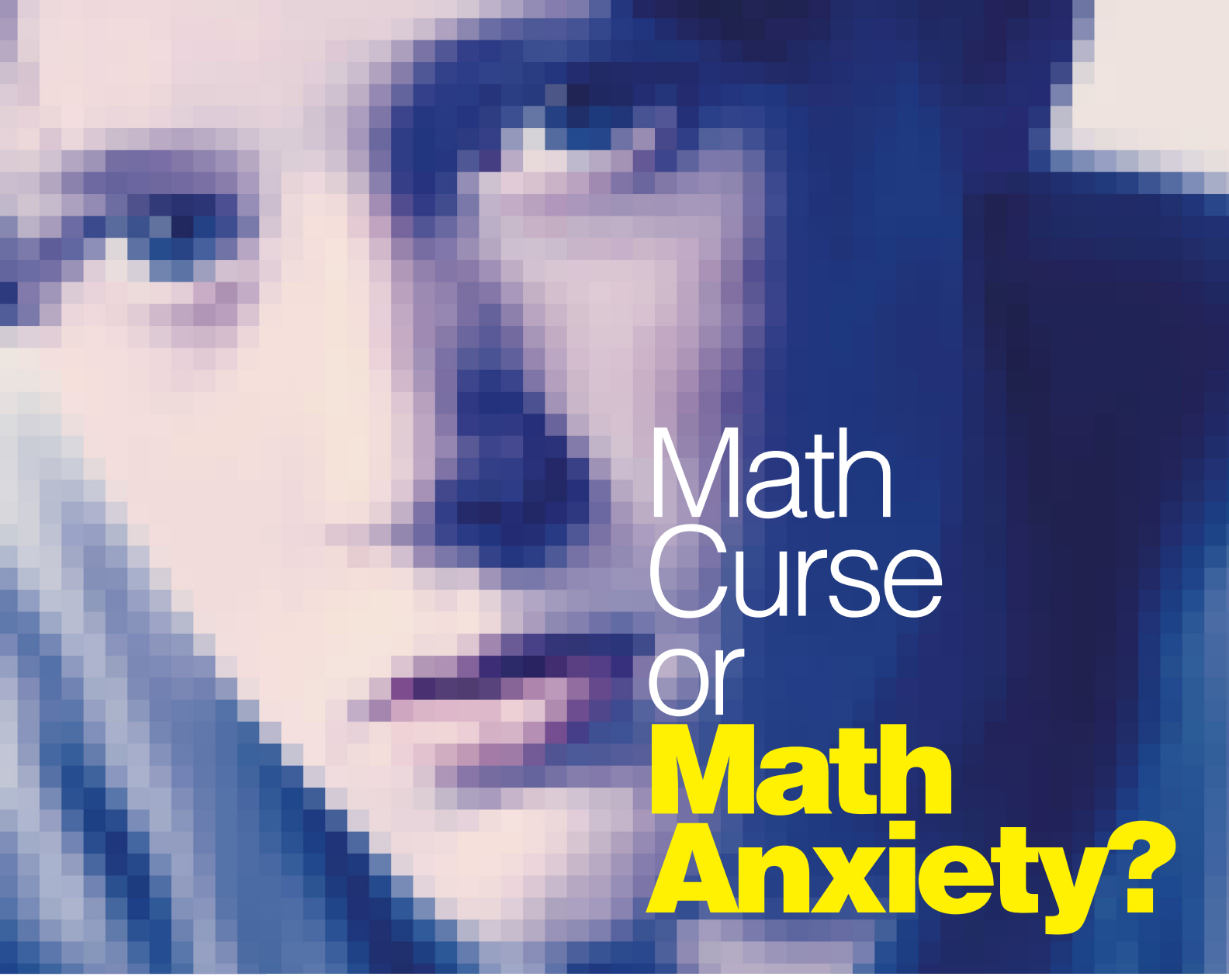

Math Curse or Math Anxiety?

Vanessa B. Stuart

Imagine that you are a fifth-grade mathematics teacher. You have two classes totaling fifty-four students. These students all exhibit different academic and behavior levels. Some students like mathematics; others do not. Mathematics comes easily for some of your students; others struggle every step of the way. Your task is to create a challenging curriculum that improves test scores while allowing all students to be successful. That challenge is a real-life problem!

