Teach.
Learn.
Grow.
the education blog

Math isn't magic: How to build keen and confident math students

nwea

Table of contents

The math classroom can be an incubator for student empowerment.

While many students are inadvertently stifled in their ways of thinking and doing mathematics, it doesn't have to be that way. You can help them build a more positive math story. You can give them the kinds of learning experiences that get them excited about math, that help them build a positive math identity and develop a lifelong love of the subject.

This compilation of **Teach. Learn. Grow.** blog posts by NWEA® math experts will guide you through this important work. It's structured around three guiding questions that are deeply rooted in formative assessment practices:

1. **Where are we now?** Becoming aware of our own math identities and their impact on our teaching is the first step toward helping young people develop a healthy math identity themselves. The first post in this eBook, **"3 ways to be a 'math person,'"** will help you start at the beginning: by understanding yourself.

2. **Where are we going?** A student can gain a very strong math identity through success in learning algorithms, memorizing techniques, and being a good test taker. This type of student will likely lose confidence when they encounter a teacher who values sense making over procedural fluency. **"What's wrong with tracking students by math ability?"** and **"Pointless points and plotless plots: The dangers of accelerating mathematics learning"** explore ways to think about the goals of instruction so that we're supporting students in both their ways of *doing* and their ways of *thinking about* math.

3. **How do we get there?** Safe and brave learning environments—where inquiry and mistake making during the learning process are encouraged—are key to empowering our math students. The onus of helping kids develop healthy math identities is on us, their teachers. For pragmatic tips for things to try in your classroom that can help you get the results you're after, read **"Embrace mistake making in math"** and **"How to support math growth with differentiation and scaffolding."**

All kids are capable of success in math. We hope this eBook will help you support them in realizing their full potential.

Partnering to help all kids learn®.

3 ways to be a "math person"

Fenesha Hubbard

Although I have a degree in mathematics and taught middle school math, it took nearly a quarter of a century before I identified as a "math person." I'm certain you can name at least five people who consider themselves to be "not a math person." My certainty lies in the fact that our society has made "illiteracy in math acceptable the way illiteracy in reading is unacceptable," as the late Bob Moses, founder of [The Algebra Project] and co-author of *Radical Equations*, said.

In this case, I define "illiteracy" as inadequate conceptual or procedural understanding and demonstration of a topic or concept. I don't aim to trigger shame or pass judgment by using the word "illiteracy." In fact, I posit that a student's understanding is gained through their illiteracy. It is their math mistakes and misunderstandings that can lead to better clarity and comprehension, when their thinking is directed by a competent and confident math teacher who has a healthy math identity.

Identity is a critical part of learning

In education, identities are the dispositions and beliefs a person has about a topic. Teachers and students have identities, whether they are aware of them or not, and our identities shape teaching and learning experiences. For example, my math identity is anchored in my experiences of not always being a successful math student. My ways of thinking about and doing math were usually not affirmed and guided, nor considered within success criterion, which indirectly told me that I was not a good or successful math student. I was lucky that I became aware of my math identity early on and was able to reflect on how it could influence my instruction. Once I became a math teacher, I was able to employ strategies to help all students thrive in the mathematics classroom.

Mathematics is a topic that, when approached with curiosity, can help a student unfold their thinking in a way that makes sense to them.

A student's experiences in your classroom will greatly influence how they engage with math and the thoughts and feelings they associate with math. Negatively perceived experiences, such as incorrect answers without affirmation of their way of thinking or being told their way of thinking is wrong, can lead a student to believe they are "not a math person." My colleague Nick Joe explores this in more depth in his blog post **"Embrace mistake making in math."**

How to build strong math identities

> **A student’s experiences in your classroom will greatly influence how they engage with math and the thoughts and feelings they associate with math.**

Mathematics is a topic that, when approached with curiosity, can help a student unfold their thinking in a way that makes sense to them. Making meaning of mathematics is foundational to success. Supporting children’s development of a positive math identity by allowing them to navigate understanding in a way that feels authentic to them is foundational, too. So how do we foster healthy math identities? Here are three things I suggest.

1. Tell our stories

The first step toward building a healthy math identity is reflecting on one’s math experience through what is called a mathography. Completing a mathography is a self-reflective practice for students and teachers to get clear on how they think and feel about math, using some guiding questions and prompts such as:

- How do you feel about math?
- What did it mean to be a successful math student when you were young?
- What types of grades did you get in math? Why?
- What do you remember teachers or other adults saying about your capabilities as a math student?
- Who were the successful math students in your class? How did you know they were successful?
- Describe your most memorable good experience in learning math, inside or outside the classroom.
- Describe your most memorable bad experience in learning math, inside or outside the classroom.

