

inflexion

Math Anxiety Research Brief



Introduction:

Math anxiety is a common experience that causes a person presented with mathematical tasks to feel worried or panicked about solving the problems, ultimately making it harder for the person to think. Math anxiety can present as fear, tension, apprehension, opposition, or confusion when faced with mathematical tasks, or even at the thought of entering a math classroom. Math anxiety is a significant issue among students of all ages and can get progressively worse through middle and high school and continue into adulthood if not addressed. This research brief aims to provide an overview of math anxiety in middle and high school students, explore its causes and consequences, and present potential strategies for mitigating its impact.

Prevalence of Math Anxiety:

According to a prominent 2009 study by Ashcraft and Moore, 17% of Americans overall report having “high levels of mathematics anxiety.” Math anxiety is prevalent among middle and high school students. Research studies indicate that approximately 25-30% of students experience moderate to high levels of math anxiety, with higher rates observed in females compared to males. The onset of math anxiety often occurs during middle school, coinciding with the transition to more complex mathematical concepts, although studies have shown that children as young as 7 years old experience math anxiety.

Causes of Math Anxiety:

Math anxiety can stem from various factors, and are often co-existing, including:

- **Lack of Foundational Concepts:** Becoming lost and missing key math concepts in their educational trajectory can lead to adverse effects on students' academic performance and long-term attitude towards math.
- **Lack of Student Self-Efficacy:** Students may perceive math as difficult or believe that they are inherently bad at it, leading to feelings of anxiety and fear.
- **Historical Biases:** Some students may experience anxiety and underperformance in math due to the fear of confirming negative stereotypes associated with their gender, race, or other social identities.
- **Negative Experiences:** Previous failures, poor grades, or embarrassing experiences in math classes can contribute to the development of math anxiety.
- **Parental Attitudes:** Parents' math anxiety and negative beliefs about mathematics are often a significant indicator of and can influence their children's perceptions and attitudes towards the subject.
- **Teacher Influence:** Teachers' instructional methods, classroom environment, and attitude towards mathematics, particularly towards groups of students who may have experienced historical biases, can impact students' math anxiety levels.
- **Social Pressure:** Peer comparisons, fear of judgment, and the competitive nature of math education can increase math anxiety among students.

Consequences of Math Anxiety:

Math anxiety can have significant consequences on students' academic and emotional well-being, including:

- **Reduced Performance:** Math anxiety hampers students' ability to concentrate, solve problems accurately, and perform to their full potential in math assessments. A recent meta-analysis described a strong association between math anxiety and math achievement. The results of the study found that people with higher feelings of anxiety toward math tend to have lower math achievement.
- **Negative and Avoidant Behavior:** Math anxiety often leads to negative attitudes towards mathematics, diminishing students' motivation and interest in the subject. This can lead to an avoidance of math-related activities, creating a cycle of avoidance and further reinforcing math anxiety.
- **Career Choices:** Math anxiety can limit students' career options by discouraging them from pursuing fields that require strong mathematical skills. Many students discontinue mathematics early in high school, inadvertently limiting their educational and career prospects in a job market that increasingly demands strong mathematical abilities. According to a 2011 study from the National Research Council, 75% of Americans stop studying math before they have completed the educational requirements for their career or job. A substantial body of research has demonstrated that students who have high levels of math anxiety have lower levels of math achievement and may be less likely to pursue math courses or math-related careers.

Strategies for Addressing Math Anxiety:

Despite many studies confirming the existence and impacts of math anxiety, there has been less research on how to prevent or reverse this issue. However, there are several strategies that have been shown to alleviate math anxiety among middle and high school students, as follows:

- **Early Intervention:** Identifying math anxiety early and providing interventions during elementary school can prevent its escalation in later years.
- **Supportive Learning Environment:** Creating a positive and supportive classroom environment where mistakes are seen as learning opportunities can help reduce math anxiety. In addition, some studies have shown that letting students talk about or write about their nervousness before a test can lessen the negative consequences and break the vicious loop where anxiety results in poorer performance. These activities also work to promote a growth mindset approach, emphasizing effort over perfection, and highlighting the potential for improvement that can help students develop resilience and overcome math anxiety.
- **Hands-on and Real-life Applications:** Incorporating hands-on activities and real-life applications of mathematics can enhance students' engagement and reduce anxiety by showcasing its relevance.
- **Teacher Training:** Providing professional development opportunities for teachers to learn about math anxiety and share effective instructional strategies can contribute to reducing its prevalence. Some teachers have chosen to confront the topic head on by addressing math anxiety in math classrooms and using methods to evaluate and track students' levels of math anxiety over time, such as surveys or individual interviews. In addition, teachers can provide materials to parents/guardians that they can use as at-home strategies as well, encouraging parents to help students develop positive math identities and limiting negative language about math as much as possible.

