Math Anxiety

Facilitator's Guide

Time: 60 minutes
Facilitators: Instructional coaches or teacher leaders who work with elementary school teachers
Audience: Upper elementary school math teachers

Background Reading

- Beilock, S. L., & Willingham, D. T. (2014). Math anxiety: Can teachers help students reduce it? Ask the cognitive scientist. *American Educator*, *38*(2), 28–33. http://eric.ed.gov/?id=EJ1043398
- Khng, K. H. (2016). A better state-of-mind: Deep breathing reduces state anxiety and enhances test performance through regulating test cognitions in children. *Cognition and Emotion, 31*(7), 1–9.

Session Outcomes

By the end of the session, participants will be able to:

- Define math anxiety
- Describe the impact of math anxiety on academic performance and other outcomes
- Apply actionable strategies to alleviate math anxiety in classrooms

Materials and Supplies

- PowerPoint slides
- REL Northwest animated video on math anxiety http://bit.ly/2rKvhyj
- Audiovisual equipment to play video
- Teacher Guide: Focused Breathing to Reduce Math Anxiety (enough copies for all participants)

Session at a Glance

Timing	Segment	Key Activities
10 minutes	Welcome and Introductions	Participants engage in one or two icebreaker activities that help them get to know one another and assess their experiences with and attitudes about math.
15 minutes	Overview of Math Anxiety	Math anxiety is defined and described, and its causes and impact on student academic performance are discussed.
10 minutes	Classroom Strategies to Reduce Math Anxiety	Participants get an overview of strategies teachers can use or adapt to manage math anxiety, both in themselves and in their students.
8 minutes	Activity: Mixed Messages	Participants review common adult responses to children's math struggles and generate alternatives that are more empowering and confidence-boosting.
12 minutes	Activity: Focused Breathing Practice	Participants watch a video about focused breathing, then they review and practice this mindfulness technique using a provided teacher guide.
5 minutes	Closing Reflection	Participants reflect on what they learned in the session and think about how they will apply it in their work.

Timing	Topic/Steps/Activities	Facilitator Notes	Resources/ Materials
10 minutes	**Welcome and Introductions** 1. Introduce yourself. 2. Lead participants through one or both of the following icebreaker activities to help them get to know one another and begin framing the session. **Option 1:** a. Display the first icebreaker option slide and ask participants to reflect on their response to the images on the slide using the following prompts: • *What is the first word that comes to your mind when you see these images?* • *What do you notice about your reactions to these images?* b. Have participants share their responses to the prompts with a partner at their table. c. Ask for a few volunteers to share their responses with the large group. d. Point out that math is not just something that happens in classrooms; many real-life situations require math. e. Ask participants how their answers might change if these tasks were subject to some of the extra challenges that students face on school math tasks, e.g. public evaluation, timed responses, and high-stakes assessment. **Option 2:** a. Display the second icebreaker option slide and ask participants to complete their "math autobiography." They can write out the complete autobiography or just jot down their responses to the prompts. b. Have participants share their math autobiography with a partner at their table. c. If time permits, ask for a couple of volunteers to share their autobiography with the large group.	Direct participants to the background reading to deepen their understanding. These icebreakers can be done with a group of any size. If desired, you can print copies of the image and/or the math autobiography form and distribute them as handouts.	Slides: Icebreaker (two options)

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	3. Review the icebreaker and set up the session using the following key points. **Key Points** ➢ In addition to talking about students' math anxiety, a big focus for today is to consider how educators' feelings about math can be "contagious," in both beneficial and not-so-beneficial ways. ➢ As we'll see, teachers' own math anxiety is easily transmitted to students and can have a big influence on how those students approach math. ➢ We will talk about ways to work on messaging that reduces the harmful impact of math anxiety and promotes success. 4. Display and review the session learning objectives.		Slide: Learning Objectives
15 minutes	**Overview of Math Anxiety** 1. Walk through the slides that define and describe math anxiety, using the following key points. *Defining Math Anxiety (2 minutes)* **Key Points** ➢ Show the slide with the quote from the 10-year-old girl about her least favorite subject. ➢ As the quote illustrates, math anxiety is different from just not liking math. Symptoms of math anxiety are tension, apprehension, and fear of situations involving math. Math anxiety can be triggered when students simply anticipate doing math. ➢ Math anxiety is distinct from other forms of anxiety, such as test anxiety or general anxiety, and it is not the same as having poor math skills. ➢ Research suggests that math anxiety is a global phenomenon and	When possible, connect these key points to insights and experiences participants shared during the icebreaker(s).	Slides: What is Math Anxiety? (two slides)

