MINDSET FOR MATH

COACHING CYCLE EMPOWERS STUDENTS AND TEACHERS

BY SUE CHAPMAN AND MARY MITCHELL

If we want students to see themselves as capable of learning and doing mathematics, then teachers must possess confidence in their own abilities to understand and use mathematics.

If we want students to see mathematics as relevant to their lives, as worthy of their time and interest, then teachers must proclaim the importance of mathematics in their own lives and have a passion for empowering students with mathematical tools and ways of thinking.

If we want students to recognize the satisfaction that comes from tackling and persevering through challenging mathematics problems, then teachers must also see themselves as mathematics learners.

But what if teachers don't see

EXAMPLES OF PRODUCTIVE BELIEFS FROM *PRINCIPLES TO ACTIONS*

Guiding principle for school mathematics	Productive beliefs
TEACHING AND LEARNING	Mathematics learning should focus on developing understanding of concepts and procedures through problem solving, reasoning, and discourse.
ACCESS AND EQUITY	Mathematical ability is a function of opportunity, experience, and effort — not of innate intelligence. All students are capable of participating and achieving in mathematics, and all deserve support to achieve at the highest levels.
CURRICULUM	Mathematics is a dynamic field that is ever-changing. Emphases in the curriculum are evolving, and it is important to embrace and adapt to appropriate changes.
TOOLS AND TECHNOLOGY	Finding answers to a mathematical computation is not sufficient. Students need to understand whether an answer is reasonable and how the results apply to a given context.
ASSESSMENT	Assessment is a process that should help students become better judges of their own work, assist them in recognizing high-quality work when they produce it, and support them in using evidence to advance their own learning.
PROFESSIONALISM	Teachers of mathematics continue to learn throughout their careers.

Source: National Council of Teachers of Mathematics, 2014.

mathematics as comprehensible, purposeful, and fun? Unfortunately, this is the case for many teachers, including elementary teachers who are charged with mentoring the next generation into a lifelong relationship with mathematics.

As mathematics education leader and researcher Jo Boaler describes it, these teachers do not hold a mathematical mindset. That mindset involves "knowing that math is a subject of growth and [the math user's] role is to learn and think about new ideas." This is due in large part to teachers' own experiences as math learners in school. Boaler asserts that many elementary teachers "have, at some point in their own learning, been told they cannot do mathematics, or that mathematics is not for them. Many teach mathematics with their own fear of the subject" (Boaler, 2016, p. 8). For example, in a mathematics methods course one of us teaches for preservice teacher candidates, students often describe the subject as confusing, stressful, difficult, and "a necessary evil."

A teacher's mindset influences many aspects of her teaching and her students' learning, including the learning tasks she offers, the ways in which she orchestrates classroom discourse, her response to mistakes, and the assessment practices she employs.

When teachers learn about the research behind mathematical mindsets (Boaler, 2016; Dweck, 2008; Saphier, 2017) and when they examine their own current mindsets, they can begin to reset their approach to learning and teaching math.

They can choose to believe that all students are capable of understanding and enjoying it, and to set them all up for success.

DEVELOPING A POSITIVE MATHEMATICAL MINDSET

The landmark National Council of Teachers of Mathematics publication *Principles to Actions: Ensuring Mathematical Success for All* (2014) acknowledges the prevalence of negative beliefs about math and counters them by describing productive beliefs that constitute a mathematical mindset. The beliefs or principles are informed by research and can accelerate efforts to ensure success in mathematics for all students. (See table above.)

A COACHING CYCLE TO EXPLORE MATHEMATICAL MINDSET

Coaching is a method suited to supporting teachers as they learn to recognize and navigate their internal mindsets because mindset awareness and choice are metacognitive processes that can be learned and strengthened

PLAN THE COACHING PARTNERSHIP	
Steps	**Possible questions**
CLARIFY GOALS.	• What are you hoping to accomplish for your students as a result of our exploration of mindsets in your classroom? • Why are these goals important to you?
ESTABLISH CRITERIA FOR SUCCESS.	• How will you know if you have achieved these goals? • What evidence might you look for?
DECIDE ON FOCUS QUESTION.	• What questions do you have related to mindset? • What specific question are you interested in studying now?
IDENTIFY STRATEGIES.	• What strategies might you try to promote growth mindsets? • What might you see or hear during this lesson that would provide insight into your students' mindsets?
DETERMINE DATA SOURCES AND DATA COLLECTION PROTOCOLS.	• What kinds of information might help you to answer your research question? • What are some ways we might collect this data?
SPECIFY TIMELINE.	• What is your timeline for trying out the strategies you've identified? • When will we collect the data? • When will we meet to review and analyze the data?

through practice.