Conclusion:

Math anxiety is a real and significant concern among middle and high school students. Understanding and alleviating math anxiety in K-12 students is crucial for several reasons. Firstly, math anxiety can hinder a student's academic performance and overall mathematical achievement. When students experience anxiety, their cognitive abilities are compromised, making it difficult for them to think clearly and solve problems effectively. By addressing math anxiety, educators can help students unlock their full potential and excel in mathematical concepts. Secondly, math anxiety can have long-term effects on a student's attitude towards mathematics and their future career choices. If left unaddressed, it may lead to a persistent fear of math and limit opportunities in fields that require mathematical skills. Moreover, math anxiety can contribute to a negative mindset towards learning in general, affecting a student's overall confidence and self-esteem. By understanding and alleviating math anxiety, educators can create a supportive and inclusive learning environment and utilize math anxiety interventions that foster a positive attitude towards math and empower students to embrace the subject with confidence.

Empathy Interview Student Profiles

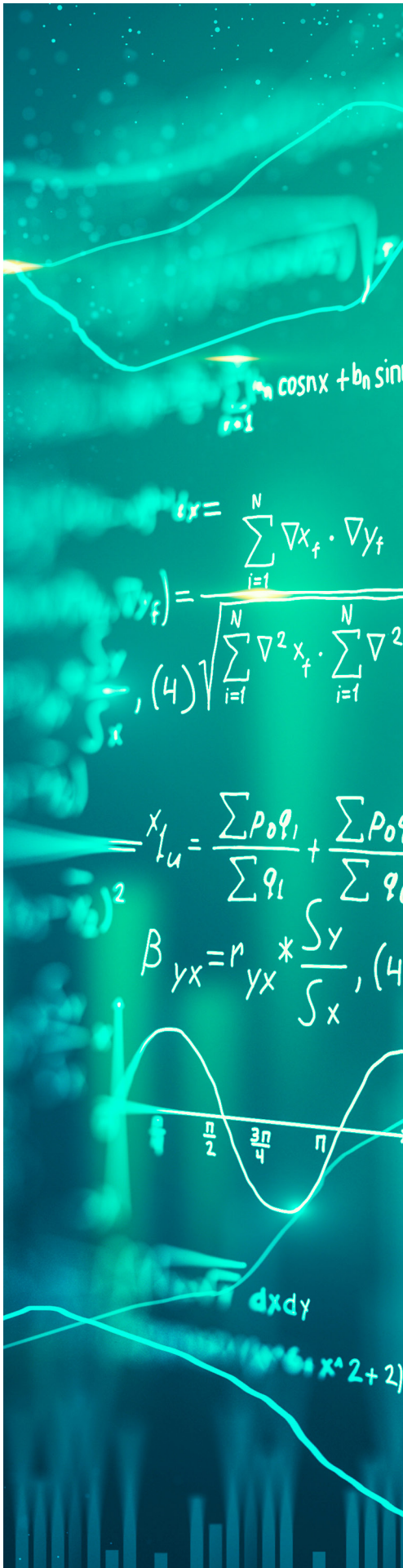
In March of 2023, Inflexion researchers conducted empathy interviews with 14 high school students from Math 1 classes across Anaheim, Cypress, and Loara High Schools. Interview participants represented students with a range of attitudes about and skills with math, and from a variety of demographic groups. The purpose of the interviews was to gain a deeper understanding of students' experiences with math and in math classes, among those participating in the OCDE EIR project. The research team analyzed the data and categorized student responses into four distinct profile types, each representing common themes and characteristics shared by the participants. These profiles, using pseudonyms and found on the following pages, provide a comprehensive overview of the key qualities, experiences, and themes prevalent among the group of students.



Alex

I'm pretty sure math has always been my favorite subject, but I think it's been for different reasons. I really liked math in elementary school because I knew I could count higher than all the other kids in class. I just remember it was really fun. We basically did the same thing every day, and my mom would help me a lot with math. Then I just got really used to it. It made me feel good knowing that I was good at something. In middle school, I realized I could do multiplication and division without having to write it down. Come along fractions and I could just see how they fit together. I wouldn't say that it all just came to me naturally, but I think I just pay really close attention and that helps me see it faster. Learning math was a little difficult during the pandemic, but I actually wanted to learn unlike a lot of my classmates, so I taught myself. I just kept practicing because I knew I was already good at it, so why not get even better?