A quick Google search will yield several resources available to guide you in completing your own mathography or asking your students to do one, like this one from Benson High School in Portland. It can be important for students to hear honest stories about your own struggles so they have clear proof that your journey into math education was the result of hard work and dedication, not just luck or being a “math person.”

2. Provide safe and brave learning spaces

As Geneva Gay says in ***Culturally Responsive Teaching: Theory, Research, and Practice***, “Academic success is a nonnegotiable goal for everyone and the responsibility of all participants in the teaching-learning process.” There can be barriers to creating a safe and brave learning space if students are feeling embarrassed about their thinking or performance, have had experiences in the past that made them not feel smart, or are feeling unseen or unheard.

Imagine a math classroom where curiosity and questioning are encouraged, where getting the wrong answer is expected along the learning journey (and not always penalized), and various ways of thinking are celebrated. In this environment, the teacher has a mindset that all students are capable of learning and students have faith in their intellectual capabilities. This is growth mindset at is best. For specific tips on how to go about this, I encourage you to read **“20 tips for creating a safe learning environment”** on Edutopia. **Stress- and trauma-sensitive practices** can also support your efforts to create a safe classroom culture.

3. Continue to be open to your own learning

A person’s math identity is not fixed. Before we can successfully teach our students this, it is imperative that we continue to expand our math identities through professional learning. You can strengthen your math identity through the act of teaching, staying abreast on industry trends and best practices, and being self-reflective in your practice.

It’s also important for you to continue to be a math learner as well as a teacher, so you can be well prepared for the myriad ways students think about mathematics. Professional learning supports a teacher in understanding the vertical and horizontal coherence of math topics and grade-level standards, and it presents opportunities to talk with colleagues about student thinking.

Now is the time

So much of what we know and can learn is tied into what we believe about ourselves. A lot of it hinges on embracing growth mindset and encouraging ourselves, as teachers, to believe in our potential. When we’re confident in our own abilities—and when we challenge long-held misconceptions about what it takes to be successful in math—we can better reach our students and help them see that anything is possible. **TLG**

What's wrong with tracking students by math ability?

Ted Coe

It's clear that the pandemic has been anything but cooperative when it comes to teaching and learning. Through all of this, we now find ourselves in a situation where there is an urgent need to address intractable questions like this one: Given the wildly varying learning experiences during school closures, the unpredictable interruptions to learning, and the challenges of ongoing, day-to-day instruction, how can we efficiently meet students where they are and provide student-centered mathematics instruction based on appropriate and high expectations?

Spoiler alert: There is no easy answer. And as we're seeing **varied mathematics growth** for many students right now, we should be exceedingly cautious about one possibility.

Tracking doesn't add up

Many of us grew up in a time or place where we were at some point separated and sorted for mathematics instruction. I'm not talking about some students going to first hour and some to second hour. I'm referring to sending students, such as middle school students, to different *types* of math classes. Some students were sorted into low-level classes, others into high-level classes, all based on a *perception* of student ability. It's a practice known as tracking.

Overall, tracking does not improve achievement but it does increase educational inequality.

In recent years, though, researchers have studied the impacts of tracking. The results, which provide reasons to question the assumption of its efficacy, are reflected in the recent Washington Post article **"Is it time to stop segregating kids by ability in middle school math?"** The article tells the story of Ithaca City School District, in New York, and their decision to stop the practice when educators there noticed it didn't appear to be working to anyone's benefit.

Ithaca certainly wasn't **the first to rethink tracking**. In 2014, San Francisco Unified School District ceased the practice of tracking middle school mathematics in a **decision supported by research**. Their results show that **detracking works remarkably well** and has resulted in more students taking higher-level mathematics classes.

These aren't the only instances of questioning the practice of tracking. In 2020, the National Council of Supervisors of Mathematics (NCSM) released this **bold statement on tracking**: "As a practice, tracking too often leads to segregation, dead-end pathways, and low quality experiences, and disproportionately has a negative impact on minority and low-socioeconomic students. Additionally, placement into tracks too often lacks transparency and accountability. Overall, tracking does not improve achievement but it does increase educational inequality. In light of this, NCSM calls instead for detracked, heterogeneous mathematics instruction through early high school, after which students may be well-served by separate curricular pathways that all lead to viable, post-secondary options."

Reconsidering tracking

Despite some districts bravely moving away from tracking, the practice is widespread. Tom Loveless, **in a 2016 study for the Brookings Institution**, noted that for grade 8, "[t]he average state tracked about three-quarters of its math students." And, while there is debate as to what benefits tracking may provide—and to whom—there is enough evidence to warrant being exceedingly cautious about tracking, questioning its impacts, and recognizing the power it has to block student access to mathematics.