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	is very prevalent, even in young children. For example, one study found that a third of a sample of first-graders reported anxiety about math. Research suggests that math anxiety, particularly in relation to testing, begins in elementary school and increases as students get older and accumulate experiences. ➢ The image on the slide depicts an example of a scale researchers use to measure young children's math anxiety. *Implications of Math Anxiety (5 minutes)* ➢ Research evidence supports the link between math anxiety and poorer performance in math. Correlational evidence shows that math anxiety is negatively related to math performance. This has been replicated at all academic levels, from elementary school to college. ➢ Further, studies have shown that the predictive power of math anxiety is specific to math (finding little association between math anxiety and performance on a reading comprehension test, for instance). ➢ Unfortunately, math anxiety can feed into a negative reciprocal cycle. Students who are anxious about math often end up avoiding math, which only exacerbates the problem because it limits opportunities for improving math skills. ➢ This is concerning because math avoidance closes students off from lucrative career paths. Science, technology, engineering, and math (STEM) fields and occupations drive technological innovation and bring economic and public health benefits, yet many countries face shortages of skilled STEM workers. ➢ Inherent in the concept of math anxiety is the implication that someone would be better at math if they had less anxiety about it. This is supported by a growing body of research evidence. ➢ Math anxiety appears to impact the amount of "working memory" people have. Working memory is what allows people to keep several things in mind simultaneously (such as rubbing your tummy while patting your head), and it takes energy. ➢ When the brain spends energy on being anxious, it has fewer resources to devote to the task at hand. The student now has to do two things at once: solve the math problem (rub the tummy) AND be anxious about it (pat the head).		Slides: Implications of Math Anxiety; Reciprocal Cycle; Math Anxiety Robs Performance

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	➢ Ironically, students with the highest levels of working memory can be the ones who struggle the most with math anxiety, possibly because they use more complex approaches instead of simple ones. *What Causes Math Anxiety? (5 minutes)* ➢ Math anxiety can stem from many interrelated sources that are likely operating at once: • The student perceives that their math skills need work. • The student is trying to use a lot of higher-order approaches instead of simple ones. • The student didn't learn some of the fundamental "building blocks" in early years. • The student is picking up subtle (and not-so-subtle) cues from their environment that convey negative messages about math (e.g., that it should be feared, that only certain types of people are good at it, etc.). ➢ Math anxiety in adults can spread to children. In casual conversation, you're far more likely to hear someone say, "I'm not a math person" than "I'm not a reader," for example. This kind of negativity about math can be contagious. ➢ A study found that parents with high math anxiety had children who learned less math and were more math anxious, especially if their parents helped them with their homework. ➢ Teacher attitudes about math also matter. Another study found that higher math anxiety among female elementary school teachers is related to lower math achievement among their female students at the end of the year. Also, the more anxious teachers are about math, the more likely girls are to believe the stereotype that "boys are good at math, and girls are good at reading." ➢ The transmission of negative messages about math is especially harmful to girls and students of color. Math is different from some other domains because, as a society, we have very strong stereotypes about who belongs in this field. ➢ The stereotypes our society holds about math make it likely that some students—girls and students of color in particular—are most likely to question their belonging in this domain. ➢ Research suggests that children adopt the pervasive stereotypes	For more information on these studies, see Beilock, Gunderson, Ramirez, and Levine (2010); Maloney, Schaeffer, and Beilock (2013); Galdi, Cadinu, and Tomasetto (2014); Maloney, Ramirez, Gunderson, Levine, and Beilock (2015); and Master and Meltzoff (2017) in the reference list.	Slides: What Causes Math Anxiety?; Adult Math Anxiety Impacts Students; Math Stereotypes; What's Inside a Stereotype?

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	of their culture starting at a surprisingly young age. For example, children will show evidence of automatic associations, such as "math = boys," before they even endorse stereotypes more explicitly. Children's stereotypes then influence their academic attitudes and performance. ➢ Math anxiety and "stereotype threat" likely share a common mechanism: They both consume working memory. An individual experiencing stereotype threat ruminates and processes negative thoughts, temporarily reducing working memory that could be devoted to task performance. ➢ Although many factors influence gender gaps in STEM, the gender difference in young students' interest and motivation in STEM is a major contributor to later disparities in majors and careers in the field. ➢ Master and Meltzoff (2017) hypothesize that two stereotypes are intertwined: a ''cultural fit'' stereotype (the belief that ''math is for boys'') and an ''ability'' stereotype (the belief that boys have more ability to do STEM problem-solving than girls). ➢ New research establishes that these two stereotypes begin to influence girls' self-concepts, interest, and motivation as early as elementary school and continue to do so through older grades. ➢ Cultural stereotypes contribute to educational inequities, but together, educators and policymakers can help reduce stereotyping and boost interest in STEM among girls and students of color worldwide. *Wrap-Up (3 minutes)* 2. Use the following key questions to prompt participants to integrate the information presented.  **Key Questions** • When you were growing up, in what ways did adults' math attitudes and experiences affect your relationship with math? • If you experience math anxiety, what strategies have you found useful in helping you overcome or work through it?		