The following steps can help coaches and the school leaders who oversee and support them facilitate a cycle of inquiry to transform teachers' mindsets and students' learning. This plan can and should be adapted for specific contexts.

1. Invite thinking about mathematical mindset.

A coach can lay the groundwork for professional learning about mindset by offering experiences that provoke thought and conversation on this topic. What do your teachers know about mindset? Have they considered how their mathematical mindsets influence their effectiveness as teachers? What experiences might you provide to help teachers examine the interplay of mindsets within their own classrooms?

Here are some options for engaging teachers in this first step:

- **Pose this question: How is mindset impacting our students' mathematics achievement?** You can introduce the topic with something like this: "I've been hearing about the latest brain research and its implications for learning, including the fact that students' mathematical mindsets are as important as overall growth mindset. I'd like to hear your thoughts about how we might apply these findings in our school. We're having a brief discussion about mathematical mindsets after school today. I hope you can join us."
- **Offer a miniworkshop.** See the sample outline on p. 63.
- **Facilitate an article study.** See p. 64 for a list of suggested articles.
- **Survey teachers and/or students about their attitudes towards mathematics.** Share and discuss the results. See a list of questions in this Google doc: http://bit.ly/2PIVYeB.

2. Plan the learning partnership.

The purpose of this step in the coaching cycle is to plan an informal action research study to learn more about mathematical mindsets. Action research is the process of trying out new instructional practices and collecting data about the impact of these practices with the goal of improving student learning (Dana & Yendol-Hoppey, 2008).

The steps and coaching questions above suggest a possible map for this planning conversation. Coaches may move through the steps in any order and may revisit steps in whatever ways best support the teacher's thinking and planning.

Start by engaging teachers' curiosity. Ask teachers what they are wondering about, what they hope to learn, and what they want to accomplish for students. Here are some example wonderings to get them going:

- How can I tell if my students are experiencing the right level of cognitive struggle?

REFLECT ON THE DATA	
Steps	**Possible questions**
DESCRIPTION	At first glance, what are you noticing in the data?
SENSE-MAKING	• What are some ways you might organize the data? • What patterns may be emerging? • Are there any data that stand out? • What surprises you?
INTERPRETATION	• What might these patterns mean? • How do the patterns relate to the questions you have posed?
IMPLICATIONS	• What are you learning about your students? • What might be some implications for your teaching? • What are you learning about yourself as a teacher? • How might you act on your new understandings? • What next steps might you take? • What support might you need? • What new questions do you have?

- How can I encourage a sense of joy and wonder in my math class?
- How can I celebrate mistakes as opportunities for learning?

Use the steps that follow to work with teachers to plan the action research.

3. Gather data.

Because the teacher must construct the meaning of the data, it is critical that she own decisions about the data to be collected and the processes for gathering this data. According to Costa and Garmston (2002, p. 48), "The intent is to cast the colleague in the role of experimenter and researcher, and the coach in the role of data collector."

You and your teachers may opt to collect data from classroom observations — for example, the number of students who volunteer to answer questions, who explain their thinking, or who respond to peers' thinking and ideas. Instead or in addition, you may look at student work to examine evidence of students engaging in a rigorous task when given choices or students reflecting on the influence of mistakes on their learning.

To obtain this data, you might work together to design a student survey or an observational recording form for noting when students participate in a discussion. You might ask students to complete a journaling prompt with questions related to mindset such as "What advice might you give another student who is having trouble with math?" You also might make a video or audio recording of the lesson so teachers can later review and analyze it.

4. Reflect on the experience.

As the teacher and coach review and analyze the data together, they find answers to the action research question posed.

They also co-construct a deeper understanding of the dynamics of mindset in the classroom. The questions in the table at top can serve as tools to support teachers in making sense of the data collected and in thinking about causal relationships that may be suggested by the data.

