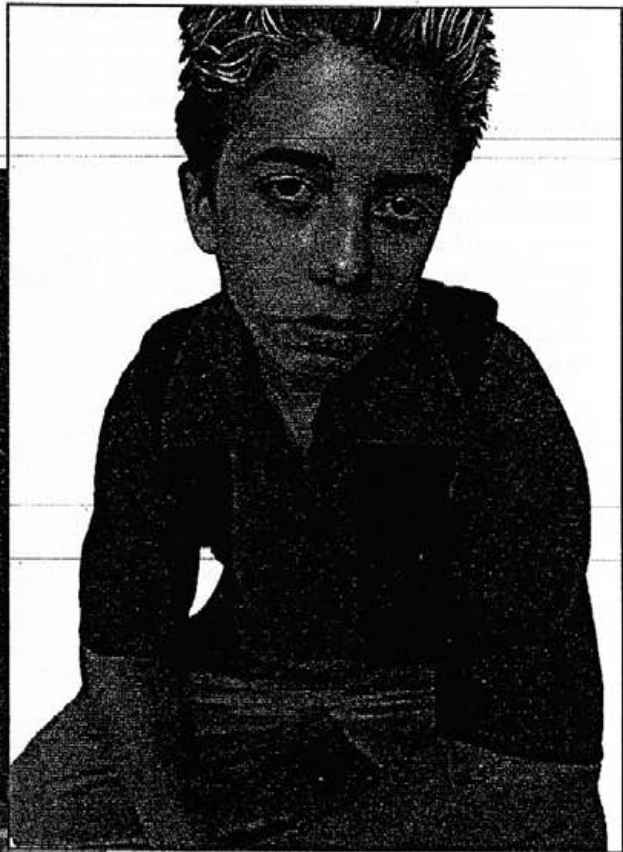
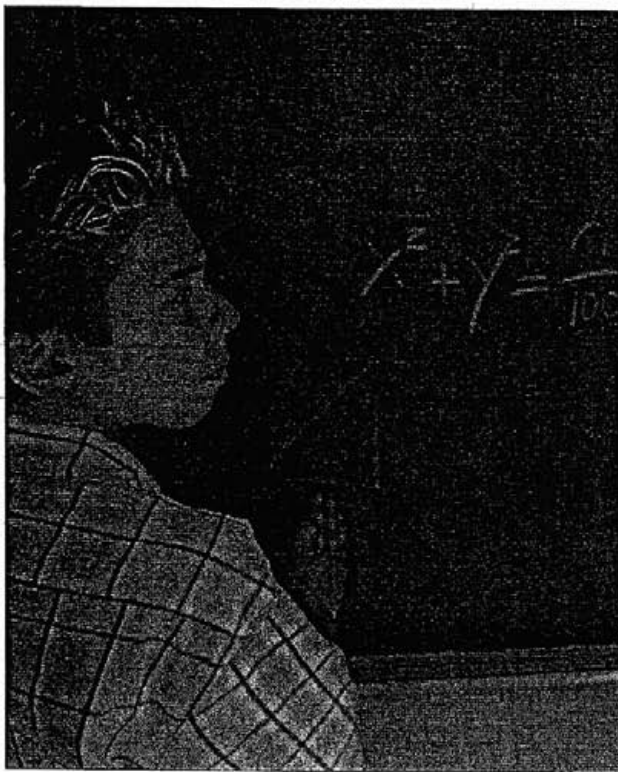


# Equity for All Students in the New Millennium: *Disabling Math Anxiety*

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AND MARY LOU DUFFY



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As educators, we must prepare all students to compete globally in a world that relies heavily on using mathematics confidently. This article presents suggestions for classroom teachers to help both prevent and reduce math anxiety for students, particularly students with learning disabilities.

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"I really don't like math, but I do okay."—Julie, 14

"I just don't like math; it's the same thing and big numbers, and I don't like big numbers."—Brian, 13

"When I hear the word *math*, I get goosebumps."—Starry, 9

"Math makes me shake."—Seth, 10

"When I think of math I don't get nervous, I get bored."—Chad, 11

These comments from students are just a sampling of many students' feelings about mathematics. Mathematics anxiety in students has become a concern for our society. Research by Jackson and Leffingwell (1999) has shown that only about 7% of Americans have had positive experiences with mathematics from kindergarten through college. Similarly, Burns (1998) has contended that two thirds of U.S. adults fear and loathe math. Whether it is 93% or two thirds of Americans who have negative math experiences, a problem clearly exists. If math anxiety is such a problem, why isn't much being done about it? Many children, including those with disabilities and those without disabilities, as well as adults, do not feel confident in their ability to do math.