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A Definition of Math Anxiety

As so eloquently stated by Mrs. Fibonacci, a fictional character from Scieszka and Smith's (1995) *Math Curse*, "Everything can be thought of as a math problem." I was starting to think that this particular problem was too challenging for even the greatest of problem solvers. However, as I looked more closely, I began to see that some students were academically very capable yet still struggled with mathematics. This realization was my first clue as to how to meet the mathematical needs of all students in my classroom. First, I had to determine why some students feel relaxed and competent in mathematics, whereas others feel nervous and stressed anytime that they are confronted with mathematical questions. I discovered that their distress is much more than a "curse"; it is a real affliction called "math anxiety" (Tobias 1978).

It is ironic that the subject seen as the most log-

ical and intellectual is also the one that ignites so many passionate emotions. Many people think of mathematics as a punishment or something that induces stress (Zaslavsky 1994). Tobias describes math anxiety as a feeling of "sudden death." It is an obsession with the idea that "everyone knows that I don't understand. I'd better not draw attention to myself by asking questions." Math anxiety can even develop into the more serious math avoidance and math phobia (Tobias 1978).

Math anxiety usually arises from a lack of confidence when working in mathematical situations. Many people incorrectly assume that math anxiety and an inability to be successful in mathematics are inherited from one's parents. Several legitimate factors contribute to, and increase the severity of, this perception. For instance, gender and ethnic backgrounds are not determining factors in mathematical competence, but peers' and teachers' attitudes toward gender and ethnicity may increase or decrease one's confidence in mathematical skills (Tobias 1978). The methods used to teach mathematics skills may affect whether a student feels successful and develops mathematical self-confidence. Finally, family and peer attitudes may positively or negatively influence students' attitudes toward mathematics, which in turn affect their levels of confidence. My own hypothesis is that mathematics is like a sport: 90 percent mental—one's mathematics confidence—and 10 percent physical—one's mathematics competence in performing mathematical skills.

Development of a Research Study

After observing several very math-anxious students, I conducted a survey to identify where my fifth graders fit into the continuum of mathematics confidence. I wanted to see how their own attitudes, as well as those of the people around them, affected their confidence level. I also wanted to know what teaching strategies the students thought worked best for them. If I could somehow relate mathematics to what the students enjoyed and felt successful with, then I could help them overcome or completely avoid math anxiety.

Some questions for the survey were created on the basis of factors influencing "math confidence." Other questions supported some of my own theories correlating students' interests and ability levels. I wanted both quantitative and qualitative data. Quantitative questions would provide statistical data, whereas qualitative questioning would give me the best information for adapting my mathematics curriculum.

The survey questions directed the students to select an answer and then to explain or justify their choice. The questions centered on the students' academic and recreational interests; they also concerned students' mathematical attitudes and perceptions of themselves compared with those of others around them. Students were asked to make judgments about their parents' feelings about mathematics. Other questions involved the effectiveness of manipulatives and cooperative groups as learning tools. I wanted to know whether the students thought that they would use mathematics when they were adults and, if so, how they thought they would use it. Finally, students were asked to relate their best and worst experiences in mathematics and to name one thing that they would change about their own mathematics class. The survey is reproduced in **figure 1.**

The sampling for this survey consisted of twenty-two female and twenty-five male students from nine to twelve years old. Because most of the research on mathematics competence focuses closely on gender, I separated my results into gender groups for analysis (Tobias 1978). This sample also included eleven students identified as gifted and talented and seven students who qualified for special education services.

Analysis of Student Responses

The first two questions dealt with the students' best academic subjects and hobbies. Students were free to choose whichever subject was their personal best and their favorite hobby or pastime. Students consistently commented that their best subject was the one that they enjoyed the most and in which they had received recognition for success. As for the hobbies, answers ranged from various sports and athletic activities to fine-arts categories. The two factors most affecting students' extracurricular interests were family-member or peer involvement in the same activity and personal feelings of success and accomplishment.

Family and peer attitudes may influence students' attitudes toward mathematics

The next four questions addressed the students' personal attitudes and feelings about mathematics, their ability levels, and how they felt they compared with others in the classroom. Their responses to these questions clearly described students' confidence levels and were particularly interesting when tallied according to the students' gender (see **figs. 2** and **3**). Of the males who like mathematics and said that they

FIGURE 1

The math survey

Gender: Male Female Age: _____

My best academic subject is _____. I am good at it because _____
_____.

My favorite hobby is _____. I am good at it because _____
_____.

I (like, dislike) math. Explain your answer. _____
_____

I feel that I am (good, not so good) at math. Explain your answer. _____
_____

Compared with other students in my class, I feel that I do (better, worse, about the same) as they do in math class. Explain your answer. _____
_____

When I am asked to do math problems, I feel (confident, worried, indifferent). Explain your answer.
_____

Using manipulatives such as color tiles, place-value blocks, and pattern blocks (does, does not) help me when I am trying to understand a **new** concept.

