The Effects of Math Anxiety on Post-Secondary Developmental Students as Related to Achievement, Gender, and Age

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Abstract
Woodard examines the nature of math anxiety in developmental students and proposes ways to alleviate their worries.

Having taught developmental mathematics for a number of years, I am keenly aware of the effects of math anxiety on developmental math students. Math-anxious students complain of such things as nervousness, inability to concentrate, a blank mind, and a feeling of sickness when they are confronted with taking a math test.

One of my algebra students was so math anxious that she could not take a math test without becoming extremely nervous. When she failed Algebra II twice, she threatened to quit school because the Algebra course was the only thing preventing her from seeking a degree in Respiratory Therapy. However, after being allowed to take Respiratory classes along with the Algebra course, she became more relaxed with the math and began doing much better.

Another student could not function in the regular Basic Math course because of her anxiety. After working with her on an individual basis and moving at a slower pace, I was extremely pleased when she passed the course. Although it took her two semesters to complete the requirements, she felt a sense of accomplishment at the end.

Nature of the Problem

Math anxiety is described as “feelings of tension and anxiety that interfere with the manipulation of mathematical problems in a wide variety of ordinary life and academic situations” (Richardson and Suinn, 1972, p.551). Studies indicate that math anxiety is found in elementary students (Jackson and Leffingwell, 1999; Steele and Arth, 1998), in high school students (Hembree, 1990; Jackson and Leffingwell, 1999), and in college students (Bitner, Austin, and Wadlington, 1999; Tobias, 1990). In my experience, math anxiety is extremely prevalent in our developmental math community college students.

Math anxiety can result from environmental factors such as myths, teachers, and parents (Steele and Arth, 1998; Trujillo and Hadfield, 1999). Intellectual factors that affect math anxiety include learning styles, persistence, self-doubt, and dyslexia (Harper and Daane, 1998; Trujillo and Hadfield, 1999). Personality factors such as low self-esteem, shyness, and intimidation can also affect math-anxious students (Fotoples, 2000; Levine, 1995).

Research has shown relationships between math anxiety and achievement, between math anxiety and gender, and between math anxiety and age. A negative relationship between math anxiety and math achievement has been found across all grade levels, K-college (Betz, 1978; Ma, 1999). In the early grades, there is no significant difference in the math anxiety experienced in either gender (Gierl and Bisanz, 1995), but females exhibit more math anxiety in secondary school and in college (Bernstein, Reilly, and Cote-Bonanno, 1992; Campbell and Evans, 1997). Some studies support the belief that nontraditional-aged students exhibit more math anxiety than traditional-aged students (Betz, 1978; Royce and Rompf, 1992). However, Bitner, Austin, and Wadlington (1994) found no evidence of this trend, although they did find that nontraditional-aged students reported more anxiety in general than traditional-aged students.

Recent research suggests various ways that teachers can prevent and reduce math anxiety: designing better

teaching practices (Cornell, 1999; Steele and Arth, 1998), creating a comfortable atmosphere (Jackson and Leffingwell, 1999; Steele and Arth, 1998), providing encouragement (Godby, 1997; Jackson and Leffingwell, 1999), using alternative assessment (NCTM, 1995; Steele and Arth, 1998), and exhibiting a better understanding of learning styles (Fiore, 1999; Fotoples, 2000). Parents can also help students to curb their math anxiety (Sutton, 1997), and students can help themselves in the effort, as well (Kitchens, 1995; Tobias, 1990).

Over the years, I have found a variety of techniques that can help with math anxiety experienced by community college students. Creating an atmosphere in which students do not feel threatened by being called on to give oral answers or by being embarrassed in front of others allows them to relax. Cooperative grouping helps students to understand that others have the same problems with math as they do, and that the problems can be worked out with some assistance and perseverance. Giving students a second chance at test-taking gives them confidence that all is not lost and helps them to continue trying. And being available to tutor students lets them know the teacher cares and wants them to succeed. I have also found that slowing instruction so that students can better comprehend the material is beneficial, and providing extra tutoring sessions or an extra semester spent in the course has proven successful for some of my students.