In their revised and updated standards, the National Council of Teachers of Mathematics (NCTM, 2000) specifically identified "equity" as their first principle for school mathematics: "Thus, excellence in mathematics education requires high expectations and strong support for all students" (p. 11), including "accommodating differences to help everyone learn mathematics" (p. 13). All students have the right to learn math and feel confident in their math abilities, and teachers must strive to see that "mathematics can and will be learned by all students" (NCTM, 2000, p. 13).

Much has been written about the decline of math scores on the Scholastic Aptitude Test (SAT). Furthermore, the Third International Mathematics and Science Study showed U.S. students' math scores declining as students increase in age from Grade 4 to Grade 12 (Schmidt, 1998).

The trend is mirrored in the school-age population of students with disabilities. Most diagnoses of students with learning disabilities (LD) for example, are linked to reading and writing difficulties, thus likely underidentifying the prevalence of math learning problems (Fleishner & Manheimer, 1997). For example, for a student who may be labeled as LD because of a visual processing deficit that results in lower reading skills, it is not far-fetched to conclude that the visual processing deficit would also interfere with math skills (Fleishner & Manheimer, 1997; Miller & Mercer, 1997).

Poor performance in math has been linked to an increase in math anxiety. Buckley and Ribordy (1982) defined *math anxiety* as an "inconceivable dread of mathematics that

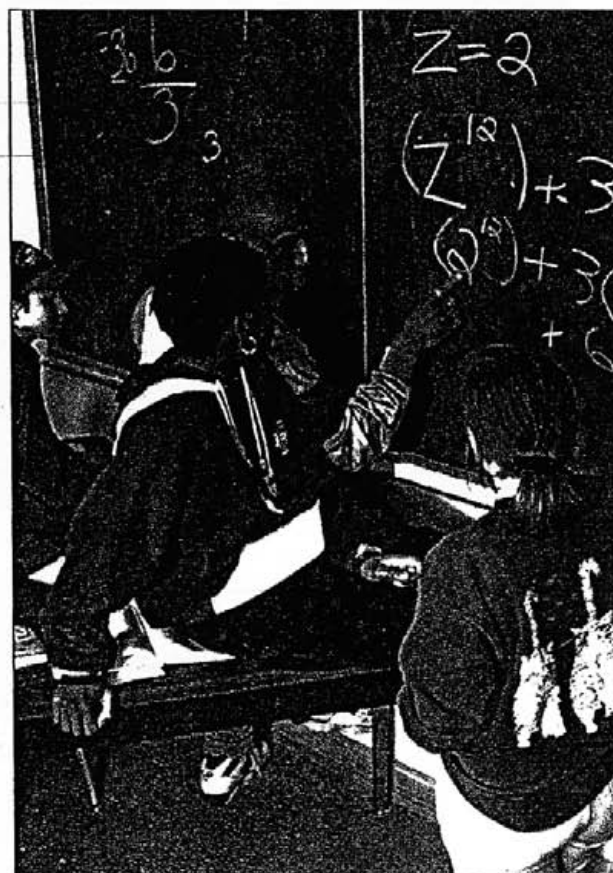
can interfere with manipulating numbers and solving mathematical problems within a variety of everyday life and academic situations" (p. 1). NCTM (1989) recognized math anxiety as a problem and has specifically recommended that teachers assess their students' mathematical dispositions (NCTM Standard No. 10; see Appendix A). As educators, however, we need to know what causes this dread of mathematics so that it can be prevented and/or reduced.

In a recent study, Jackson and Leffingwell (1999) cited many covert (veiled or implied) and overt (apparent and definite) behaviors exhibited by math instructors that cause math anxiety in students, including

- being hostile,
- exhibiting gender bias,
- having an uncaring attitude,
- expressing anger,
- having unrealistic expectations, and
- embarrassing students in front of peers.

Other problems that cause math anxiety include

- communication and language barriers,
- quality of instruction,
- evaluation methods, and
- difficulty of material.



Oberlin (1982) found that several common teaching techniques cause math anxiety, such as assigning the same work for everyone, teaching the textbook problem by problem, and insisting on only one correct way to complete a problem. Also, a student's lack of success with math may be caused by any one of several factors, such as poor math instruction, insufficient number of math courses in high school, or misinformation about what math is and what it is not.