Tracking almost certainly has the ability to reinforce inequity in education. In the 2019 **Branching Out** report from **Just Equations**, authors Phil Daro and Harold Asturias connect the sociological Matthew Effect to mathematics learning. This notion, wherein the rich get richer and the poor get poorer, illustrates how gaps widen over time. It truly provides an apt metaphor for tracking: “Perhaps the most obvious and cruelest example of the Matthew Effect is the failure to offer all students a realistic opportunity to learn the mathematics needed for advanced high school courses, then tracking the same students away from those courses because they are assessed as lacking the mathematics they never had a chance to learn. Tracking doesn’t solve the failure to prepare many students. It multiplies the damage.”

If your school tracks students, or plans to do so, I hope you can address these questions fully and honestly:

- Do you study disaggregated long-term impacts on students?
- Do you know which students are disproportionately tracked into lower levels?
- Is the placement of students into tracks accurate and proven?
- Do the methods of placement justify blocking opportunity and the resultant long-term impact it will have on students?
- How easily can students switch tracks? How often does it happen?

You’ll likely realize it would be best to avoid tracking. Try heterogeneous grouping instead. This form of grouping requires **meeting individual students where they are** and supporting them with the **high-quality instruction they need to develop powerful habits of thinking**. Teachers can strategically use tools, such as MAP® Accelerator™ or **others**, to facilitate differentiation. Not tracking may not be the easiest path, but it will very likely be the best one for students. TLG

Pointless points and plotless plots: The dangers of accelerating mathematics learning

Ted Coe

Everyone likes a good movie. Good movies tell a story. They have a plot. They keep the viewer engaged and interested.

Good mathematics instruction tells a story. [...] The story line shouldn't be impossible to follow, there should be no plot holes, and the experience should feel anything but random.

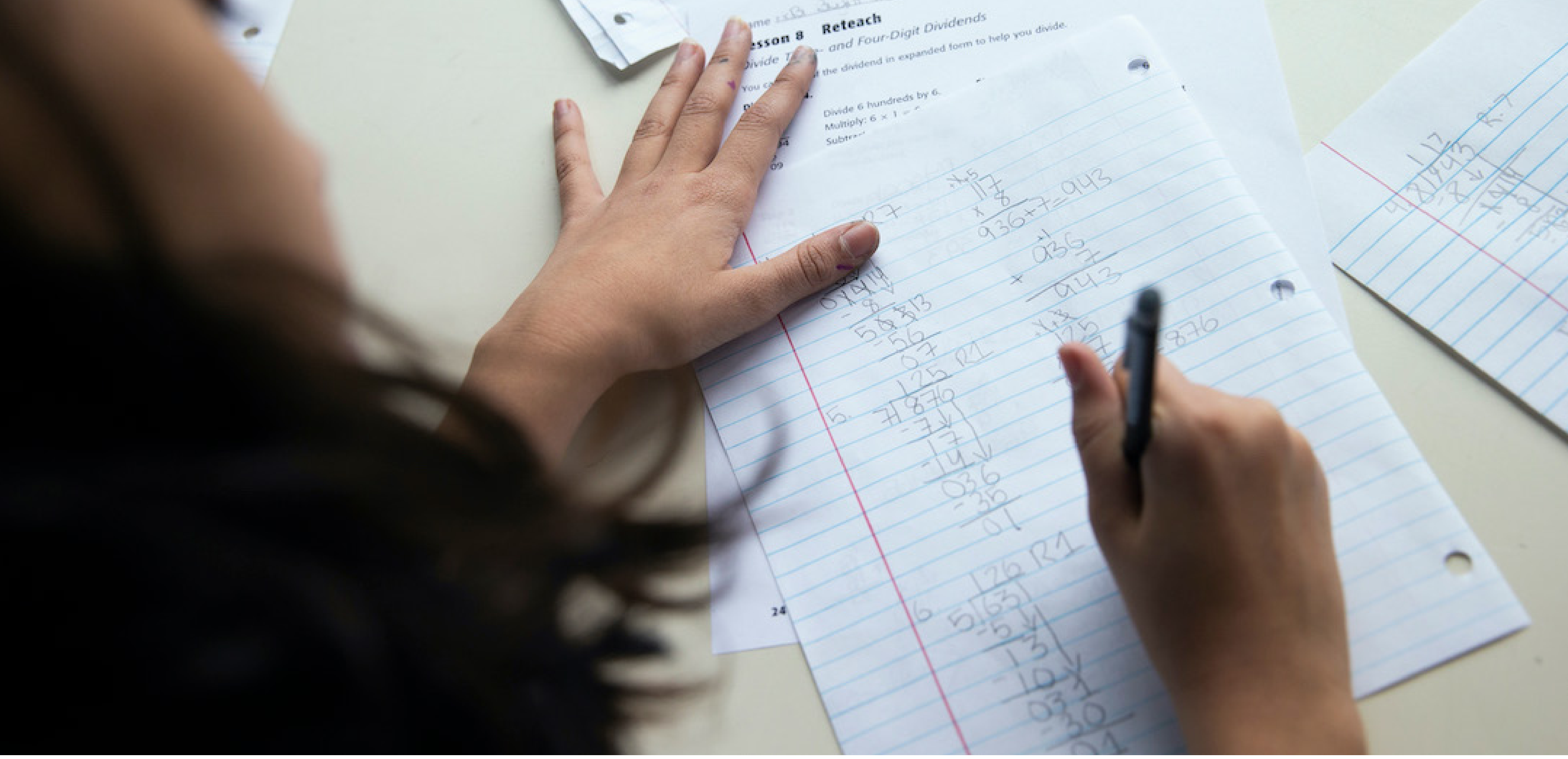
Some movies, though, are forgettable. The story line might be impossible to follow. The plot is full of holes. There are moments that are engaging, interesting, or humorous, but they seem random and disconnected. Have you ever watched a movie that would have suffered no loss if the scenes had been randomly shuffled? I thought about that after watching one particular movie. (I won't mention the name, but it took place on another planet.) It was more a piecemeal collection of scenes than it was a work of art. Movies, after all, have to be something more than simply a collection of bits if they want to be successful, if they want to tell a story that means something and connects with their viewers.

