

1-1-2016

07. Math Anxiety and the Impact on QMaSC Services

Gail Hilyard
Holyoke Community College

Follow this and additional works at: https://digitalcommons.usf.edu/qmasc_handbook

Recommended Citation

Gail Hilyard (2016), "Math Anxiety and the Impact on QMaSC Services", <http://dx.doi.org/10.5038/9780977674435.ch7> in G. Coulombe, M. O'Neill, M. Schuckers (Eds.) A Handbook for Directors of Quantitative and Mathematical Support Centers, Neck Quill Press, http://scholarcommons.usf.edu/qmasc_handbook.

This Center Leadership and Management is brought to you for free and open access by the USF Libraries at Digital Commons @ University of South Florida. It has been accepted for inclusion in QMaSC: A Handbook for Directors of Quantitative and Mathematics Support Centers by an authorized administrator of Digital Commons @ University of South Florida. For more information, please contact digitalcommons@usf.edu.

Math Anxiety and the Impact on QMaSC Services

© Gail Hilyard,
Holyoke Community College

1 Introduction

How can a QMaSC support math anxious students? Math anxiety is a major barrier to student success in learning mathematics, especially developmental mathematics. In order to provide sufficient services, QMaSC directors must be fully informed about math anxiety, its causes, and the impact of anxiety on learning.

2 Understanding Math Anxiety

Research demonstrates that learning mathematics is often emotionally charged, evoking strong feelings of hatred and fear of failure, thereby causing math anxiety. Chinn believes that most math anxiety is due to a learning disability called dyscalculia [1]. Shields, along with some educators, believes that teachers need to address the issue of math anxiety as soon as it appears in the classroom [2]. Because students with math anxiety typically assign blame to teachers for its cause, educators must analyze the causes of the math anxiety and address the anxiety immediately instead of letting it fester in the learning environment. The article “Coping with Math Anxiety” discusses

Suggested Citation: Gail Hilyard (2016), “Math Anxiety and the Impact on QMaSC Services”, <http://dx.doi.org/10.5038/9780977674435.ch7> in G. Coulombe, M. O’Neill, M. Schuckers (Eds.) *A Handbook for Directors of Quantitative and Mathematical Support Centers*, Neck Quill Press, http://scholarcommons.usf.edu/qmasc_handbook.

This material is based upon work supported, in part, by the National Science Foundation under Grant DUE-1255945. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation

various definitions of math anxiety, social and educational causes, math myths that lead people to math anxiety, how to take control over anxiety, and strategies for succeeding at math [3].

Other students will choose or have chosen to avoid taking mathematics courses to protect their self-worth and to avoid embarrassment in front of others. Jackson and Leffingwell argue that an investigation of different types of instructors (K through college) and their associated behaviors verifies that some instructors may create and exacerbate anxiety in students. The authors determined that math anxiety first occurs in these students in the third grade [4].

Chapter Four of *Student Learning and the Learning Environment* discusses how mathematics faculty and their institutions need to create a student-based environment to maximize student learning in mathematics in and outside of the classroom by enabling students to be partners in the learning process [5].

Marchewka criticizes the approaches of many researchers and educators who only address ways to ease the symptoms of math anxiety through humor, coping strategies, and specialized instruction, but do not examine the main reasons for the math anxiety. He argues that math anxiety is a *bona fide* anxiety that needs to be addressed because it causes students difficulties with learning mathematics [6].

3 How Students Bring Math Anxiety to Developmental Mathematics

Woodard explains the nature of anxiety for developmental students and suggests ways to alleviate such anxiety [7]. She sees herself as an expert after having taught developmental mathematics for several years and having witnessed the effect math anxiety can have on developmental math students. Woodard's study explores the differences in math anxiety scores based on gender or age, and if there is a relationship between math anxiety scores and achievement scores. She used the Mathematical Anxiety Rating Scale (MARS) to measure math anxiety levels and to determine the relationship between the anxiety levels of the students and their achievement scores. Her results indicate there is no significant difference in math anxiety among traditional (less than 25 years of age) and non-traditional (over 25 years of age) students.

Likewise, Smith's study examines the psychological predictors of academic achievement in students enrolled in self-paced developmental math courses [8]. Smith used online instruments to gather data from students in order to measure the psychological predictors such as procrastination, optimism, self-esteem, anxiety, locus of control, need for achievement, and fear of success. Smith concludes that an estimated 95 percent of college students have procrastination issues, that self-esteem and anxiety are related to procrastination, and that a relationship exists between procrastination and age. Both Smith and Woodard found a higher level of anxiety in women than men.

Guevara's investigation of the Fall 2005 implementation of the Achieving the Dream initiative at Vista College found no significant differences in achievement between Hispanic female and male students enrolled in their first developmental math courses [9].

Knowing how math anxiety impacts developmental math students can help the QMaSC director/coordinator better design support services and programs to help these students.

4 Resource Literature on Math Anxiety

The QMaSC director may choose to provide a collection of books on math anxiety for students to borrow. The self-help handbook *Math! A Four Letter Word*, written by Sembera and Hovis, gives suggestions for helping to change negative math attitudes and to develop study habits [10]. Researchers Kogelman, Warren and Smith offer students a series of workshops to address negative attitudes towards math, to debunk math myths, to identify the causes of and strategies for decreasing math anxiety, and to suggest approaches for working on certain math problems [11][12]. *Mastering Mathematics*, by Smith, gives strategies to improve learning and math grades, offers a diagnostic test that contains numerous suggestions for activities, and includes a section in the appendix titled, "Study Habits Improvement Check" [12].