I like to work in a group (always, sometimes, never) when learning a **new** concept in math. Explain your answer.

When I grow up, I think that I (will, will not) use math. Explain your answer. _____
_____.

I think that my parents (like, dislike) math. Explain your answer. _____
_____.

My best experience in math was when _____
_____.

My worst experience in math was when _____
_____.

If I could change one thing about my math class, it would be _____
_____.

were good at it, more than half also said that they did better than most of the other students in class. In contrast, only 36 percent of those females who liked mathematics and said that they were good at it thought that they did better than most of the other students in class. This drastic difference in perspective indicated early social conditioning of even our best students. Overwhelmingly, students of both sexes who dislike mathematics also believed that they were not good at it and that they performed worse than their classmates. These same students also said that they worried when asked to do mathematical tasks. Although these conclusions do not necessarily mean that these students all have math anxiety, they do show the students' low self-confidence in mathematics.

As manipulatives and cooperative groups become more widely used in mathematics classes, I wanted to know whether students perceived these aids and situations as being useful learning tools (see **fig. 4**). Three-fourths of the students thought that using manipulatives when learning a new mathematical concept was helpful. Most of the comments indicated that using manipulatives first helped students see the origin of the numbers in the formulas. Fewer than one-

fourth of the students said that manipulatives were not helpful learning tools, stating that they were confusing.

Overall, most students appreciated the opportunity to work in cooperative groups. Students' comments pointed out that sometimes peers could explain things better than the teacher. Others said that they enjoyed helping one another over working alone. Only a few students said that they never like working with a group. Some of the negative aspects cited of working with groups included the concern that one person would be doing all the work and that people might not get along, as well as the fear that team members might laugh at others. Again, the latter response is a good indicator of low confidence in mathematics.

The next question addressed whether students thought that they would use mathematics as adults. Only a few said that they would not use mathematics as adults. Two males said that they would not use mathematics because they were going to be football players. One young female said that she would not use mathematics because she was not good at it; therefore, she should not do it as an adult. The remaining respondents were able to come up with ways that they knew they would use mathematics either occupationally or in everyday life.

One of the last factors that I thought would have a big impact on students' mathematics attitudes was how they perceived their parents' attitudes (see **fig. 5**). Although they all had some ideas about what their parents thought about mathematics, those perceptions did not correlate well with their own attitudes. Apparently, students like or dislike mathematics on the basis of their own experiences. Students are likely to have more positive experiences if their parents are supportive and helpful in their mathematical endeavors.

The next two questions gave students an opportunity to relate their best and worst experiences with mathematics. As expected, the positive experiences could all be related to good grades, awards, teacher praise, and overcoming a mathematical difficulty. Likewise, students' worst experiences involved failure, criticism, and difficulties yet to be overcome. Those aspects that students would change about mathematics class included introspective answers involving personal goals, suggestions of more independent work or less independent work, and recommendations about making mathematics classes harder and longer or shorter and easier. These conflicting data reinforced what all teachers know—no single approach is best for all students.

The comment that impressed me the most was from one male who had achieved academic recognition in both the reading and writing sections of the Texas Assessment of Academic Skills the previous year. He said that what he would change is for "me to be the smart one!" I think that no statement better sums up the frustration that people with math anxiety feel.