Math classes, too, must be more than a collection of seemingly unconnected bits. Good mathematics instruction tells a story. It has a plot. It keeps the student engaged and interested. The story line shouldn't be impossible to follow, there should be no plot holes, and the experience should feel anything but random.

Where we lose the plot

Think back to your own experiences as you learned mathematics. Was it presented as a collection of random bits or were you engaged in the unfolding of a story?

Over the years I've heard many times, from many people, about how mathematics doesn't make sense. It's a remarkable thing when you think about it, as mathematics, arguably more than any other school discipline, is entirely grounded in sense-making. That's what it is all about. Ideas in mathematics build on other ideas in a logical fashion. Nothing just "pops up" or stands alone. It's



all logically interconnected. Something is seriously broken when students see mathematics as the subject that doesn't make sense when it is arguably the subject that makes the most sense.

Yet here we are. This disconnect, this losing of the plot, is a natural consequence of a focus on "ways of doing" mathematics while **ignoring the "ways of thinking" about the mathematics**. It's what happens when we are OK with pointless points and plotless plots, with merely collecting procedures.

For example, think about how you would answer the question, "How many years was it from February 14, 1912, to February 14, 2007?" Using the standard algorithm to find 2007 minus 1912 to answer this question would not be necessary, nor even efficient, but relating the quantities through subtraction as comparison and using mental strategies would be a wonderful approach. Think about how much less powerful only knowing the algorithm (the end of the subtraction progression) would be.

Mathematical procedures are players in the plotline of mathematics, but they are not the climax of the story. We are happy they are there, as they help move the plot along more efficiently, but the story doesn't end with them. I think, perhaps, that some of this confusion arises from where procedures are generally positioned in state standards: they tend to come at or near the end of multi-year progressions. It's tempting to think of the end of a progression as the goal of the progression, but it is not. Knowing the procedure is not a substitute for the thinking that corresponds to the relationships of the quantities within that procedure. The progression—the whole progression—is a story to understand.

Math takes time

Learning mathematics, truly learning mathematics, and not just that which is easily measurable, takes time. It's about understanding and connecting ideas. It's about being able to see the plot all the way back to the beginning. It's not a race.

Now, with the interruptions of learning that have taken place over the past year and a half, there are many conversations about the need to accelerate students to help them catch up. There is a clear drive to get students back on track with respect to grade-level expectations.

One can accelerate math instruction by cutting content, speeding through content, or merging content, and each carries risks to learning mathematics deeply. Cutting content risks leaving out significant parts of the story line. Will students still be able to trace the plot back to the beginning? Speeding through content makes little sense when the standards in a grade are already sufficiently challenging. Have you ever tried to watch a movie at double speed? Merging content risks continuity as well, unless it's done with great care. Can it be done without losing sight of the plot? Possibly, but it will take effort.