Math anxiety can also be influenced by the school system, gender, socioeconomic status, or parental background. Indeed, some educators believe that teachers and parents who are afraid of math can pass that math anxiety on to the next generation by modeling behaviors of their own discomfort with the subject. Many people blame their difficulties with math on their lack of a mathematical mind, the notion that men are better than women at math, or poor memories or learning disabilities.

Often, a large part of math anxiety may actually be test anxiety. For example, Arem (1993) believed that test anxiety is threefold: poor test preparation and test-taking strategies, psychological pressures, and poor health habits. With the emphasis on paper-and-pencil and standardized testing, a great deal of pressure is placed on our students. Teachers need to consider other alternative forms of assessment that can help students gain confidence. Journal writing, self-reflections, portfolios, and interviews/observations are just a few alternatives that can take the pressure off the student to always perform well on a right or wrong paper-and-pencil test.

## Ways to Help Prevent Math Anxiety

Schools can help prevent math anxiety; however, the issue goes beyond the classroom. Parental involvement is critical in developing positive dispositions toward math. Please refer to the sidebar, "Recommendations for Preventing Math Anxiety," for a listing of the NCTM (2000) recommendations for preventing math anxiety. These general guidelines parallel techniques found to be effective with students with disabilities. For example, when the NCTM advises "letting students have some input into their own evaluations and emphasizing the importance of original, quality thinking rather than rote manipulation of formulas," researchers in the field of LD concur, suggesting that self-talk is helpful in developing positive self-evaluations. *Self-talk* is defined as a "guiding self-dialogue engaged in by an individual while completing a task" (Kamana & Wong, 1993, p. 630). In Kamana and Wong's study, students talked themselves through math problems to help them discover ways to solve the problems. The self-talk strategy provided cues that fostered positive task-approach self-talk; that is, the strategy included statements such as the following: "What am I supposed to do first?" "I must remember to go slowly," and "I am doing my best." State-

### Recommendations for Preventing Math Anxiety

- accommodate for different learning styles
- create a variety of testing environments
- design positive experiences in math classes
- remove the importance of ego from classroom practice
- emphasize that everyone makes mistakes in mathematics
- make math relevant
- let students have some input into their own evaluations
- allow for different social approaches to learning mathematics
- emphasize the importance of original, quality thinking rather than rote manipulation of formulas
- characterize math as a human endeavor

Note: Based on material from *Handbook of Strategies for School Mathematics* by NCTM, Council of Teachers of Mathematics, 2000. Reprinted by permission.

ments like these help students with LD have positive feelings about their skills in math.

In brief, if teachers employ best practices for teaching mathematics, students' anxiety is lessened. Based on a culmination of research, Zemelman, Daniels, and Hyde (1998) have put together what is considered the best practices for teaching math:

- use of manipulatives (make learning math concrete)
- use of cooperative group work
- use of discussion
- use of questioning and making conjectures
- use of justification of thinking
- use of writing in math for thinking, expressing feelings, and solving problems
- use of problem-solving approaches to instruction
- making content integration a part of instruction
- use of calculators, computers, and all technology
- teachers serving as facilitators of learning
- assessments of learning as a part of instruction

## Ways to Help Reduce Math Anxiety

Reducing math anxiety is much different from preventing math anxiety. Teachers almost have to take on the role of a counselor to help students lower or overcome their anx-



iety toward mathematics. According to Hembree (1990), recommendations for reducing math anxiety include systematic desensitization and relaxation training. Specifically, Davidson and Levitor (1993) advocated the use of relaxation training in conjunction with repeated positive messages and visualizations of successful math performance.

To help reduce math anxiety, teachers must help students understand how their math anxiety came about in the first place. Tobias (1987) claimed that in order to reduce math anxiety, learners must first recognize when the panic starts or, in other words, realize when they are anxious about the math they are doing—whether by going blank, getting nervous, having sweaty palms, and so on. Then, to be able to cope, they must use techniques such as controlling their breathing, visualizing success, using positive “I” messages, and so on. The real goal is to clear up the static without ceasing to work on the math problem, thus leading to success and more confidence about doing mathematics.

Hackworth (1992) suggested the following activities to assist in reducing math anxiety:

- Discuss and write about math feelings;
- become acquainted with good math instruction, as well as study techniques;
- recognize what type of information needs to be learned;
- be an active learner, and create problem-solving techniques;
- evaluate your own learning;
- develop calming/positive ways to deal with fear of math, including visualization, positive messages, relaxation techniques, frustration breaks; and
- use gradual, repeated success to build math confidence in students.

