Teachers Nurture Growth Mindsets in Math

By Evie Blad

A blend of family attitudes, cultural ideas, and frustration often lead students to believe that math ability is a fixed trait like eye color, teachers say. They believe they are either born with the skills necessary to succeed in math class or they're not.

Those pervasive ideas and the way math has traditionally been taught can make it exceptionally difficult for math teachers to nurture growth mindsets in their students, they say.

"There's a cultural mystique in mathematics and sort of salient, counterproductive conceptions about what it is, that it's somehow harder than art, which of course is crazy," said Philip Uri Treisman, a mathematics professor and director of the University of Texas' Charles A. Dana Center, which focuses on math and science education.

"It has sort of cultural baggage with it that is not helpful to the field," he said.

The concept of growth mindsets has gained a foothold in many schools, where teachers emphasize that the brain can grow and change and that students don't enter school with a set of unchangeable strengths and weaknesses. In general, that means praising effort over personal traits and encouraging students to learn from mistakes by developing new strategies to approach problems.

As more schools buy into the research that shows that student mindsets and persistence are linked to academic success, researchers are working to develop more specific strategies for nurturing positive learning attitudes in areas like mathematics.

The key, they say, is changing both the student's ideas about learning and the way teachers approach math content.

The Dana Center's Academic Youth Development program, for example, blends mindsets research with math concepts through both professional development for teachers and summer programs for students as they prepare to enter 9th grade, which is often the year

Open Math Problems
Traditional math problems often encourage students to quickly work toward one solution, but “open tasks” can teach the
students take Algebra 1. Researchers are studying the
effects of the program, which is being used in 1,250
middle and high schools around the country.

'My Favorite No'

Some teachers are also making efforts on their own to
learn about the mindset concept. Stanford University's
Project for Education Research That Scales, or PERTS,
released a series of online courses about mindsets
for parents and teachers last month. It included just
one subject-specific course: a series of videos, exercises,
and sample lesson plans tailored for math teachers.

That course includes guidance on how to "normalize
failure" by encouraging students to ask questions that
they may be afraid to ask and to share incorrect
answers with their peers.

"Sometimes it's important to simply tell students that you love mistakes because that's how
students learn," one sample discussion plan says. "Start the class with a lesson on why you like
mistakes and what students can learn from them."

Classroom teachers say many of their students approach math with the expectation that they have
failed if they can't quickly solve a problem using a prescribed algorithm.

With a mindset approach, teachers help students focus on learning from that failure and trying the
problem from a different angle so that students can understand the underlying concepts.

The Stanford course includes a video of a teacher doing a daily exercise called "my favorite no." At
the beginning of class, she has every student solve a problem on an index card, sorting the
resulting answers into a pile of correct and incorrect answers. She then copies an incorrect answer
onto the board and asks students to identify all of the correct elements before honing in on what
part of their classmate's solution led them to an incorrect answer.

These sorts of exercises allow even the students who initially solved the problem correctly to learn
from their peer's errors, said Mari Montoy-Wilson, who teaches 3rd grade at a charter school in
East Palo Alto, Calif., a small city that is mostly Latino and much less affluent than neighboring
communities in the surrounding Silicon Valley.

"People aren't equipped with this idea that if something feels hard, that's your sweet spot and you
need to persevere and unpack that," she said.

Merely challenging students to change their mindsets without also changing the way math is taught
can be "dangerous," Treisman said. Without a grasp on math skills and opportunities to apply those
skills and develop strategies, students will receive the message that even effort can't help them
improve, he said.

That's why math teachers who emphasize mindsets advocate for teaching through "open problems,"
which challenge students to explain a concept rather than quickly identify one solution. This gives
them a chance to explore strategies for solving a problem and recognize there is often more than
one way to make sense of it rather than judging their own math skills by whether or not they get
the initial answer correct.
Stanford University math education professor Jo Boaler explains the concept in a video included in the course: In a traditional problem, a teacher may give students the dimensions of a rectangle and ask them to find its perimeter. In an open problem, a teacher may ask students to draw three rectangles with a certain perimeter and explain their work.

**Exploring Concepts**

Mariel Triggs, who teaches math at a private high school in San Francisco, said her students unpack open math problems step-by-step to explore a concept.

For example, she will ask them how many baseballs it would take to fill a room, and then allow them to determine all of the information they need to solve the problem. After they arrive at the answer, she will ask them how the problem would change if they expanded the dimensions of the imaginary room.

"I get these students and they will say, 'I am not good at math,' and I began to realize that what they were really saying was, 'I don't know how to do the problem in front of me,' " she said. "I frame it like a fun puzzle."

Teachers said those strategies dovetail nicely with the Common Core State Standards' emphasis on sense-making, abstract reasoning, developing strategies to use math concepts, and critiquing the reasoning of others.

And open problems allow students to understand how math concepts relate to each other, rather than merely understanding how to use an algorithm the teacher prescribes, they said. It's not that getting the correct answer doesn't matter, Montoy-Wilson said. But open problems emphasize that the process of arriving at the answer matters too, she said.

"It's pretty scary in terms of what we want for our future to think of kids who only know the algorithm and not why it works," Montoy-Wilson said. "When you just focus on getting to the answer, you really rob kids of grappling and working on that sweet spot. You don't want to scaffold or carry the load too heavily for your kids."

Across subjects, researchers have found that a teacher's own orientation to learning can affect whether their students have a fixed mindset or a growth mindset about their own abilities.

**Views on Math**

But a teacher's views on math also matter, said Kathy Liu Sun, an assistant professor at Santa Clara University in Santa Clara, Calif., and a former public high school math teacher.

Sun used surveys to gauge the mindsets of about 3,400 students and 40 teachers. She also assessed teachers' approaches to math, whether they valued speed and memorization or "multi-dimensional" problems that allow for multiple strategies and sense making.

Through post surveys and classroom observations, Sun determined that teachers with a "multi-dimensional" view of math were more likely to have students with a growth mindset at the end of a course.

"I think that teaching is really really important," she said. "It's not just about changing kids' beliefs, it's about giving them opportunities to experience it."

Sun also identified strategies that can help boost students' confidence in the math classroom.
Teachers should encourage multiple attempts at problem solving, they shouldn't offer unsolicited help to students, and they should provide opportunities for students to resubmit their work, she said.

Some mathematicians have said professional development for math teachers should prioritize content knowledge over pedagogy. Treisman said many math teachers have the math knowledge to teach in a more open format that encourages growth mindsets, and they just need to strengthen the skills necessary to do so.

Many of today's math teachers were taught in very traditional classrooms, and many have not explored the subject in this way on their own, he said.

That's why teachers need to practice their own sense-making and model it for their students, Treisman said. If math were music, mastering the basic concepts would be like learning scales and leading students through discussions of open problems would be like playing songs, he said.

"Teachers love the idea of mindsets as almost a panacea," Treisman said, "but they themselves have very fixed ideas of their own learning.

Coverage of learning mindsets and skills is supported in part by a grant from the Raikes Foundation. Education Week retains sole editorial control over the content of this coverage.