ms. Pepper

Ms. Pepper is a 6th-grade Accelerated Math teacher. With rare exceptions, Accelerated Math is the default general education math class for all students in her school. After serving as a district librarian, she transitioned to teaching math in 2020 and earned her Single Subject credential. Known for her humor, bright classroom environment, and strong focus on student participation, Ms. Pepper emphasizes structure, affirmation, and accessible strategies. Her instruction is practical and repetition-based, designed to build student confidence through modeling and collaborative practice. She expresses strong confidence in motivating students and adapting lessons responsively, and she values collaboration with her math department colleagues as a source of professional growth.

Classroom Setting

Ms. Pepper's classroom follows a lively and structured routine: SEL check-ins, short modeling segments, collaborative vertical whiteboard work, and scaffolded independent practice. Students use mnemonic devices and visual tools like two-color counters to reinforce procedural fluency. The physical space is vibrant and colorful, with desks in pods, whiteboards around the room, and growth mindset posters. She plays music during transitions, and supplies are readily accessible. The atmosphere is energetic and inclusive—students are greeted individually, routines are clear, and effort is consistently celebrated. Mistakes are normalized, and affirmations maintain momentum and engagement.

Math Class

Accelerated Math is a mandatory course for all 6th-grade students. It covers 6th-grade standards and parts of 7th-grade content. Her class is exceptionally large, with upward of 35 students, many of whom are multilingual learners or students with IEPs. An additional support specialist is assigned to these large classes that are being piloted in some classrooms this year in the school. Instruction prioritizes procedural fluency, supported by repeated modeling, visual scaffolds, and group collaboration. While explicit math identity work is not emphasized, students experience a sense of belonging through humor, structure, and positive reinforcement.

To assess learning, Ms. Pepper uses warm-ups, whiteboard participation, worksheets, and "Prove It" assessments aligned to daily targets. Color-coded group work helps monitor individual contributions, and feedback is immediate and strategy-focused. Classroom highlights include musical math cues, developmentally appropriate math videos, student affirmations, and visible thinking routines. Her teaching reflects a belief that structure, repetition, and positive energy are essential for building mathematical confidence and success.

Ms. Pine

Ms. Pine is an 8th-grade Algebra teacher. Algebra is the common course for the majority of 8th-grade students unless their state scores are exceptionally low. She brings a dynamic, relational, and equity-driven approach to math instruction, blending high expectations with attention to student identity and belonging. Known for her humor, warmth, and academic rigor, Ms. Pine integrates BTC practices, culturally responsive teaching, and SEL. Administrators describe her as a key leader in advancing the school's goals around engagement, equity, and academic excellence. She expresses strong confidence in adapting instruction, promoting belonging, and motivating students through collaborative thinking and affirmation of their academic identity.

Classroom Setting

Ms. Pine's classroom is structured around predictable routines and collaborative learning. Students begin with SEL-based warm-ups like First 5 check-ins or Blooket games, then transition to vertical whiteboard tasks and small-group exploration. Instruction includes "mild, medium, and spicy" tasks that allow students to work at their own pace, supported by sentence starters and collaborative norms. The physical space features desk clusters, lab stations, student work displays, and bilingual affirmations. The atmosphere is lively and affirming—students are greeted by name and recite positive math affirmations in a mirror on the classroom door. Students engage in humor and encourage each other throughout the lesson. Mistakes are treated as learning opportunities, and effort is consistently celebrated.

Math Class

Ms. Pine teaches 8th-grade Algebra, preparing students for high school through a focus on algebraic reasoning, procedural fluency, and collaborative problem-solving. Most 8th-graders are enrolled in this course, unless they have a special circumstance to instead enroll in Math 8. Her students reflect the diverse demographics of the school, with a majority of Latino/a, African American, Filipino/a, and multilingual students. She uses bilingual scaffolds, SEL supports, and flexible groupings to ensure equitable access to rigorous math tasks. Instruction emphasizes conceptual understanding, multiple representations, and clear communication.

To monitor learning, Ms. Pine collects data through live observations, Blooket participation, Prove It assessments, exit tickets, and CLEVR (Claim, Evidence, Reasoning) writing tasks. She adjusts instruction based on academic accuracy and engagement, using scaffolds and feedback to support growth. Classroom highlights include vertical board work, bilingual affirmations, SEL-integrated routines, and progressive questioning. She maintains expectations through consistent systems, including lunch detentions and calls home. Her teaching reflects a balanced approach to academic and behavioral support, rooted in rigor, relationships, and visible student thinking.