## “Mathitude” Survey

Teachers can assess their students’ dispositions toward math by having them complete the survey in the sidebar, “Mathitude” Survey. Responses to this survey give teachers a better feel for the level of their students’ math anxiety and in turn allow them to better address and be sensitive to those who are feeling math anxious. Teachers should implement the survey at the beginning of the school year in order to get a feel for students’ dispositions toward mathematics. In addition to establishing a baseline, responses will serve as a gauge so that when the survey is given again later in the year, any change in attitudes toward math can more easily be detected.

### Journal Writing

Another practical idea for addressing math anxiety is to use journal writing for students to express their under-

## “Mathitude” Survey

1. When I hear the word *math* I \_\_\_\_\_
2. My favorite thing in math is \_\_\_\_\_
3. My least favorite thing in math is \_\_\_\_\_
4. If I could ask for one thing in math, it would be \_\_\_\_\_
5. My favorite teacher for math is \_\_\_\_\_ because \_\_\_\_\_
6. If math were a color, it would be \_\_\_\_\_
7. If math were an animal, it would be \_\_\_\_\_
8. My favorite subject is \_\_\_\_\_ because \_\_\_\_\_
9. Math stresses me out. **True or False** Explain if you can.
10. I am a good math problem solver. **True or False** Explain if you can.

standing of mathematical concepts or to share feelings about and experiences with math. By using this technique, teachers can get a better understanding and feel for any frustration students are experiencing.

To overcome or reduce their math anxiety, students must first be allowed to express their true feelings about math and how they arrived at their given disposition. The sidebar, “Math Journal/Discussion Questions for Students,” provides a series of questions that may be posed to students, who could then respond in their math journals. Journaling also serves as an alternative form of assessment: A teacher can read through the journals to determine if a student understands the mathematical concepts being taught and is feeling anxiety within a certain math unit.

### Planning Groups

Students with written language difficulties may find cooperative learning group discussions more useful than written journal entries. Or they may prefer to dictate their ideas in an audio journal, as their written language deficits will hamper their ability to articulate feelings about mathematics. Finally, NCTM (2000) suggested that students with disabilities may benefit from dictated journal entries if writing in their journals is too cumbersome.

## Internet

The use of the Internet can also be a means of reaching children mathematically. Many Web sites are available for teachers to use in assessing students' level of math anxiety and to use as instructional tools (see Appendix B for a list of annotated Web sites). For instance, teachers can take students on "Internet field trips" where they visit Web sites that teach, enrich, or allow practice with math concepts (Furner, Doan-Holbein, & Scullion-Jackson, 2000). Teachers can pair up children for such activities or allow students to work individually with some guided instruction. The Internet has become an interactive tool for teaching mathematics to all students while also helping students practice their computer technology skills in the classroom. It can take away the pressure and anxiety associated with worksheets and traditional practice in math and help students enjoy doing mathematics.

## Bibliotherapy

Bibliotherapy can also be a practical means for addressing math anxiety. Although the term *bibliotherapy* may sound very clinical, it is a rather simple method of using children's literature in which the characters experience a similar trauma as the intended audience; this prompts discussion of feelings to help get to the bottom of issues. In this case, it is a child confronted with math anxiety. The picture book *Math Curse* (Scieszka & Smith, 1995) is an excellent example of how educators have come to terms with the fact that not all people feel confident in their abilities to do math. This book may be used as a form of bibliotherapy to prompt discussion on the topic of math anxiety and allow students to discuss their feelings in comparison to the character in the book. (Other useful books are listed in Appendix C.)

## Putting It All Together

As mentioned, teachers can do many things to help prevent and/or reduce math anxiety in their students, including those who have disabilities. For example, teachers can change attitudes by using effective instructional techniques, focusing on what students can do, encouraging multiple outcomes, and being sensitive to past histories of frustration and failure. Teachers can also work with school counselors and encourage their schools to arrange family math nights where parents and students can "do" math and see its importance and value in life. It is the obligation of teachers to see that their students value and feel confident in their math abilities, because ultimately, decisions and career choices may be determined based on a student's disposition toward mathematics.