Perhaps the most dangerous risk in accelerating is the potential to miss the beauty in mathematics. Not only is there a plot that we can trace back to the beginning, but there is a sort of joy that everyone should have the opportunity to experience. This is summed up beautifully by the mathematician Jordan Ellenberg in ***How Not to Be Wrong: The Power of Mathematical Thinking***. "Mathematicians aren't crazy, and we aren't aliens, and we aren't mystics. What's true is that the sensation of mathematical understanding—of suddenly knowing what's going on, with total certainty, all the way to the bottom—is a special thing, attainable in few if any other places in life. You feel you've reached into the universe's guts and put your hand on the wire. It's hard to describe to people who haven't experienced it."

Let's not steal this chance from our students. **TLG**

Embrace mistake making in math

Nick Joe

Everyone makes mistakes. It's inevitable. But it often triggers feelings of guilt or shame, which can be difficult, especially if we struggle to embrace our mistakes.

Learning mathematics can be extra challenging due to the pressure of having to come up with the "right" answer.

Learning mathematics can be extra challenging due to the pressure of having to come up with the "right" answer. It is quite easy to develop a fixed mindset when it comes to learning math—"I either have it or I don't"—and a student with a fixed mindset views learning math as an innate gift rather than problem solving and reasoning skills that are developed over time. Here's just a small sampling of the kinds of lies students (and adults!) may tell themselves, lies that get in their way of learning math:

- "I just can't do this and will never be able to."
- "Making mistakes means I am (insert self-deprecating name calling here)."
- "Making mistakes means I am not a math person."
- "I'll be humiliated if I make a mistake in math class."

To shift our students' perception of making mistakes in mathematics, we need to help them see the truths.

Truth #1: Making mistakes is an inevitable part of learning

It's critical to tell kids—early and often—that making mistakes is normal whenever we're learning anything new, no matter how old we are. If your students got everything right in your math class on the first try, would they truly be learning anything? Or would it just be proof that they needed to be in a more advanced class? Remind them that learning is usually filled with twists and turns, and don't be afraid to share stories about your own learning journey, especially with something they might find easy and familiar, like playing Minecraft. Zeroing in on something that's simple for them will humanize you and prove that there's a learning curve to everything.

Another important idea for your students to understand is that it is very rare that *everything* in their mathematical process is wrong. Student work reflects student thinking, so instead of just telling them they are wrong, work with them to help them better understand their thinking. Together you can construct stronger connections to the content you're teaching. Reassure your students that not only is making mistakes OK, but it also allows them to understand that learning math is an ongoing balance on the edge of **productive struggle**. Providing this specific feedback quickly is critical to student growth, so be sure to work frequent feedback into your practice. Students need to hear from you while the work they've completed is fresh on their minds so they can remember their thinking as well as your lesson and better connect the dots.

Truth #2: Making mistakes means I am learning and growing

One of the most common things I hear from students and adults is that they were never a "math person." Many math teachers seem to agree, saying things like, "My students can't do this." That kind of thinking leads to little learning and a lot of broken spirits.

The reality is that **learning math is challenging** and, as with all difficult things, making mistakes is part of the process. For students to learn from them, instead of shut down, they need your support. Teach them that mistakes are just a sign that they're learning and growing and that each and every one they make is a chance to rethink the math in front of them and work on understanding it fully. It can be useful, once again, to share personal experiences of your own growth in math or other areas. Or ask them to consider proof that famous mathematicians had plenty of trial and error of their own.

Another useful practice is goal setting. Spend time with each student helping them understand where they are in their learning and what they are working toward. This can help them understand that there's a meaning to everything they tackle in class, and it helps them see their progress over time, too.

[An] important idea for your students to understand is that it is very rare that *everything* in their mathematical process is wrong.

Focusing on growth in these ways helps students improve in their self-assessment, mathematical thinking, and disposition toward learning mathematics.

Truth #3: Making mistakes requires safety

The first two truths were, arguably, more about challenging the lies students tell themselves. This one is more about encouraging you to build a classroom environment where students can begin to believe in their math ability. Creating a culture of learning depends on educators and how we approach learning mathematics.

Sharing your own learning journey and stories of your own mistake making, like I mentioned earlier, is a valuable way to create a safe learning environment. Another way is to rethink your grading practices. Lies about math learning can be perpetuated when teachers put a value, like a grade, on student work while kids are still in the process of learning. An example is scoring formative assessments, which should never be graded. Being penalized for practice in this way reinforces negative aspects of a student's math identity, which can trigger shame and cue fear or just giving up. Consequentially, students may be unwilling to take more risks in the future. This is learning trauma. But if we can shift our own perceptions of mistakes as something to embrace rather than to avoid, then students will eventually learn to accept that mistakes are not just OK, but expected. It can be difficult to transition to alternative grading practices, but even small changes to how you grade can make a big difference for students and their learning.