Ms. Sequoia

Ms. Sequoia teaches 6th-grade Accelerated Math and 8th-grade Algebra. Both are the default general math classes for all students unless there is an exemption. Known for her calm demeanor, affirming tone, and structured approach, she creates a classroom culture centered on collaboration, risk-taking, and growth mindset language. This is her first year teaching Algebra, and she balances content rigor with relational, student-centered instruction. Ms. Sequoia integrates BTC practices and SEL routines to foster confidence and mathematical reasoning. She expresses strong confidence in motivating students, adapting instruction, and supporting a sense of belonging, believing that math learning deepens when students feel safe to try, revise, and reason together.

Classroom Setting

Ms. Sequoia's classroom begins with clear launches, random group assignments, and differentiated tasks labeled mild, medium, or spicy. Students work in trios at vertical whiteboards, followed by huddles to discuss strategies and errors. Notebook reflections reinforce retention, and discourse is emphasized throughout. The physical space includes clustered desks, whiteboards on multiple walls, math strategy posters, and accessible supplies. A classroom calendar supports accountability and communication. The atmosphere is calm and encouraging—students collaborate fluidly, revise ideas confidently, and engage in humor and relationship building. Ms. Sequoia uses gentle redirection and celebrates effort to maintain a supportive classroom learning environment.

Math Class

Ms. Sequoia's 6th-grade Accelerated Math covers 6th through parts of 7th-grade standards. Algebra covers high school–level algebraic reasoning. Her students reflect the school's diverse demographics, including Latino/a, African American, White, and Asian students with varied math backgrounds. Instruction emphasizes conceptual understanding, reasoning, and collaborative sense-making. She scaffolds learning with sentence frames, multiple entry points, and revision opportunities to ensure access for all learners.

To assess learning, Ms. Sequoia collects formative data through whiteboard observations, huddle conversations, notebook entries, and "Prove It" assessments. She monitors group dynamics and individual participation to guide instruction. Classroom highlights include vertical whiteboarding, random group structures, embedded self-check routines, and SEL integration. Her teaching reflects a belief that math confidence grows through visible thinking, collaborative exploration, and a steady culture of care.

Mr. Sycamore

Mr. Sycamore is a veteran math teacher with over 20 years of experience. This year, he teaches 7th-grade Accelerated Math, 8th-grade Algebra, and a new elective on drones. Both Accelerated Math and Algebra are the default general education math classes for all students unless there is an exemption. Known for his calm demeanor, warmth, and precision, Mr. Sycamore blends deep instructional expertise with a growth mindset and openness to innovation. He embraces BTC practices and models lifelong learning for his students. He expresses strong confidence in motivating students, adapting instruction, and fostering belonging, while maintaining high expectations and a belief that all students can succeed in grade-level math. Before relinquishing the position this year, he was the Math Department Chair.

Classroom Setting

Mr. Sycamore's class began with a "Which One Doesn't Belong?" warm-up to spark discussion and reinforce vocabulary, followed by vertical whiteboard group work. Students collaborate in randomized groups, verbalize their thinking, and engage in whole-class huddles to share strategies. The physical space includes paired desks, whiteboards on all walls, and centrally located supplies. Posters promoting vocabulary, growth mindset, and college aspirations create a space that balances rigor and encouragement. The atmosphere is calm and respectful—students greet each other warmly, transition smoothly, and treat mistakes as learning opportunities. Mr. Sycamore uses humor, affirmation, and consistent routines to build a supportive learning community.

Math Class

Mr. Sycamore's students reflect the school's diverse demographics, including Latino/a, African American, White, Asian, and multiracial students. Instruction emphasizes conceptual understanding, vocabulary development, and precise communication. Tasks require justification, error analysis, and collaboration, with scaffolds to support language and multistep problem-solving. Group configurations are randomized to promote equity and engagement.

Mr. Sycamore collects formative data by circulating among students and listening to student explanations and informal reflections. He emphasizes self-checks, peer feedback, and alignment across multiple representations. Classroom highlights include vertical whiteboarding, structured group work, vocabulary integration, and growth mindset messaging. Despite large classes and varied readiness levels, Mr. Sycamore maintains a belief in every student's potential. His classroom reflects a commitment to care, visible thinking, and persistent practice as the foundation for mathematical growth.

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