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	3. Make the following key points to summarize and transition to the next segment. **Key Points** ➢ Math anxiety is malleable. Adults can make a difference. ➢ In the next segment, we will discuss strategies teachers can use to reduce math anxiety in the classroom.		
10 minutes	**Classroom Strategies to Reduce Math Anxiety** 1. Display the classroom strategies and key strategies slides and give a preview of the strategies that will be presented. 2. Walk through the slides that describe the strategies, using the following key points. *Cultivate Your Own Math Self-Awareness and Skill* **Key Points** ➢ Teachers should be aware of their own feelings about math and avoid expressing math negativity (for example, teachers should not disparage their own math skills). If you struggle with math anxiety, consider seeking out additional professional development opportunities so you can feel confident in your ability to teach math to your students. 3. Ask participants to reflect on the following key questions with a partner at their table. **Key Questions** • How do you usually talk to others about your experiences as a math educator? • What are some ways you express your feelings about math?		Slides: Classroom Strategies to Reduce Math Anxiety; Key Strategies Slide: Cultivate Your Own Math Self-Awareness and Skill

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	Celebrate Mistakes ➢ Teachers should cultivate a classroom culture that emphasizes learning over correct answers—which is consistent with practices that build growth mindsets. In this kind of environment, wrong answers are valuable! This may alleviate some of the pressure highly math-anxious students feel. ➢ Give your students work that encourages mistakes by keeping it at the edge of their current skill level. Emphasize that if students are getting all correct answers, the work isn't challenging enough and they aren't learning. ➢ Two activities that can help build a culture that embraces and celebrates mistakes are the inverted test and the mistakes game. • For the inverted test activity, give students a test or assignment that's been completed by a fictitious student and includes several mistakes. Have students correct the test by identifying and explaining each mistake and ask them to describe how they would approach or solve the problems differently. • In the mistakes game, students first work alone to complete a set of problems. Then students are put into groups and share their solutions. Each group must present one problem to the class, but the group must incorporate at least one intentional mistake into its solution. This could be a mistake one group member made, or the group can think of another mistake someone might make. As each group shares its problem with the class, the class listens and attempts to find the mistake. Direct the class to use questioning to get the group to admit its mistake. This can involve questions such as "Why did you choose to …?" and "Can you explain how you did …?". *Support Students* ➢ Students who may not have learned the fundamental basics of math could benefit from targeted exercises to boost their competencies and regulate their potential anxieties. ➢ Math anxiety seems to be triggered in public performance and timed situations. Thus, whenever possible, avoid forcing students to perform in front of a large group (e.g., with competitive drills) and having students perform math under time pressure.		Slides: Celebrate Mistakes; Celebrate Mistakes: Inverted Test, and Celebrate Mistakes: Mistakes Game Slides: Support Students

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	Be Conscious of Messages ➢ Be careful of how you speak to students who are struggling. Consolation sends a message that validates a student's opinion that they are not good at math (e.g., "Not everyone is good at this kind of problem" and "Don't worry—I was never good at math") and never will be. A better message would be "This is challenging, but I know that if you stick with it, you can do it!" ➢ In a few moments, participants will have an opportunity to review common adult responses to children's math-related struggles and think of more empowering and confidence-boosting alternatives. *Practice and Teach Mindfulness* ➢ One way to combat students' anxiety is to implement mindfulness exercises in the classroom. Mindfulness is focusing awareness on the present moment, without judgment, to calmly acknowledge and accept one's feelings, thoughts, and bodily sensations. ➢ Research has shown that practicing mindfulness in the classroom benefits both students and teachers. For students, mindfulness practices can improve self-regulation and emotional competence, as well as academic skills, self-esteem, mood, and stress levels. ➢ Mindfulness seems to help students because it reduces the emotional response to anxiety-producing testing situations, freeing up working memory resources and improving performance. ➢ Mindfulness can help teachers improve their classroom management and relationships with students. It can also increase teachers' feelings of well-being and efficacy. ➢ Teachers can implement a quiet time for students to engage in a group meditation practice. ➢ A proven way to help reduce math anxiety that is easily accessible to young children is a brief focused breathing exercise in which deep breaths are drawn into the abdomen. ➢ Deep breathing is a quick and simple technique involving minimal resources or disruption. It can be done in just minutes before a test or other evaluative math task. ➢ Research has shown that deep breaching can reduce math anxiety and boost performance by relaxing the mind and freeing up working		Slide: Be Conscious of Messages Slides: Practice and Teach Mindfulness; Focused Breathing

