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STRATEGIES FOR REDUCING MATH ANXIETY

At a Glance

Approximately 93 percent of Americans indicate that they experience some level of math anxiety. Math anxiety is defined as negative emotions that interfere with the solving of mathematical problems. Studies have found that some students who perform poorly on math assessments actually have a full understanding of the concepts being tested; however, their anxiety interferes with their ability to solve mathematical problems. Researchers believe that implementation of strategies to prevent or reduce math anxiety will improve the math achievement of many students. This Information Capsule summarizes strategies that teachers, parents, and students can use to prevent or reduce math anxiety.

Math anxiety is a serious obstacle for many children across all grade levels. Math-anxious students learn less math than their low-anxious peers because they take fewer math classes and get poorer grades in the math classes they do take. Math anxiety has been studied for many years but has recently received renewed attention. Researchers now believe that implementation of strategies to prevent or reduce math anxiety will improve math achievement for many students (Geist, 2010; Mission College, 2009; Cavanaugh, 2007).

Math anxiety is defined as negative emotions that interfere with the solving of mathematical problems. It is more than just disliking math and leads to a global avoidance pattern - whenever possible, students avoid taking math classes and avoid situations in which math will be necessary (Sparks, 2011; Hellum-Alexander, 2010; Ashcraft & Krause, 2007). Tobias, often referred to as a pioneer in the study of math anxiety, described it as "the panic, helplessness, paralysis and mental disorganization that arises among some people when they are required to solve a mathematics problem" (Tobias & Weissbrod, 1980).

Physical symptoms of math anxiety include increased heart rate, clammy hands, upset stomach, and light headedness. Psychological symptoms include an inability to concentrate and feelings of helplessness, worry, and disgrace. Behavioral symptoms include avoidance of math classes, putting off math homework until the last minute, and not studying regularly (Mission College, 2009; Plaisance, 2009; Jackson, 2008; Woodard, 2004).

Approximately 93 percent of Americans indicate that they experience some level of math anxiety. Math anxiety can develop at any age. For many children, negative attitudes toward math begin early in life, sometimes even before they enter kindergarten. In fact, studies have found a negative relationship between math anxiety and math achievement across all grade levels. Some researchers have found that math anxiety is most likely to begin around fourth grade and peak in middle and senior high school (Geist, 2010; Legg & Locker, 2009; Sun & Pyzdrowski, 2009; Scarpello, 2007; Woodard, 2004).

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Evidence suggests that anxiety is more of a factor in math than in other subjects. Studies have also found that math anxiety is more common in girls, especially at the middle and senior high school levels (Beilock et al., 2010; Cavanaugh, 2007; Woodard, 2004).

Students' math anxiety is often based on years of painful experiences with math. Studies indicate that the origin of math anxiety is complex and that anxiety forms as a result of personality, intellectual, and environmental factors. Personality factors include low self-esteem, inability to handle frustration, shyness, and intimidation. The intellectual factor that most strongly contributes to math anxiety is the inability to understand mathematical concepts. Environmental factors include overly demanding parents and negative classroom experiences, such as unintelligible textbooks, an emphasis on drill without understanding, and a poor math teacher. Researchers agree that math teachers who are unable to adequately explain concepts, lack patience with students, make intimidating comments, and/or have little enthusiasm for the subject matter frequently produce math-anxious students (Plaisance, 2009; Sun & Pyzdrowski, 2009; Scarpello, 2007; Furner & Berman, 2004; Woodard, 2004; Brown, n.d.).

Research indicates that there is a strong negative relationship between math anxiety and test scores. In other words, as students' math anxiety increases, their test scores decrease (Furner & Berman, 2004; Woodard, 2004; Brown, n.d.). Researchers concur that educators have reduced the diagnostic ability of math tests by administering them in stressful situations (Sparks, 2011; Geist, 2010; Ashcraft & Krause, 2007; Cavanaugh, 2007). Scarpello (2007) stated that over reliance on high-stakes tests has reinforced the development of negative attitudes toward math and increased students' anxiety levels by turning math into a high-risk activity.

