

**Math Anxiety:
Finding Solutions to a Multifaceted Problem**

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Abstract

Math anxiety is becoming more prevalent in classrooms around the world. Students with math anxiety experience both physiological and psychological symptoms, in addition to long-term effects. This article examines the global context of math anxiety, the causes of math anxiety, and what educators can do to support students who experience math anxiety in hopes that students can have a positive lifelong relationship with math.

Many people are under the misconception that there are those who are “math people,” and those who are not. This mentality is one of the elements that can lead to people feeling anxious about math (Boaler, 2016). Math anxiety is a worldwide problem affecting people of all ages (Luttenberger et al., 2018). Math anxiety refers to feelings of apprehension and fear, as well as physiological symptoms, when individuals perform, or anticipate having to perform, math tasks (Gerado et al., 2018). Math anxiety has been reported in students as young as first grade and can continue to be a problem for some people into adulthood (Pantoja et al., 2020). In the U.S.A., two-thirds of adults report some fear of math, despite their background or culture (Mitchell, 2018). In adults, math anxiety has been shown to interfere in both daily life and academic situations (Pantoja et al., 2020). If there is evidence that this phenomenon can start as early as first grade, and plague people into adulthood, affecting even their choice of career, then it is the duty of educators and parents to understand what math anxiety is, what causes it, and how to use practical strategies to help alleviate students’ anxiety surrounding math.

The Common Global Denominator of Math Anxiety

To fully understand the impact of math anxiety on our students, we need to look at how math anxiety looks in classrooms around the world. The PISA 2012 results provide a comprehensive look at math data from students around the globe. To gather data specifically on math anxiety, students were asked a series of questions about how they feel when performing math tasks (OECD, 2013). Across the Organization for Economic Co-operation and Development countries, 59% of students worry that a math task will be difficult for them, 33% get very tense when they must do math homework, 30% feel helpless when performing a math task and 61% worry about getting a poor grade in math (OECD, 2013, p. 98). The study found that there has been an increase in math anxiety since PISA 2003. In countries that saw an increase in math anxiety, there was a decrease in self-efficacy and self-concept surrounding mathematics. The PISA results indicated that higher levels of math anxiety led to lower performance results. The countries that experienced the least amount of math anxiety were ones where the students generally performed averagely. Across all countries and economies, at least one in three students worried about their math performance (OECD, 2015, p. 2). These statistics are staggering, showcasing just how widespread the phenomenon of math anxiety is.

Isolating the Variables of Math Anxiety

Math anxiety has many causes and not all factors may play a part in each students’ individual anxiety. Factors that may contribute to math anxiety are the influence of teachers, the influence of parents, gender stereotypes, prior experiences, and classmate interactions. It is

important to understand how each of these causes engenders math anxiety so that we can then find strategies to help our students alleviate the anxiety and find success in math.

Teachers can be a positive influence in a child's mathematical learning; however, the opposite is also true. The majority of students' math knowledge is learned in the classroom, and, depending on their home life, this may be the students' first exposure to math learning (Gerado et al., 2018). Due to their influential nature, teachers can increase students' math anxiety for several reasons. One of the ways teachers can contribute to students' math anxiety is through their own attitude toward math (Luttenberger et al., 2018). If a teacher perpetuates the idea that math is something that one either knows or does not know, it can damage students' math self-efficacy, causing anxiety. This fixed mindset approach to learning can cause students to believe that they will never be able to learn math. Behaviours that perpetuate fixed mindsets are praising math talent, instead of praising the process, and trying to make students feel better about not being a "math person," when the students do not do as well as they had hoped (Dweck, 2018, p. 8). Both strategies promote a fixed mindset, instead of the growth mindset teachers should hope to instill in their students. Additionally, if a teacher has a negative attitude toward mathematics learning, that can transfer to the students (Oxford Learning, 2017). Higher math anxiety in teachers has been found to indicate lower math achievement in students, and more gender stereotyping (Gerado et al., 2018). Research has found that female teachers are more likely to pass on their anxiety to female students, further perpetuating the gender stereotypes that often accompany math (Luttenberger et al., 2018). There are many ways that teachers can help students with math anxiety, but first they must reflect and see whether their behaviour is the cause of it.