A safe learning environment also allows for students to take risks in discussions and their work. It creates opportunities for honest conversations during whole- and small-group work as well as opportunities for self-reflection during and at the end of each lesson. Encourage your students to explain their thinking, rather than focus on the "right" answer, so they can learn to understand that the process is as critical a part as arriving at the answer. When judgment is removed from mistake making in this way, student conversations will flourish. Learning will become enriched by a community of support, and students become allies in learning with each other—and with you. If you need ideas on how to get started, try the following:

- **Check out *5 Practices for Orchestrating Productive Mathematics Discussions*** for ideas on encouraging deeper student discourse.
- **Use My Favorite No**. With this instructional strategy, students work on a warm-up problem, then you collect their anonymous work and choose your favorite incorrect solution to talk through with the class. The anonymity creates safety for students, and the group discussion allows them to support one another by discovering and correcting mistakes.
- **Try error analysis.** When I taught middle school math, my approach to error analysis was to pair my students up. They would redirect each other by clearly identifying a mistake that had been made and then writing out the correct steps and reasoning. I would also include at least one error analysis problem on each summative assessment to help students develop their justification skills.

Closing thoughts

I encourage you to reflect on your approach to teaching mathematics. What does it mean to you to learn math? Are there changes you can make in your practice to support mistake making?

As you try the tips listed here, note the changes in your classroom environment and how your students view themselves as math learners. Remind yourself that you may make mistakes in your instruction and that's OK. A bad lesson does not mean you are a bad teacher. It's an opportunity for you to learn and grow as an educator. At the end of the day, we are not all that different from our students. **TLG**

How to support math growth with differentiation and scaffolding

Nick Joe

It has been more than a year since COVID-19 flipped our world upside down. While hospital beds filled up, classroom desks emptied out. As educators, we were not prepared for an event like this. We were not prepared to teach our students from afar and to face challenge after challenge, uncertainty after uncertainty, in what is already one of the hardest jobs out there.

Yes, maybe some of us had dabbled in creating YouTube video lessons or experimented with a flipped classroom, but no K–12 educator was prepared to teach in a fully remote environment. And I don't say that as a way to blame anyone or anything because there is no one to blame. I say it as a matter of fact. This is what happened, and this is our reality.

Learning to seize what's in my control

COVID-19 has forced everyone to think—really think—about what we can and cannot control. In our current learning environments, there have been many aspects that we definitely can't control: Who has reliable internet access. Who turns their camera on consistently. Computers, as they decide to restart moments before class begins.

Luckily there have been many things still in our control (thank goodness for small favors, am I right?). Though **research shows learning gains have been uneven in math** this past year, we can still rely on formative assessment to gauge how our students are doing, even if those **formative assessment strategies look a bit different online**. And we've still been able to differentiate and scaffold instruction. Schools that use **MAP® Growth™** interim assessments have been using **content providers that connect MAP Growth data to instructional content**, or they've been using **MAP Accelerator** to automatically build learning pathways in **Khan Academy**.

Reflecting on what's within my control and what isn't has done a lot to center me during this chaotic year. I'd like to share some strategies for differentiation and scaffolding for middle school math in the hopes that they will help you see what's in your sphere of influence and what to let go of, too.

Differentiation and scaffolding in the math classroom

Differentiation refers to the separate tasks groups of students work on that are built to address their specific learning needs. Scaffolding is providing different levels of support to students, eventually removing those supports so kids can become self-directed learners. Often teachers provide scaffolds to students who need remediation, and it's an excellent approach for students who need enrichment, too.

As an example, I am going to share a lesson well-suited for eighth-grade math. The **Common Core Standards** state that all students should be able to understand and apply the Pythagorean theorem by the end of the year.

When beginning work on this standard in my classroom, I would start by using data from my students' most recent MAP Growth assessment, in addition to formative assessment and behavioral data, to get a more complete picture of where they were in their learning. This helped me find their respective **zones of proximal development (ZPD)**, that sweet spot where a student has enough knowledge to approach a subject with context and confidence but not so much that they're unchallenged by the material and get bored. Looking at the big picture all of this information created made it clear to me that my students usually fell into three distinct groups: kids needing support to access the grade-level content, kids right at grade level, and kids ahead of the curve who could benefit from some enrichment.

Differentiation refers to the separate tasks groups of students work on that are built to address their specific learning needs. Scaffolding is providing different levels of support to students, eventually removing those supports so kids can become self-directed learners.