Math anxiety has been universally recognized as a non-intellectual factor that impedes math achievement. Some students who perform poorly on math assessments have a full understanding of the mathematical concepts being tested; however, their anxiety interferes with their ability to solve mathematical problems (Sparks, 2011; Hellum-Alexander, 2010; Ashcraft & Krause, 2007; Cavanaugh, 2007; Tsui & Mazzocco, 2007). Beilock and colleagues (2010) concluded that "the fears that math-anxious individuals experience when they are called on to do math prevent them from using the math knowledge they possess to show what they know."

A number of researchers have hypothesized that math anxiety disrupts performance because it reduces students' working memory, leaving them unable to block out distractions and irrelevant information or to retain information while working on tasks (Sparks, 2011; Legg & Locker, 2009; Ashcraft & Krause, 2007; Cavanaugh, 2007; Beilock & Carr, 2005).

Teacher Strategies for Reducing Students' Math Anxiety

Researchers have found that teacher practices have a strong influence on students' math anxiety (Geist, 2010; Hellum-Alexander, 2010; Scarpello, 2007; Furner & Berman, 2004; Curtain-Phillips, 2001). Following are techniques that teachers can use to lessen their students' math anxiety.

- **Develop strong skills and a positive attitude toward math.** Researchers have found that teachers with math anxiety or a negative view of math contribute to the development of math anxiety in their students (Sparks, 2011; Beilock et al., 2010; Hellum-Alexander, 2010; Furner & Berman, 2004; Brown, n.d.). Studies highlight the need for more teacher training that develops educators' math skills and positive attitudes toward math (Sparks, 2011; Beilock et al., 2010). For example, Jackson's (2008) survey of British primary teaching students found that 68 percent of respondents indicated a lack of confidence in their ability to teach math and 81 percent reported that they experienced negative physical and/or emotional feelings about math. Beilock and colleagues (2010) found that children are more likely to emulate the attitudes of same

gender teachers. Since most elementary teachers are female, the researchers concluded that girls are more likely to be effected by their teachers' negative attitudes towards mathematics than boys.

Researchers also suggest that teachers attend workshops on new research-based best practices for teaching math and become more informed about the effects of math anxiety by reading related literature and attending conferences on the topic. Teachers should also be encouraged to network with each other about issues and ideas surrounding math anxiety (Cavanaugh, 2007; Furner & Berman, 2004; Woodard, 2004).

- **Relate math to real life.** Teachers should make math relevant to students' lives and make connections to everyday applications, such as counting change and going grocery shopping, to help students realize that math is an important and useful tool (Geist, 2010; Sun & Pyzdrowski, 2009; Jackson, 2008; Furner & Berman, 2003; Haralson, 2002; Curtain-Phillips, 2001).
- **Encourage critical thinking.** Teaching methods that emphasize memorization and rote repetition instead of understanding can increase students' math anxiety. When students are taught with an emphasis on drill and practice and rote learning of formulas, they often don't develop a meaningful understanding of math. Instead, teachers should present math as a thinking and decision-making tool and encourage students to think critically (Geist, 2010; Helling-Alexander, 2010; Furner & Berman, 2004; Haralson, 2002; Brown, n.d.).
- **Encourage active learning.** Studies have found that students learn best when they are active rather than passive learners. Students must be engaged in exploring, thinking, practicing, and using knowledge, rather than listening to verbal descriptions of concepts. Researchers suggest that teachers incorporate games and activities into math lessons so that students can experience math in a hands-on fashion (Sun & Pyzdrowski, 2009; Curtain-Phillips, 2001; Schreiner, n.d.).
- **Accommodate students' varied learning styles.** Teachers can help students overcome math anxiety by accommodating the diverse array of learning styles within their classroom and modifying their teaching practices to ensure that all students experience math success. For example, new math concepts can be taught through visual aids, discussions, play acting, hands-on activities, and technology (Woodard, 2004; Curtain-Phillips, 2001).
- **Place less emphasis on correct answers and computational speed.** Researchers recommend that math instruction focus more on the computational process and less on results (Geist, 2010; Furner & Berman, 2003; Haralson, 2002). Woodard (2004) suggested that when grading tests and quizzes, teachers check the procedure instead of only checking the final answer to gain a better understanding of where students need help. Miller and colleagues (cited in Brown, n.d.) stated that unfortunately, "in the test environment, there is not only just one right answer, but often only one correct way to get it. Add to this the knowledge that a tiny mistake can result in the loss of all points and conditions can be quite stressful." Studies have also found that some math anxiety is related to teaching techniques that emphasize the speed at which students arrive at correct answers (Geist, 2010; Jackson, 2008; Haralson, 2002).
- **Organize students into cooperative learning groups.** Math anxiety has been linked to teaching techniques that emphasize competition among students and require students to work in isolation. Researchers therefore recommend the use of cooperative group work. Cooperative groups provide students with opportunities to exchange ideas, ask questions freely, verbalize their thoughts, justify their answers, and debate processes (Geist, 2010; Helling-Alexander, 2010; Woodard, 2004; Haralson, 2002; Curtain-Phillips, 2001).