In addition to teachers, students can have influential math relationships with other people, including their parents. Parents can contribute to math anxiety in a variety of ways, such as while helping with homework and through their own attitudes about math or fixed mindset beliefs. In general, parents want to see their children succeed and often like to be involved in their school life (Gerado et al., 2018). Parents may spend time with their children talking about school and helping with homework. However, parents who have math anxiety may cause their children to become math anxious when helping with homework (Gerado et al., 2018). When parents struggle with math, it is easy for them to make comments that children perceive as a negative attitude toward math (Mitchell, 2018). For example, the PISA 2012 revealed that 90% of students thought that their parents believed math to be important, but only 58% of students believed that their parents liked math (OECD, 2013, p. 100). This disconnect may lead students not to embrace math like they should. On the other end of the spectrum, a parent who is comfortable with math may step in too quickly, and not allow the student to struggle, which is a key part of learning (Mitchell, 2018). Parents can also have high expectations for their child's academic success (Gerado et al., 2018). The expectations and judgements of their child's math capabilities may influence the child's math anxiety, especially if the parents are math anxious themselves (Luttenberger et al., 2018). Parents need to recognize the important role they play in their child's math learning, and work together with educators to help students manage their math anxiety.

Unfortunately, gender also plays a role in math anxiety. Females are more likely than their male peers to experience math anxiety (Luttenberger et al., 2018). Studies have looked at when the gender differences start, and have found there can be a difference as early as first grade, which continues into higher education, with females scoring higher on math anxiety indexes than males (Gerado et al., 2018). Some of the gender differences in math anxiety can be attributed to stereotypes and beliefs about girls' math, because girls tend to internalize stereotypes more than their male peers (Luttenberger et al., 2018). According to the 2012 PISA results, boys are more likely to participate in extracurricular mathematics activities than girls (OECD, 2013), which shows that girls are missing out on valuable math learning opportunities due to their anxiety. We need to work hard to help undo these internalized stereotypes, so that girls no longer experience more math anxiety than boys.

Prior experience with math can contribute to students' math anxiety in the present. Research has found that students' levels of math anxiety are directly related to how they interpret their past math experiences (Gerado et al., 2018). There are several layers to prior experience. The first is fear of public embarrassment (Oxford Learning, 2017). If students have previously had a negative experience with math, which has caused them prior embarrassment, they are more likely to be anxious during future math encounters (Dweck, 2008). Time pressure could be another stressor students have previously encountered that made them feel overwhelmed (Oxford Learning, 2017). If students remember that they struggled to finish their assignments, or more importantly their tests, during the allotted time, they may have increased anxiety on any timed math task in the future. Students do not want to repeat prior uncomfortable experiences so they may try to avoid challenging math tasks in order to not face embarrassment again, which leads to more anxiety in the future (Dweck, 2018). Educators need to find strategies to remove the negative associations students may have with math, in order to help alleviate anxiety in the future.

The beliefs that students have about their classmates' math abilities can also impact students' own math anxiety. The 2012 PISA results found that 60% of students believe that their friends do well in math (OECD, 2013, p. 100). Further research found that when a student thinks that classmates did well, the student will feel more anxious, even if the student did well (OECD, 2015). This may be compounded by the fixed mindset belief that math is either a talent one has or does not (Mitchell, 2018). Comparison to peers and fixed mindsets are challenges to overcome as we try to find solutions to help with students' math anxiety.

Finding Solutions and Checking Our Work

The causes of math anxiety are unique to each student, and therefore the solutions will be unique as well. A variety of strategies help to alleviate math anxiety for students, such as a safe classroom environment, engaging instructional strategies, intentional feedback, parental involvement, and fostering a growth mindset. By implementing these strategies in classrooms, teachers can set their students up for mathematical success, and reduced math anxiety.