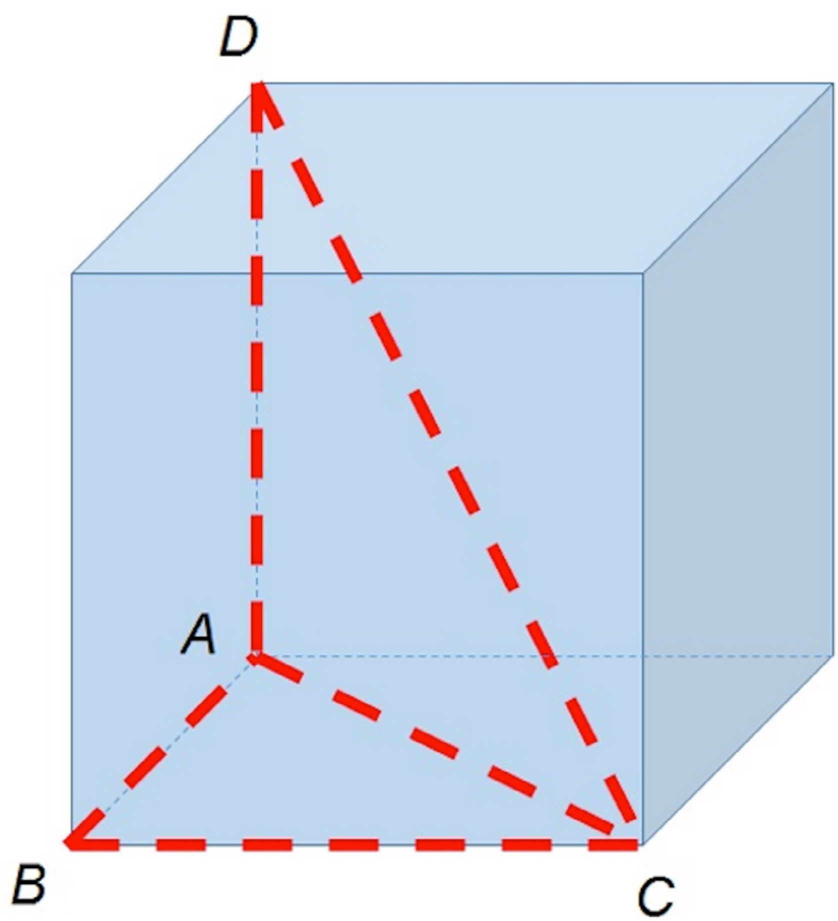
Tackling work on the Pythagorean theorem through small groups like these is a perfect example of differentiation. Because each group of students had different learning needs, **temporarily separating them** allowed me to tailor my instruction to each, making it a little different and better able to meet their needs. I would give each group a different task to complete.

For students below grade level

Here is an example of a task from **Open Curriculum** that is appropriate for that first group of students:

Task: *Some deep sea fishing poles can be very long. What's the longest pole that can fit in the classroom?* *Decide what information you need to know (beside the answer) to determine your solution and then find it.*

I often used this task, and my students were only allowed to use their meter sticks to measure the length, width, and height of the classroom. If this task is done correctly, students only need to apply the Pythagorean theorem two times: first to calculate the hypotenuse of the rectangular base (AC) and then to calculate the hypotenuse from opposite vertices of the classroom (CD). See the image below.



I chose this task for these students because it required them to think of a plan before jumping into the math. It also empowered them to use math in a physical manner—by literally getting out of their chairs and measuring things—and it encouraged the type of peer collaboration and communication that so often fosters learning. If students were struggling to start the task, I would then begin to scaffold my instruction by asking questions like "What do you know about a square?" and "Are there any right angles in squares?"

I made it clear to my students that the process they followed to figure out the problem was as important as the solution, so I wouldn't give them the right answer right away. If they got stuck, I would scaffold further with questions like "What are the measurements you can take of the room?" and "If you draw a diagram of the room and label all the lines, are there any right angles in your drawing?" With about 5–10 minutes left to complete the task, I would share that ACD triangle and ask my students to think about how they could calculate diagonal CD. I would always ask them to share their answer and explain why they thought it was right.

(Side note: This task can easily be adjusted to a remote learning environment. In a breakout room, one student can find the length, width, and height of the room they're in and share that data with the rest of the group. If they don't own a measuring tool, they can use another object as a unit, like a notebook).

For students on grade level

For the second group of students, the ones who are right on grade level, this problem from **Illustrative Mathematics** is appropriate as it requires application of the Pythagorean theorem in real-world problems in two dimensions. It also pushes students' problem solving and reasoning skills, because determining a strategy requires analysis of the details of the problem.