- **Provide support and encouragement.** Teachers should provide encouragement to all students, emphasize that everyone makes mistakes, and refrain from tying self-esteem to success in math (Geist, 2010; Plaisance, 2009; Cavanaugh, 2007; Furner & Berman, 2003; Curtain-Phillips, 2001). Jackson (2008) noted that students may believe it when a teacher tells them they can't do math, and it takes only one teacher to create lasting math anxiety in a student.
- **Avoid putting students in embarrassing situations.** Teachers should create an atmosphere in which students don't feel embarrassed in front of others or threatened when they are called on to give oral answers. Researchers recommend that teachers avoid forcing lower-performing students into intimidating circumstances, such as working problems on the board or being singled out to answer a question in class. They should instead provide these students with alternative ways of participating in class until their confidence level improves (Ashcraft & Krause, 2007; Woodard, 2004; Haralson, 2002).
- **Never use math as a punishment.** Furner and Berman (2003) stressed that assigning math problems as punishment for misbehavior can lead to math anxiety.
- **Use manipulatives.** Studies indicate that most elementary school children show greater interest in math class and are better able to master mathematical concepts and skills when teachers teach with concrete materials, such as manipulatives. Using manipulatives to represent abstract ideas allows young learners to more easily understand the concepts they represent. In addition, students enjoy the change from lectures and books to hands-on learning (Plaisance, 2009; Woodard, 2004; Furner & Berman, 2003; Curtain-Phillips, 2001; Brown, n.d.).
- **Use technology in the classroom.** Studies have found that technology can be used as a helpful tool to reduce math anxiety in the classroom at all grade levels. For example, computer-based assignments allow students to work at their own pace and receive instant feedback; the Internet gives students the opportunity to quickly access a wide variety of resources; and online bulletin boards provide students with a cooperative learning platform (Hellum-Alexander, 2010; Sun & Pyzdrowski, 2009).
- **Dispel harmful but popular misconceptions.** Once math anxiety is established, it is often supported by a variety of cultural attitudes that undermine math achievement. These misconceptions include: males are better at math than females; individuals are either good or not good at math no matter how hard they work; there is only one right way to solve a mathematical problem; and all mathematicians solve problems quickly and in their heads. Teachers need to help students realize that these commonly held beliefs are not true (Jackson, 2008; Ashcraft & Krause, 2007; Woodard, 2004).
- **Use a variety of assessments.** Research suggests that teachers can prevent or reduce math anxiety by using alternative assessments. Alternative assessment techniques include oral questioning, observation, demonstration, discussion, learning logs, and retesting with a former test. Projects, performance tasks, and portfolios are also effective assessment tools (Furner & Berman, 2004; Woodard, 2004; Brown, n.d.).
- **Prepare students for high-stakes testing sessions.** Cavanaugh (2007) suggested that teachers train students to become more accustomed to working under pressure by regularly administering timed practice tests.

Parent Strategies for Reducing Children's Math Anxiety

Studies have found that parents have a strong influence on their children's attitudes toward math (Scarpello, 2007; Furner & Berman, 2004; Woodard, 2004). Following are strategies parents can use to prevent or reduce their children's math anxiety.