FIGURE 2

Students' attitudes and perceptions

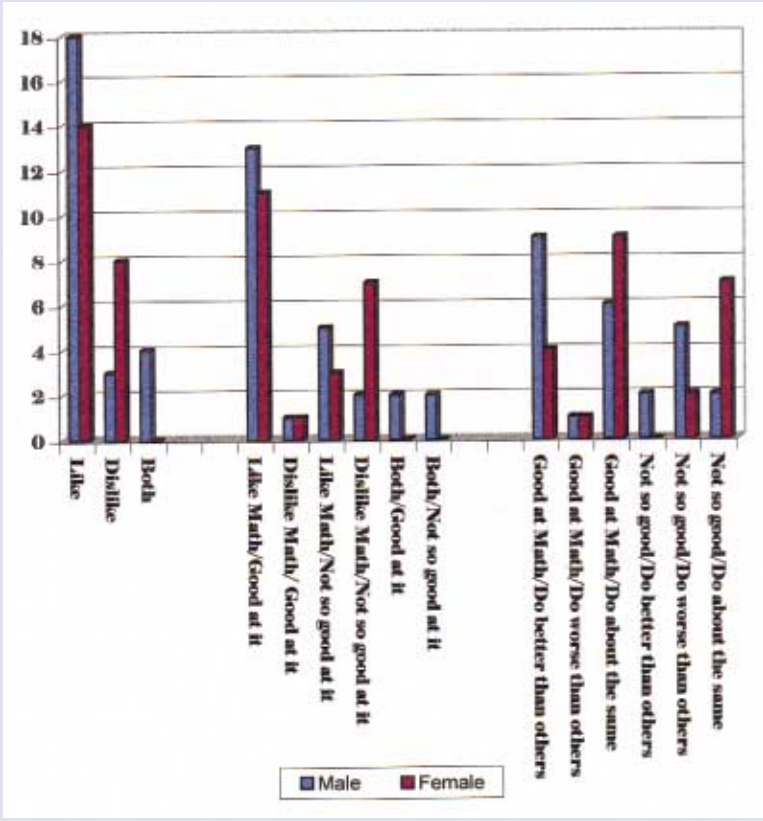


FIGURE 3

Students' anxiety levels and attitudes

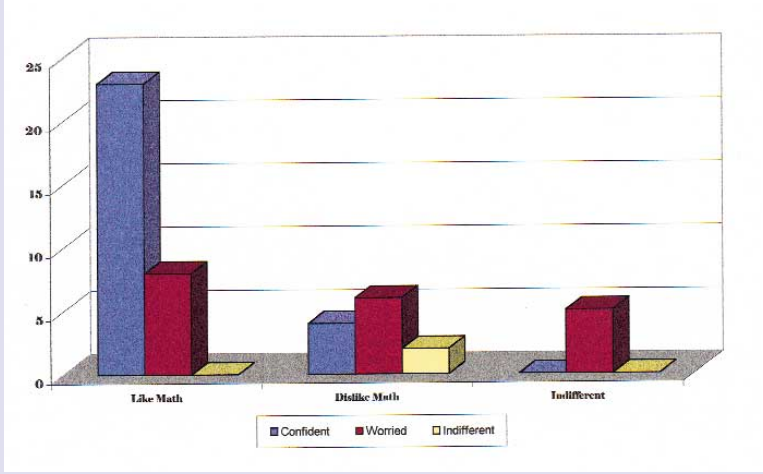


FIGURE 4

Perceived helpfulness of manipulatives and cooperative groups

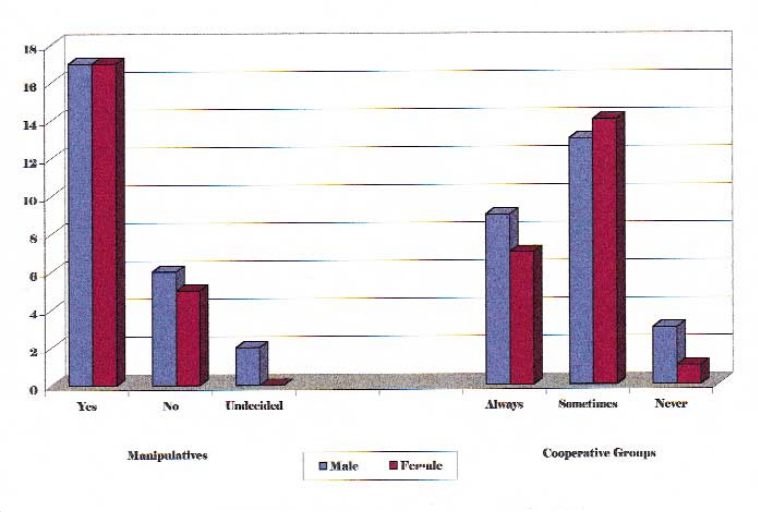
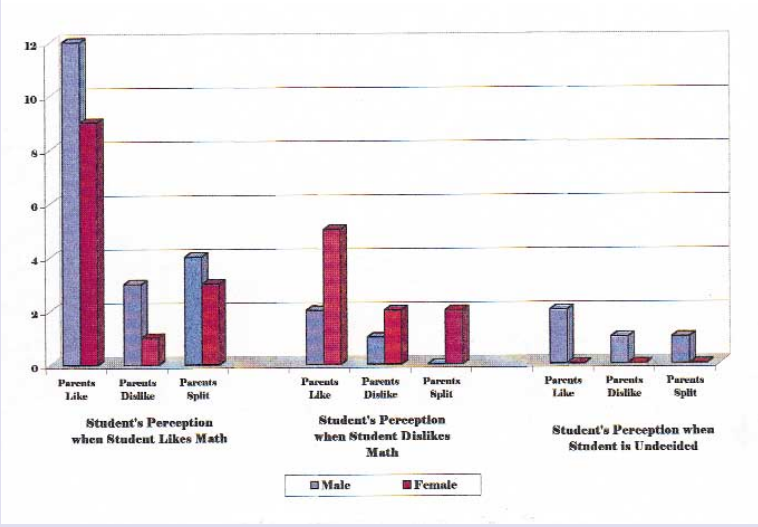