Now that I've started high school, I like math even more. That could be because I just don't like the other subjects. What I really appreciate about math is that I don't need to describe what I think is going on like they make us do in English class. In math, there's always just one answer and I share it if I get called on. It's comforting to know the answer and that there is one correct answer instead of having to rack my brain around some hidden message about some flowers in a book. Math is my first period class this year and it's my favorite way to start the day. It gives me a reason to get out of bed sometimes. And it gives me a reason to socialize with people. I don't really have a lot of friends because usually I'm too afraid to strike up a conversation, but in math, people know I'm good at it. They come to me. It makes me feel good to know that people want my help with something.

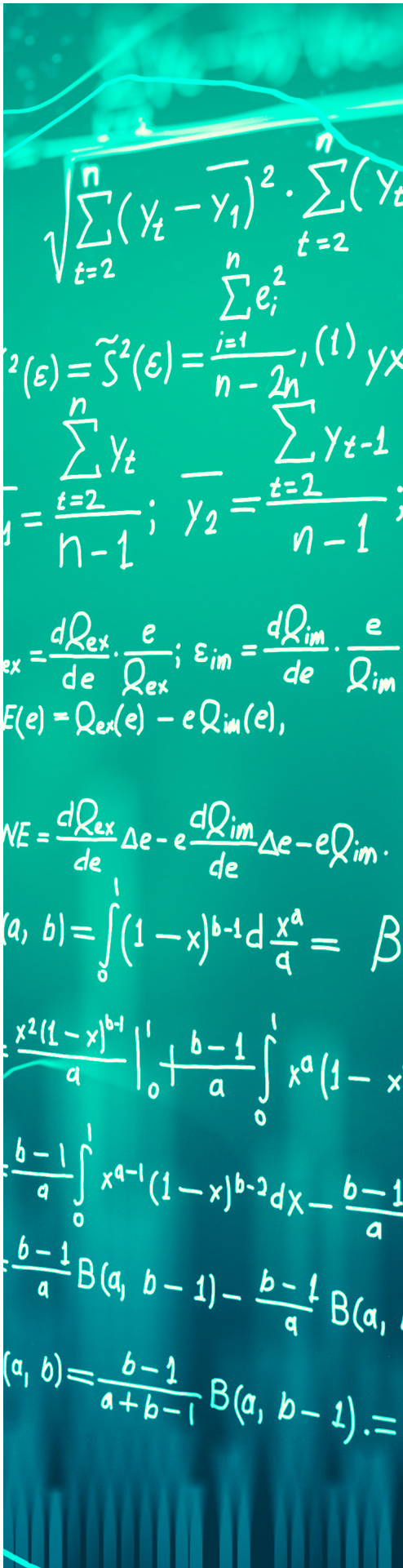


Jamie

As a kid, math came easy to me. It was actually really fun when we got to play with shapes and learn how to measure while getting to do art. Second grade, I think that was the last time I truly enjoyed math. It was probably the last time I really understood what was even going on. The shapes, they made sense. It was fun when I was allowed to tap into my creative side during math time. We could put them together and build beautiful things. I used to be excited to go to math class. It was simple. Somewhere along the way they started to add math to it. Now when I walk in class, it's like my body drops and I feel small.

I don't like going to class. You know when the teacher gives you a problem and he says he's going to call on someone, that's when the anxiety really hits me. I'm like, "I need to find the answer. I need to find the answer. I hope he doesn't pick me this time." And it seems like most of us don't have enough confidence to raise our hands to the answers because like we don't know the answer, right? I have that problem. I wish someone would so I wouldn't have to risk getting called on. Once my teacher shows us the answer, it's funny because a lot of the time I actually solved the problem, but I don't know if the answer is right or not, so I do nothing because I don't want to risk the embarrassment. Just with the thought of that I'm shaking now.