- **Do not express negative attitudes about math.** Parents who are afraid of math may pass on math anxiety to their children, not genetically, but by modeling behaviors of their own discomfort with the subject. Researchers emphasize the need for parents to conquer their own math fears and avoid passing them on to their children (Sparks, 2011; Geist, 2010; Furner & Berman, 2003; Curtain-Phillips, 2001; Brown, n.d.).
- **Have realistic expectations.** Parents increase their children's math anxiety when they have unrealistically high expectations for their success (Cavanaugh, 2007).
- **Provide support and encouragement.** Parental encouragement in math has been found to strongly influence children's attitudes toward math. Parents must let children know they believe they can succeed at math and provide them with the needed academic support (Cavanaugh, 2007; Scarpello, 2007; Furner & Berman, 2004).
- **Monitor children's math progress.** Parents should follow their child's progress by examining their math books, tests, and homework and asking the teacher for a schedule of math topics to be taught. Parents who notice math anxiety should discuss the problem with their child's teacher. Teachers may be able to pinpoint areas of struggle and suggest specific topics where extra effort is needed (Furner & Berman, 2003; Lauren, n.d.).
- **Demonstrate positive uses for math.** Parents should show their children how math is used in positive ways, such as sports, hobbies, home repairs, puzzles, and number games. Curtain-Phillips (2001) noted: "Math is often associated with pain and frustration. For example, unpaid bills, unforeseen debts, unbalanced checkbooks, and IRS forms are a few of the negative experiences associated with numbers."

Student Strategies for Reducing Math Anxiety

Researchers have suggested several strategies students can use to overcome their math anxiety. They include:

- **Practice math every day.** Researchers recommend that students practice math problems daily. They emphasize that repetition is important in math and that with practice, students will develop the confidence needed to solve mathematical problems (Freedman, 2010; Cavanaugh, 2007; Haralson, 2002; Rispoli, n.d.).
- **Use good study techniques.** Students should become acquainted with good study techniques. For example, space out studying time to increase retention; study in a location with few distractions; and don't over-study because it can lead to information overload (Furner & Berman, 2003; Lauren, n.d.).
- **Study according to one's own learning style.** To reduce math anxiety, students should study according to their individual learning style. For example, visual learners learn by using pictures, diagrams, illustrated textbooks, and videos; auditory learners learn best through verbal lectures, discussions, and talking things through with others; and tactile/kinesthetic learners learn through a hands-on approach and active exploration within their environment (Freedman, 2010; Rispoli, n.d.).

- **Don't rely solely on memory.** When students are nervous and have memorized a mathematical concept without truly understanding it, their memory may quickly fail them. When students understand a concept, they minimize the amount of material they must memorize and are better able to solve problems (Freedman, 2010; Rispoli, n.d.).
- **Focus on past successes.** Unsuccessful experiences with math may cause students to doubt their ability to do well in math, so researchers suggest that students focus on past successes rather than failures. Students can build their confidence in math through gradual, repeated success (Scarpello, 2007; Furner & Berman, 2003; Haralson, 2002).
- **Ask for help.** Students should immediately seek assistance when they don't understand a math concept. If a student needs extra help, it is often better to be tutored by someone other than the classroom math teacher because other individuals may have different ways of explaining concepts that are easier for the student to comprehend (Freedman, 2010; Haralson, 2002; Rispoli, n.d.).
- **Practice relaxation techniques.** Some researchers recommend that students practice relaxation techniques to reduce math anxiety, such as deep breathing, visualization, positive messages, and frustration breaks (Furner & Berman, 2003).

Summary

Math anxiety is the way in which students' lack of confidence in that subject undermines their academic performance and is a serious obstacle for many children across all grade levels. Math-anxious students learn less math than their low-anxious peers because they take fewer math classes and get poorer grades in the math classes they do take.

Math anxiety has been recognized as a non-intellectual factor that impedes math achievement. Studies have found a strong negative relationship between math anxiety and test scores, such that as students' math anxiety increases, their test scores decrease. A number of researchers have hypothesized that math anxiety disrupts performance because it reduces students' working memory, leaving them unable to block out distractions and irrelevant information or to retain information while working on tasks.

Researchers have found that both teachers and parents have a strong influence on students' math anxiety. This Information Capsule summarized strategies teachers and parents can use to prevent or reduce math anxiety. For example, teachers should develop strong skills and a positive attitude toward math; relate math to real life experiences; encourage critical thinking and active learning; and de-emphasize correct answers and computational speed. Parents should avoid expressing negative attitudes about math; provide their children with support and encouragement; and carefully monitor their children's math progress. This Information Capsule also included strategies students can use to overcome their own math anxiety. Students should practice math every day, study according to their individual learning style, and seek immediate assistance when they don't understand a particular mathematical concept.

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