One of the strategies teachers can use to help alleviate math anxiety is to create a safe classroom environment (Kaskens et al., 2020). When students feel safe, they are more likely to participate in the lesson and ask for clarification when they need it. A safe classroom environment also promotes engagement in small-group learning (Mitchell, 2018). By making the classroom a space where it is okay not to know the answer and okay to fail, teachers can reduce math anxiety for all of their students.

Another approach that can help reduce math anxiety is the use of engaging instructional strategies. Teachers should try to instruct in a way that engages students and ties the math learning to relevant topics (Luttenberger et al., 2018). When students participate in activities that engage and challenge them, and they can collaborate with their peers, students build mathematical resilience (Reid & Reid, 2020). Instructional strategies that help students who struggle with math anxiety are clear instruction, adapted teaching, modelling, scaffolding, and efficient classroom management (Kaskens et al., 2020). When choosing instructional strategies, teachers should also be mindful of the importance of reducing the working memory load. Specific strategies that help with reducing working memory load are breaking down the information into smaller steps, the use of visual aids, and personal supports (Reid & Reid, 2020). By giving students strategies to reduce the working memory load, we are enabling them to be successful in their mathematical tasks and reducing their anxiety.

Feedback is another area where teachers can help to reduce math anxiety. In the PISA 2012, students were asked a variety of questions about teacher feedback, such as whether their math teacher told the class how well they were doing, whether the teacher gave specific feedback on the students' individual strengths and challenges, and whether the teacher told the students exactly what they needed to do to improve (OECD, 2015). These practices have been

shown to reduce math anxiety in students, and educators need to keep that in mind when providing feedback in the future.

Parents can play a role in reducing math anxiety in their children. One way in which parents can help is to keep a positive attitude about mathematics (Luttenberger et al., 2018). Many parents have had a negative experience with math, but by focusing on changing their attitude they can help their children succeed. Another way in which parents can reduce anxiety is for them to have realistic expectations of their children's math ability (Luttenberger et al., 2018). Not placing too much pressure on the students will help to reduce the anxiety they feel.

The final math anxiety reduction strategy is fostering a growth mindset. This strategy is important not only for math anxiety, but for success in life. A fixed mindset is one whereby people believe that someone is born with a set intellectual ability, and nothing they can do will change that (Dweck, 2008). On the other hand, a growth mindset is one where people believe that intelligence can be achieved by hard work and practice (Dweck, 2008). Unfortunately, math is the subject that has the most fixed mindsets surrounding it (Boaler, 2016). Teachers must take on the challenge of changing math from a subject of fixed mindsets to one of growth. One of the ways to do this is to praise the process, not only the end results (Dweck, 2008). We need to show students that we value mistakes and learn from failure. Productive struggle means that "brains are growing, synapses are firing, and new pathways are being developed that will make them stronger in the future" (Boaler, 2016, p. 178). Other ways educators can foster a growth mindset in math is by encouraging mistakes, accepting that there is more than one way to solve a problem, and valuing rich questions (Miller, 2020). Teachers should also be mindful of shifting the focus from answering questions quickly and correctly, to the process of learning and growing in mathematics (Reid & Reid, 2020). By showing students the positives in failure, and changing our narrative about how we measure success, we can help students to achieve a growth mindset, and therefore reduce math anxiety.

The Final Answer

Unlike a typical math problem, there is no clear solution at the end of the problem of math anxiety. Math anxiety is a real phenomenon affecting students of all ages. By understanding possible causes of math anxiety, such as the influence of teachers, parents, and classmates, prior experiences, and gender stereotyping, we, as educators, are better able to find solutions that will help our students. Safe classroom environments, engaging instructional techniques, effective feedback, positive parent involvement, and fostering a growth mindset are all powerful tools for combating math anxiety in the classroom. As we continue to normalize that learning math takes effort and consistency, we will see a decrease in math anxiety, and an increase in a lifelong love of mathematics.

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About the Author

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