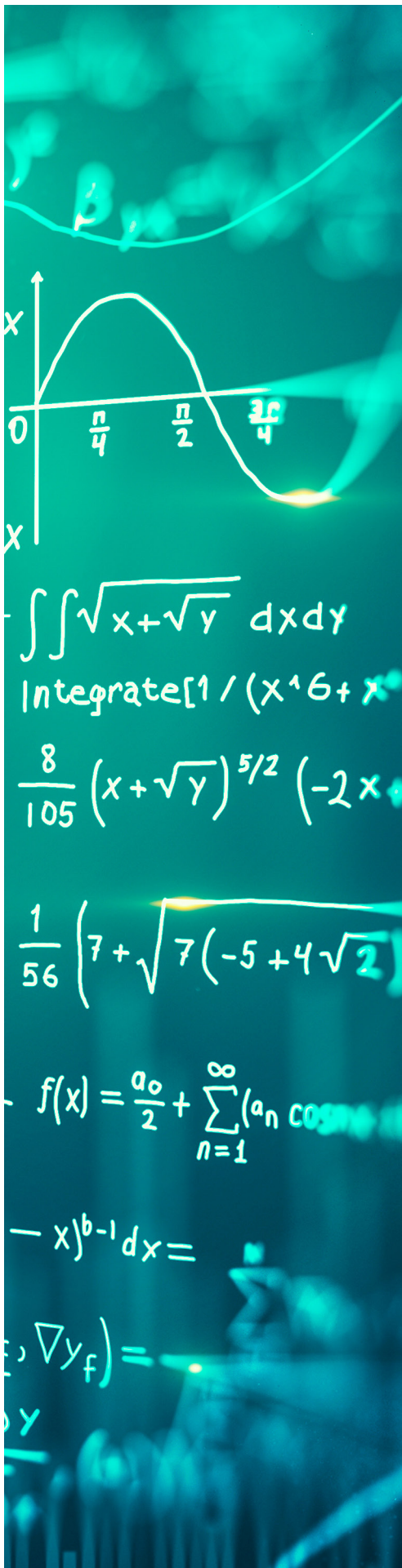
Honestly, just the thought of asking for help in something I think I should already understand makes me feel a little dumb. It gets worse because I'm afraid to fail a test because I don't want to let my teachers down by failing on something they taught me. I should know how to do something that I've been practicing and really, I pay attention in class, but I think there's something wrong with me. I am never going to get past this. Cecilia was teasing me in class the other day because I was using my fingers to do that little trick with multiplying 9's. That's the only way I can do it. As usual, I ended up just sitting there thinking "Hey, what do I do? I don't know what to do. Where do I go? What do I do?" on repeat in my head. It's like building blocks. If the building blocks have a good foundation, then the rest should be simple. I left the blocks in second grade.



Angel

Math has always kind of sucked, but I think I've just never really had a math teacher that really helped me to get what I was doing. I don't really like school in general, but math is just the hardest for me. It definitely sucks more than the rest of my classes. I would say it changed during seventh grade, where I went from elementary to junior high. It was a whole new world of math, not like what we were doing before. We started using letters, and so I'm like, "Oh my God. What is this?" And then it made me feel kind of nervous, because I know that as I went from one grade level to another, stuff from the current year is based off previous years. So I knew that if I didn't understand this, how am I going to understand later?

The biggest problem in math class right now is that my teacher just doesn't know how to explain things in a way I understand. It makes me feel bad when I see other students nodding along like they understand. I feel like it's almost like they're pretending? There's just no way everyone actually has a clue about what's going on. I even tried asking questions a couple of times, but I feel like people looked at me like I was dumb and my teacher wasn't reassuring in any way, like my question was too basic for him. In the past, like in elementary school, I think I had a couple math teachers that weren't so bad, but nothing has compared to them since. They were slow when explaining and just made it easy. Math has become more difficult for me, so I just decided to kind of avoid math. I'm not sure where I will use some of this math in real life, why do I even need to go? I'm not going to college. I don't even need high school to be a baker. But, I think if more teachers were more chill, I wouldn't mind math as much. Maybe I'd even go to class more, or show up before the end of it.



Juan

I think, fourth grade, when we were learning division, I didn't really understand it. It was very confusing to me. I didn't get the inside numbers and the outside numbers and how they come up. It was very hard for me. The thing with math is that there are just so many steps to it and sometimes I couldn't keep up with them. I would get confused and mix up the steps, and it would just throw me off and make me become stressed and frustrated about it, and that's why I had to give up. It's the complexity of math that overwhelms me. There are so many steps and procedures, and when I try to keep up, the steps get confused if they are not right in front of me. The hardest part is that I really want to be an engineer. I don't really know what an engineer does, but my family told me it was a good job and I should do it. I think I need math for it, but I'm not sure. But that's what's been motivating me to keep trying. It's just kind of hard when there's so much to learn and I can't keep up with it because I'm still trying to understand the last thing we learned.

I guess I've always had kind of a hard time with math. I never really felt like I totally understood it. It feels like I have more trouble than other kids, especially because I'm usually too nervous to ask the teacher for help. But when I actually do understand math and get the lessons, I feel pretty confident. I can appreciate a teacher who doesn't put too much pressure on us. Last year my math teacher never gave us homework besides what we didn't finish in class. That was really helpful since the transition back to school after the pandemic. Nothing really happened in online learning, I think we all just kind of accepted we weren't going to learn, but maybe we would one day. Coming back to school was hard after that, but I guess I got through it. That low pressure teacher was also really helpful. He explained things until all of us understood and I didn't even feel dumb when I had a question. Usually I feel too dumb to ask. Sometimes he would even stay after school to help us if we needed and he would stay with us, however long it took for us to understand. He would say words that we could understand, that we already knew, and he tried to explain things in more than one way, using examples. That was really helpful in understanding something I normally wouldn't like. It's the environment especially and the teacher that really affects my attitude with the class and how I do in it. I guess math isn't always that bad.

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