Research Study

When I realized how many developmental math students have math anxiety, I wanted to find out more about the subject. The purpose of my research study was to determine if differences in math anxiety scores are related to gender or age, and if there is a relationship between math anxiety scores and achievement scores (exit exams). A total of 125 developmental math students (33 males; 92 females) from Southwest Virginia Community College participated in the study. The study was conducted during the Spring semester of 2002 with 45 Basic Math Students, 51 Algebra I students, and 29 Algebra II students.

The instrument I used to measure the math-anxiety levels of the students was the Mathematical Anxiety Rating Scale (MARS). The MARS is a valid and reliable instrument that was developed by Richardson and Suinn in 1972. It is a 98-item scale dealing with descriptions of behavioral mathematical situations, and has been used frequently with college students (Zettle and Raines, 2000).

In order to determine if there were any relationships between the anxiety levels of the students and their achievement scores, I ran the Pearson Product Moment Correlation procedure on the anxiety scores and exit exam scores (Table 1). A significantly low negative relationship was found between exit exam scores and math anxiety scores ($p=.027$; $r= -.2013$). This indicates that as math anxiety scores increase, achievement scores decrease. This finding is consistent with Betz (1978) and Ma (1999), who also found a negative relationship between these two variables.

To test for any differences in the anxiety levels of males and females, and traditional-aged and nontraditional-aged students, I used independent t-tests (Tables 2 and 3). The results indicate that female math students are significantly more math anxious than male students ($t= -2.66$; $p=.009$). This is consistent with studies by Bernstein, Reilly, and Cote-Bonanno (1992) and Campbell and Evans (1997). No significant difference in the math anxiety of traditional-aged (<25) and nontraditional-aged ($\geq$25) was indicated in the study ($t=.03$; $p=.974$). This corresponds to studies by Bitner, Austin, and Wadlington (1994), but is in contrast with studies by Betz (1978) and Royce and Rompf (1992), who found that nontraditional-aged students exhibit more math anxiety than traditional-aged students.

Table 1: Pearson Product Moment Correlation between Exit Exams and Math Anxiety Scores

Group	n	r	p
Students	120	-.2013	.027

Table 2: Means of Math Anxiety Scores of Males and Females

Gender Category	Mean	SD	t	p
Male (n = 33)	210.8485	57.422	-2.66	.009
Female (n = 92)	247.4891	71.086		

Table 3: Means of Math Anxiety Scores of Traditional-Aged and Nontraditional- Aged Students

Age Category	Mean	SD	t	p
Traditional (<25)	238.0345	62.208	.03	.974
Nontraditional (≥25)	237.6269	75.616		

Recommendations

As educators, we need to recognize the causes of math anxiety – such as poor math instruction, negative attitudes about math, negative math experiences, and low self-esteem – and work to help students cope with these factors. We instructors can become more informed about the effects of math anxiety by reading related literature and attending workshops and conferences on the topic. We can also help students realize that myths such as math aptitude being genetic and math being a male domain are simply not true.

In class, we can also implement prevention and reduction techniques. Teachers can become more flexible when grading math tests by checking the procedure instead of only checking the answer, as this gives the teacher an understanding of where the student needs help. The use of manipulatives, graphing calculators, and computers gives students with different learning styles alternative methods for learning new concepts. Assessment techniques other than tests can be used to give students a chance to demonstrate what they actually know. Some of these alternative assessment techniques include oral questioning, observation, demonstration, discussion, journal writing, and retesting with a former test. Projects, performance tasks, and portfolios are also good assessment tools. Other helpful strategies for instructors to use include presenting clear explanations, reviewing the basics, teaching critical thinking, exhibiting enthusiasm about the subject, giving feedback and partial credit, reviewing for exams, and offering alternative testing times.

College counselors can also help. They can interview math-anxious students and make a math-anxiety problem known to an instructor before the semester begins. Furthermore, math anxiety scores and college placement scores could be compared to determine if a relationship exists between them. This could help educators determine if math anxiety has an effect on placement testing and if alternative means need to be used when placing students in developmental math courses.

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