FIGURE 5

Perceptions of parents' math attitudes



Teaching Strategies to Reduce Math Anxiety

One might wonder, "So now what?" The overall conclusion of my survey is that people like to do something if they think they are good at it, and to feel good about mathematics, you have to believe that you are good at it. Therefore, as teachers, we must be the mathematics coaches—the ones to build that self-confidence while refining the skills needed to be successful. "Classrooms should be mathematics communities that thrive on conjecturing, inventing, and problem solving that build mathematical confidence in students" (NCTM 1991, 6). The NCTM (1995) has developed some suggestions to help reduce stress and anxiety in the mathematics classroom (see **fig. 6**).

FIGURE 6

Practices to reduce math anxiety

1. Accommodate different learning styles.
2. Create a variety of testing environments.
3. Design experiences so that students feel positive about themselves.
4. Remove the importance of ego. It should not be a measure of self-worth.
5. Emphasize that everyone makes mistakes.
6. Make math relevant.
7. Empower students by letting them have input into their own evaluations.
8. Allow for different social approaches.
9. Emphasize the importance of original quality thinking rather than manipulation of formulas.
10. Characterize math as being a human endeavor.

Adapted from NCTM (1995)

In my classroom, I implemented these practices by incorporating cooperative groups in problem-solving situations. Given a variety of problems, students worked together and shared their solutions. Students learned to share and accept more than one correct solution or strategy. They began to trust one another and take risks in their problem-solving endeavors, thus increasing their mathematics confidence.

Students' other academic strengths were called on to help them feel successful in mathematics class. I asked them to write about their problem-solving endeavors formally, in traditional writing formats. I gave students prompts generated from fictitious businesses that needed our class to solve problems related to the current topic of study. Students wrote letters to the business or company, explaining our solutions. Students wrote compare-and-contrast papers about such mathematical concepts as area and volume, as well as fictional stories about geometric figures and essential attributes. Students also wrote their own problems and used their artistic abilities to illustrate them.

Students wrote informally in their mathematics journals, using writing as an extension of their thinking to clarify new concepts and question ideas that remained unclear. Journals allowed students to verbalize frustrations that they felt and to explain concepts for deeper understanding. This valuable tool allowed me to assess students' progress informally and to communicate with

them discreetly so as to avoid triggering their self-conscious feelings.

Applying mathematics skills within the realms of science and social studies boosted students' confidence by providing meaningful contexts for their work. Students used mathematical skills during science experiments to calculate results and complete tables and graphs. Geography provided application experience when drawing maps to scale. In social studies class, students could calculate differences in dates on a timeline. Students interested in technology enjoyed using computer programs in which they applied mathematical skills.

Conducting individual conferences with students about previous standardized test results, areas of strength, and areas needing improvement helped them to develop a personal plan of action. Having some control in their mathematics education empowered students. They were able to realize mathematical strengths rather than focus only on their weaknesses. Being informed participants with individual, agreed-on strategies for improvement signed by both the teacher and the student was a great motivator.

Standardized Test Results

Recent standardized test results proved to be better than I expected. Of the identified special education students, 50 percent raised their scores to passing and 88 percent raised their Texas Learning Index (TLI) by at least one year. An examination of the other students' scores showed that 100 percent passed the test and 96 percent gained at least a year in their TLI. Of those students, 49 percent achieved more than a year's growth. My students who had seemed to have the most math anxiety made the most dramatic improvements, with learning indexes increasing 10 to 30 percentage points.

More important than the improved test scores was a change in students' attitudes toward mathematics. Those students who had viewed mathematics negatively began to appreciate it and feel more confident about their abilities. This confidence in turn helped them to be more successful in subsequent mathematics-related tasks. Even the students who had a neutral-to-positive view of mathematics began to have a deeper appreciation of it as a result of learning practices implemented during the year.

As mathematics educators, we need to be aware that math anxiety is a real affliction that affects many of our students. However, we also need to know that with appropriate teaching strategies and sensitivity, we can reduce or even eliminate the problem. Williams (1988, 101) paraphrased a Chinese proverb: "Tell me mathematics and I forget; show me mathematics and I may remember; involve me . . . and I will understand mathematics. If I understand mathematics, I will be less likely to have math anxiety. And if I become a teacher of mathematics, I can thus begin a cycle that will produce less math anxious students for the generations to come."

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