> ***Task:*** *At a restaurant, a trash can's opening is rectangular and measures 7 inches by 9 inches. The restaurant serves food on trays that measure 12 inches by 16 inches.*
>
> *The restaurant's manager says it is impossible for the tray to accidentally fall through a trash can opening because the shortest side of the tray is longer than either edge of the opening.*
>
> *Do you agree or disagree with the manager's explanation? Explain your reasoning.*

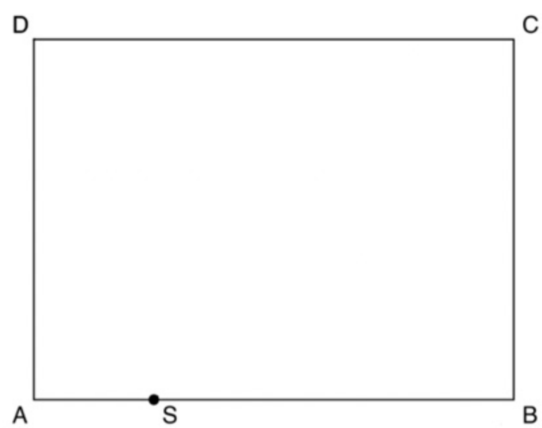
If students are struggling with starting the task you can scaffold instruction by asking a probing question, such as “Would it be easier to think of a strategy to solve if you had a diagram?” or “What information do you have and what are you trying to solve for?” Sometimes it is necessary to scaffold with redirecting questions, such as “Can you point to the shortest side of the tray in your diagram?” and “What is the size of the opening the manager is referring to?”

It is always important for any students below grade level to get exposure to grade-level content and, in this particular example, to the level of problem solving and reasoning skills required to solve this task. To do this, I recommend using this task as part of a whole-group discussion following small-group work.

For students above grade level

The third group of students can be given this task from the [Mathematics Assessment Project](#):

> ***Task:*** *Some children are playing a game in a rectangular schoolyard, named ABCD, that measures 12 yards by 16 yards. The diagram below shows the schoolyard viewed from above.*
>
> *The children start at point S. They have to run and touch each of the other three walls and then get back to S. The first person to return to S is the winner. What is the shortest route for them to take?*



The students given this task are ready for content above grade level, and it’s perfect for enrichment for a few reasons: The solution is not obvious or inferred. A strategy is required prior to beginning. There are many solution pathways but only one shortest pathway.

Similar to the fishing pole problem, this task allows for deep conversations about how students know the path they created is truly the shortest one. Because students in this group are performing above grade level, I encourage you to require that they explain their thinking in writing as well as out loud.

As with previous tasks, scaffolding should occur prior to students moving beyond productive struggle. For example, I might ask, "Can you show a solution by drawing in one possible pathway?" and "What are some conditions for the shortest route?" I would also ask students who are finished, "How do you know this is the shortest route?"

You *can* do this

When we identify a student's ZPD and use **ZPD to guide our scaffolding and differentiation** efforts, we create a space for students to take more ownership of their learning and to trust themselves and each other. Regardless of whether they're learning online, in person, or in a hybrid format, students will benefit from differentiation and scaffolding.

As you're reading this, maybe you're worried that you can't do this for your students. I understand your fear. This work takes time, and **the unfinished learning many students are facing** can feel daunting. But maybe believing is where it all starts. Believing you can do this for your class. TLG

About our authors

Ted Coe
With over 25 years of experience as a teacher, professor, department chair, administrator, and non-profit director, Ted Coe uses his experiences to weave together thought-provoking perspectives in mathematics education. He has worked full-time as a high school mathematics teacher, a community college faculty member, the mathematics chair at two community colleges, and an assistant dean at the university level. Prior to joining NWEA in 2020 as the director of Content Advocacy and Design, he served as the director of Mathematics at Achieve. Ted earned his BAE, MEd, and PhD degrees from Arizona State University, each with a focus on mathematics education.

Fenesha Hubbard
Fenesha Hubbard joined NWEA in 2012 and currently serves as a content designer, creating professional learning experiences for educators. Prior to designing, Fenesha delivered professional development for K–12 educators with NWEA. She specialized in the delivery methods of teaching, coaching, facilitating, training, and consulting. Fenesha's field experience includes being a former middle school math teacher, instructional coach, and workshop facilitator with Chicago Public Schools. She's passionate about creating authentic learning experiences and helping others grow. Fenesha holds a BS in math from the University of Illinois at Urbana-Champaign and an MEd in instructional leadership from the University of Illinois at Chicago.

Nick Joe
Nick Joe joined NWEA as a professional learning consultant in 2019. Prior to taking on this role, he was a math educator for seven years and served as math department chair and a committee member on his school's grading learning team. He has a bachelor's in math from the University of Illinois at Urbana-Champaign and a master's in math education from Eastern Illinois University. He is very passionate about math assessment, empowering student voice through discourse, and helping all students become self-directed learners.

Read more at

Teach. Learn. Grow.
the education blog

NWEA.org/blog

AUG21 | KAP6873