A MINIWORKSHOP ON MATHEMATICAL MINDSETS

1. Ask teachers to create mind maps representing how they think and feel about the subject of mathematics. Share and discuss the results.
2. Review the *Standards for Mathematical Practice* (NGO Center & CCSSO, 2010, pp. 6-8) or your state's standards for mathematical practices. Invite teachers to share their personal mathematics learning stories as they reflect on these standards.
3. Share a productive belief and a parallel unproductive belief from *Principles to Actions: Ensuring Mathematical Success for All* (NCTM, 2014). Have teachers identify the underlying assumptions and consequences of each belief.
4. Invite teachers to create "I wonder" statements related to mindset that could be investigated using an action research process.

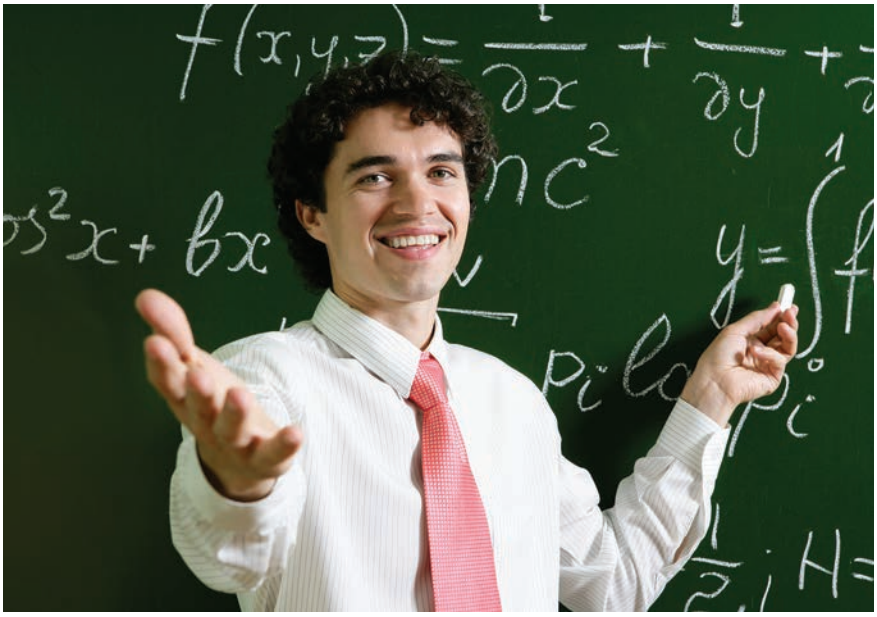
NEXT STEPS

Having completed a coaching cycle focused on mathematical mindsets, the teacher and coach can decide together what their next steps might be. Options include launching another coaching cycle based on questions that came from the reflective conversation; sharing the results with others to generate new ideas and questions; broadening the scope of the action research (for example, to a whole department or school); or working with a team to write a schoolwide belief statement about mathematics.

These projects can change minds to ultimately change teaching and learning. Think about a teacher you know who lacks confidence teaching mathematics. Now picture this teacher passionately engaged in making sure her students not only understand mathematics but also experience the joy of working on really hard problems.

Visualize this teacher enthusiastically talking with colleagues about her students' mathematical thinking and collaborating in designing rich learning tasks. Imagine her telling students, "I am a math person and so are you."

The end goal in cultivating a mathematical mindset is to empower students to be self-directed in their math learning, a critical skill for their futures. Teachers must hold themselves accountable for nurturing students' mathematical mindsets as well as understanding concepts and honing skills. This is the key to providing all students in all classes in all schools with opportunities to learn and succeed in mathematics.



ARTICLE STUDY SUGGESTIONS

- "Teacher mindsets and student learning": https://mathsolutions.com/uncategorized/teacher-mindsets-and-student-learning/
- "Actionable feedback as a means of promoting a growth mindset": https://mathsolutions.com/uncategorized/actionable-feedback-as-a-means-of-promoting-a-growth-mindset/
- "Helping struggling students build a mathematical mindset": https://mathsolutions.com/uncategorized/helping-struggling-students-build-mathematical-mindset/
- Blog posts from Jo Boaler's website: youcubed.org

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