## Math Journal/Discussion Questions for Students

1. When you solve your math problems for homework or in class, draw a line down the middle of your paper. As you solve the problem on one side of the line (column), in the other column describe how you are feeling at each step until you have solved the problem.
2. Imagine yourself doing or using math either in or out of school. What does it feel like? Describe.
3. For me, math is most like \_\_\_\_\_ way?
4. Are you the type who does well in math class? Why or why not?
5. Describe how you feel in a math class.
6. Pretend that you have to describe mathematics to someone. List all the words or phrases you could use.
7. In your own words, write a general rule for adding two 2-digit numbers together, adding fractions with like denominators, dividing with decimals, and so forth. (The students could do this for almost any math concept in the curriculum.)

Parents, educators, and society as a whole must work toward making a difference in students' attitudes toward math. In a globally competitive world, our children will not only compete with classmates or people from their own country for jobs but with others worldwide. With technology playing a driving force, students must have the content knowledge and feel confident in their abilities to do mathematics. The NCTM (2000) principles remind us that we must strive to see that all students in our democratic country receive an "equity for all" approach to succeeding at mathematics. Students with disabilities may need special accommodations to meet high mathematics expectations. Teachers need to incorporate strategies, such as those mentioned in this article, to prevent and reduce math anxiety, thereby assisting students in becoming confident mathematical thinkers. In the new millennium, we want to hear more kids say, "Math is my favorite subject" or "I am great at math!"

## ABOUT THE AUTHORS

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## Appendix A:

### What NCTM Says About Mathematics Anxiety and Dispositions Toward Mathematics

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#### Standard 10: Mathematical Disposition

As mathematics teachers, it is our job to assess students' mathematical disposition regarding

- confidence in using math to solve problems, communicate ideas, and reason
- flexibility in exploring mathematical ideas and trying a variety of methods when solving problems
- willingness to persevere in mathematical tasks
- interest, curiosity, and inventiveness in doing math
- ability to reflect and monitor thinking and performance while doing math
- value and appreciate math for its real-life application and connections to other disciplines and cultures and as a tool and language

#### *In a Nutshell: How to Reduce Math Anxiety*

1. Use psychological techniques, such as anxiety management, desensitization, counseling, support groups, bibliotherapy, and classroom discussions.

2. Once students feel less fearful about math, encourage them to build their confidence by taking more mathematics classes.
3. Help students confront their math anxiety by some form of discussion/counseling. Most research shows that without this step no best practices in math will help.

#### *In a Nutshell: How to Prevent Math Anxiety*

1. Use best practice in mathematics, such as manipulatives, cooperative groups, discussion of math, questioning and making conjectures, justification of thinking, writing about math, problem-solving approach to instruction, content integration, technology, assessment as an integral part of instruction, etc.
2. Incorporate the NCTM Standards and your state standards into curriculum and instruction.
3. Regularly discuss feelings, attitudes, and appreciation for mathematics with students.

*Note.* Based on material from *Principles and Standards for School Mathematics* by National Council of Teachers of Mathematics, 2000, Reston, VA: Author.

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## Appendix B:

### Web Sites That Address Math Anxiety and Teach Mathematics

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#### <http://www.mathpower.com>

This great Web site by Professor Freedman offers great resources for both teachers and students. Students can take a math anxiety test to evaluate their level of math anxiety, and they can learn math study skills and get help with basic math and algebra. The Student's Math Anxiety Bill of Rights is great for hanging in the classroom. For teachers, the Web site provides a plethora of information on math anxiety and ways to help students who are math anxious.

#### <http://www.funbrain.com>

This Web site, designed for teachers, parents, and students, provides great math activities and games that offer practice in a game-like setting. It also offers teachers tools for making tests and activity sheets and provides a grade book. Parents will find the site wonderful for teaching and motivating their children to learn

math, as well as language arts, science, history, music, geography, art, technology, and physical education.

#### <http://funschool.com>

This great site for teachers, parents, and children is like educational software presented through the Internet. It offers a wide variety of math and literacy games and activities to keep any child engaged and motivated mathematically for a long time.

#### <http://coolmath.com>

One of the most exciting Web sites for children, it is full of color and offers exciting activities in math and science, including many interesting math facts and statistics. Kids can practice running a business selling lemonade while dealing with the weather and other factors, using both math and science skills in a real-life application.

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## Appendix C:

### Suggested Teacher Resources Related to Mathematics Anxiety, Children's Literature, and Writing in Math

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- Burns, M. (1975). *The I hate mathematics! book*. Boston: Little, Brown.
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