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	memory resources. Experimental studies have shown that when highly math-anxious students underwent a focused breathing intervention just before a stressful math performance situation, they performed better. ➢ In one exercise, students spent 15 minutes in guided meditation, during which they focused attention on their inhalations and exhalations and were encouraged to draw their focus back to the breath if their mind wandered. Students who underwent the intervention reported feeling calmer and also had more correct responses on a math exam relative to students in control conditions. ➢ Focused breathing can be done as a ritual children can perform before a challenging task. Rituals have been shown to improve performance on high-stress math tasks by reducing anxiety. ➢ We realize the word "ritual" might have some strange connotations, especially when it comes to something that happens with young learners in a classroom. Here, when we say "ritual," we are simply referring to any pre-defined sequence of formal, repeated, symbolic actions. Throughout history and across cultures, rituals are often incorporated into life events (such as graduations and weddings), as well as stressful performance situations (such as public speaking and sports events). ➢ For example, "Before every show, singer Beyoncé Knowles listens to the same playlist of songs, says a prayer with every member of her band, completes a specific set of stretches, sits in a massage chair while she has her hair and makeup done, and spends exactly one hour meditating" (Brooks et al., 2016, p. 71). ➢ Performing the rigid, repetitive actions of a ritual may satisfy a fundamental need for order. Rituals can serve as a potent form of distraction, blocking negative thoughts from entering a person's mind. Rituals may provide a sense of meaning and purpose, allowing people to expand their working self-concept beyond the threatened domain (i.e., they remember they are more than someone who struggles with math). Akin to a placebo effect, if an individual believes there is a chance a ritual may help them perform better, then anxiety about the performance will actually decrease, and this decrease in anxiety, in turn, will improve performance. ➢ In a few minutes, participants will have a chance to practice focused breathing.		

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8 minutes	 **Activity: Mixed Messages** 1. Display the first mixed messages slide. Note that these are statements a parent or teacher might make in response to a child saying they do not understand a math problem. 2. Ask participants to consider whether the statements might inadvertently transmit disempowering messages. 3. Ask participants to discuss with someone at their table what they think students might hear when a parent or teacher uses the statements. 4. After a couple of minutes, display the second mixed messages slide, which shows how students might negatively interpret each of the statements. 5. Ask participants to work with a partner to suggest ways the statements could be changed to support students and reduce math anxiety. Ask for a couple of volunteers to share their suggestions with the large group. 6. Display the third mixed messages slide, which lists the second set of sample statements, and repeat steps 3 through 5. 7. If time allows, prompt participants to share additional examples of messaging they observed as students or in working with other coaches or teachers.	If desired, you can print copies of the messages and distribute them as handouts.	Slides: Activity: Mixed Messages (four slides)
12 minutes	 **Activity: Focused Breathing Practice** 1. Display the focused breathing activity slide. 2. Distribute the focused breathing teacher guide (if you haven't already). 3. Remind participants that focused breathing has been shown to reduce math anxiety in students if performed before tests. It is a quick and simple mindfulness technique that can be easily learned and effectively applied by most children to alleviate some of the effects of math anxiety on psychological well-being and academic performance. Focused breathing can be done in just minutes before a math test or other evaluative math task. 4. Play the REL Northwest math anxiety video.		Slide: Activity: Focused Breathing Practice Materials: Focused breathing video; Teacher Guide: Focused Breathing to Reduce Math Anxiety

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	5. Note that participants will now have a chance to practice a brief version of a focused breathing exercise that can be used with elementary school students. 6. Using the teacher guide, walk participants through a shortened (three- to four-minute) version of the focused breathing exercise. 7. If time allows, use the following key questions to review the exercise with participants.  **Key Questions** • How could you incorporate focused breathing into your classroom and/or work with teachers? • What other calming or mindfulness techniques have you used or seen that might be helpful for easing math anxiety?	To save time, have the video cued up and ready to play. This activity can be done with a group of any size.	
5 minutes	 **Closing Reflection** 1. Display the reflection slide. 2. Ask participants to reflect on the following key questions and share their responses with the large group (as time permits).  **Key Questions** • What stood out to you, increased your knowledge, or changed your thinking during this session? • What is one thing you learned or discussed today that you will apply to your work with teachers and/or your classroom? 3. Display the references slides and encourage participants to look up the studies listed for more information. 4. Thank participants. 5. Answer any final questions.		Slide: Reflection Slides: References (two slides)