It's All Greek to Me: Math Anxiety

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"I'm not a numbers person." "Don't ask me; I never could understand math." "I just don't have a mathematical mind." "What, me do math? I can barely add two and three." It's all Greek to me!"

Sound familiar? If you have heard your students make such proclamations, then you have already had some experience with math anxiety. Tobias defines math anxiety as

> the feeling of panic, helplessness, paralysis and mental disorganization that arises among some people when they are required to solve a mathematical problem. (1980a)

The prevalence of the problem is reported to be as high as 68 percent among students enrolled in math classes (Lindbeck and Dambrot 1986). Some anxiety is desirable. Tension can serve as a motivator, but too much anxiety, as in the case of math anxiety, can inhibit learning.

Several factors contribute to the development of math anxiety (Tobias 1980b; Greenwood 1984; Martinez 1987). The first is the "math as a gift, not as a set of learned and practiced skills" misconception. Math anxious learners think only those born with a mathematical mind can fully comprehend complex numerical operations. They assume that competent math students arrive at solutions instantly, and they have little or no faith in their own ability as a result. Even when they are able to come up with a solution to a problem, they lack confidence in their answers and assume they couldn't possibly have figured it out correctly.

Math anxiety appears to be a uniquely North American phenomena. An examination of the math attitudes of Asians and Americans revealed some interesting discrepancies. The Asians thought math ability was fairly evenly distributed and that skills were developed through study, persistence and hard work. Americans, on the other hand, viewed mathematical ability as a very rare and uncommon talent (Tobias 1987).

Early math experiences can contribute to the development of math anxiety. Many of us painfully recall being summoned to the blackboard to solve a problem, only to make an embarassing blunder in front of a room full of witnesses. Some math anxious students recall negative experiences with particular teachers. They remember the stress and confusion caused by timed tests, the emphasis on one and only one correct answer and on the "right" way to arrive at solutions to problems. They remember pages and pages of drill and practice.

Some researchers believe "the principal cause of math anxiety lies in the teaching method used to convey basic mathematical skills" (Greenwood 1984). They suggest the explain-practice-memorize paradigm isolates facts from the problem solving process of which they are a fundamental part. Students who cannot understand the thought processes that underlie a problem's solution begin to perceive math as an incomprehensible mystery.

Teachers can be math anxious too. Such teachers contribute to the anxiety levels of their students by relying primarily on text explanations and do-the-problems/ correct-the-problems assignments. They often refer authoritatively to the teacher's guide and seldom work out problems with students in front of the class.

Inadequate out-of-class experience with math can contribute to anxiety development as well. Students who are never given an opportunity to solve real-life problems fail to see how the skills they have learned are applicable to situations outside the four

walls of the classroom. They lack motivation because the meaningfulness of the skills is not apparent to them.

The language of mathematics can be complicated and ambiguous. For students who never become proficient *readers* of math, this can create confusion and anxiety. Words, such as attitude and root have very different mathematical connotations. One researcher reports interviewing a student who assumed that "least common denominator" meant "most unusual" (Tobias 1978). Based on her understanding of the term, she produced unique, but obviously incorrect responses.

Gender may play a role in the development of math anxiety. Studies show that although girls account for 49 percent of the secondary school population in the United States, they comprise only 20 percent of those taking math beyond geometry (Tobias 1978). This discrepancy is not a result of differing levels of ability so much as it is a reflection of societal perceptions. Parents, teachers and peers are more likely to excuse poor math performance by girls. As a result, girls may perceive math as a primarily masculine domain and lack the confidence and motivation to develop their own skills in this area. Girls may also feel pressure to appear "dumb" in order to conform to these perceptions.

Girls may find math more difficult because they lack math experience. Few of the playthings commonly provided for girls promote the development of mathematical understandings. The toys generally provided for boys however, are of the "take apart and put together" variety that do develop these understandings. In addition, many mathematical concepts are used in sports, such as hockey, football and baseball, which traditionally have much higher levels of male participation.

Role conflict, negative math experiences, inadequate instructional emphasis, lack of understanding of the language of math and misconceptions about the nature of math learning all contribute to the development of math anxiety. Math anxiety leads to math avoidance by students who feel they cannot and will never be able to experience success in the mathematics classroom. It may also contribute to lower achievement levels by otherwise able students who, for whatever reason, panic when asked to perform mathematical computations. Helping these students overcome their anxiety and ideally, preventing it from afflicting the generations to come, is now a critical issue. Math competence has become undeniably necessary for many technological careers. Students without a firm grounding in mathematics, greatly reduce their career options.

Programs have been developed at the college level for the math anxious members of the population. Most programs include counseling and education components. Participants are involved in some form of group or individual counseling where their anxieties are examined. They are also provided with direct instruction in mathematics with an emphasis on meaningful problem solving. Although these programs are beneficial, they treat the symptoms not the cause. Preventing the development of math anxiety is the responsibility of educators.

An anxiety-free learning environment can be created by removing tension and competitiveness; students must not be afraid to ask questions and make mistakes. A nonthreatening learning environment is a necessary component of such a classroom. Allowing students to correct their own work, learn through trial and error, offer answers without fear of humiliation and solve problems as committees helps create this kind of environment and nurture student confidence.

A change in emphasis from the traditional explain-practice-memorize paradigm is also required. Math learning experiences that are creative and encourage active participation by students can contribute to the development of more positive attitudes toward mathematics.

Instruction matched to the cognitive levels of the student results in lower anxiety levels. Concepts must be understood in their concrete forms before more abstract applications are introduced. To help students visualize concepts, manipulatives can be used at all levels.

A lower level of anxiety is also evident in students for whom numbers have real-life significance. Students must be aware of the personal usefulness of math; it must be meaningful from the students' perspective.

Systematic instruction in problem solving helps reduce the levels of anxiety in math classrooms. Understanding a variety of problem solving strategies gives students the tools to attack problems successfully outside the classroom. Students must have experience in looking for solution patterns, substituting simpler numbers and diagramming or sketching problems in order to use these strategies successfully.

Some attention must be paid to the unique reading demands of math. The language of math must be clearly understood for students to succeed. Strategies, such as substituting more easily understood

synonyms, underlining and discussing problem words and rereading for clarification, if employed effectively by math students, will reduce anxiety levels.

"Most people leave school as failures at math or at least feeling like failures" (Tobias 1978). They are defeated before they even begin by their lack of confidence in their own abilities. As teachers, we can help reduce anxiety levels by changing the way we teach math. We must demonstrate the importance of math, provide students with a multitude of experimental opportunities to test mathematical concepts, and teach students the strategies necessary for effective problem solving. As our world becomes increasingly technological, we must develop more effective methods of teaching mathematics. Numeracy has become as important as literacy. We must dispell the myth that math is a secret code comprehensible only to an elite few.

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