Nolting's *Winning at Math* focuses on math reform and the future requirements of the American Mathematical Association of Two-Year Colleges (AMATYC). The goal of the book is to improve the nation's math literacy for all students, especially minority students and those with learning disabilities. Students can use the book as a study guide to learn math study habits, while instructors can use the book as a part of any math course or as an independent course [13].

Shelia Tobias, a pioneer in the study of math avoidance, wrote *Overcoming Math Anxiety* to convince women and men that their fear of mathematics is the result, and not the cause, of their negative experiences with mathematics. She encourages readers to give learning mathematics another chance. Tobias argues that when students are not successful learning mathematics, some blame themselves for failing instead of looking at the instructor as a cause of the problem [14].

5 Instruments for Assessing Math Anxiety

Many surveys and instruments exist that can be used to identify students with math anxiety. The Mathematical Anxiety Rating Scale (MARS) is commonly used to measure math anxiety levels and to determine the relationship between the anxiety levels of the students and their achievement scores. The list below in Table 1 identifies many of the available anxiety instruments categorized by those instruments that assess anxiety in general and those instruments that specifically assess math anxiety.

Table 1: Comparison of Math Anxiety and General Anxiety Instruments

Math Anxiety Instruments	General Anxiety Instruments
<p>Dreger and Aiken, 1957 – Math Anxiety Scale</p> <p>This is a 3-item scale used to assess emotional reactions to mathematics.</p>	<p>Beck, 1982 – Situational Anxiety Checklist (SAC)</p> <p>The SAC is an experiential measure of the severity of somatic and cognitive symptoms of anxiety.</p>
<p>Fennema-Sherman, 1976 – Mathematics Attitude Scales (MAS)</p> <p>The MAS is designed to measure attitudes toward the learning of mathematics by women and men. It consists of nine instruments of which one measures math anxiety.</p>	<p>Beck, Steer and Brown, 1985 –The Anxiety Checklist (ACL)</p> <p>The ACL is designed to assess the severity of anxiety symptoms in depressed patients. The 21 items selected reflect somatic, affective, and cognitive symptoms that were common to anxiety and not of depression.</p>
<p>Richardson and Suinn, 1972 – Mathematics Anxiety Rating Scale (MARS)</p> <p>The MARS is 98-item scale designed to assess anxious reactions to using mathematics in ordinary life and academic situations.</p>	<p>Hamilton, 1959 – Hamilton Rating Scales for Anxiety (HAM-A)</p> <p>The HAM-A is one of the first rating scales developed to measure the severity of anxiety symptoms. The scale consists of 14 items, each defined by a series of symptoms, and measures both cognitive and somatic anxiety.</p>
<p>Suinn and Edwards, 1982 – MARS-A</p> <p>The MARS-A is the counterpart to MARS, which is used for adolescents.</p>	<p>Spielberger et al., 1970 – State- Trait Anxiety Inventory (STAI)</p> <p>The inventory measures anxiety and differentiates it from depression.</p>
	<p>Taylor, 1953 – Taylor Manifest Anxiety Scale (TMAS)</p> <p>The TMAS is designed as a device for selecting subjects for inclusion in psychological experiments on stress, motivation, and human performance. TMAS is used as a general indicator of anxiety as a personality trait, it is not intended as a specific measure of anxiety as a clinical entity.</p>
	<p>Zung, 1971 – Self-Rating Anxiety Scale (SRAS)</p> <p>The scale is designed to measure anxiety and differentiate from depression.</p>

The appendix includes a sample math anxiety instrument for those QMaSC directors interested in developing an informal in-house survey to examine a student’s level of math anxiety

6 Possible Strategies for Addressing Math Anxiety

QMaSC directors may want to consider one or more of the following strategies to address math anxiety: employing a professional math tutor specializing in math anxiety; introducing a math anxiety workshop series; facilitating professional development and training for staff and faculty; and providing additional resources and services.

Employing a Professional Math Tutor Specializing in Math Anxiety

If resources allow, the director might hire a professional math tutor with a specialty in working with students with math anxiety. This professional tutor might explore and purchase literature on math anxiety, find methods for reducing the anxiety, and offer appropriate strategies to students. After making an initial contact with the center, which might include completing an intake form (see appendix for sample), students with math anxiety would be referred to the Math Specialist. The Specialist might begin with setting up an appointment to find out what math-related issues are going on with the student. More generally, the Math Specialist may also consider the big picture to find out why many students are anxious, consult with other learning specialists, and consult with faculty. For QMaSCs with limited budgets, the director could assume this specialized position. In addition, the campus counseling services could be of some assistance with staff training related to anxiety.

The Math Anxiety Workshop Series

The QMaSC director could develop a series of workshops on issues related to math anxiety addressing the following topics in succession: an introduction to math anxiety, strategies for reducing math anxiety, and developing a plan for success. The director or Math Specialist could conduct or lead the workshops. Such workshops might be offered outside of the math classroom or in class at the request of a faculty member. One benefit of these workshops is that students in attendance will realize that they are not alone when dealing with math anxiety. See the appendix for a sample outline of topics included in such a workshop series.

Training and Tutoring of Staff and Faculty

At a minimum, the training of staff on dealing with math anxiety should include when to refer students to the appropriate services in the center. Role-playing activities can be used to show new staff members how to recognize math anxiety, what strategies to employ, and how to refer students to more in-depth services and resources. Likewise, workshops, like those described in the previous section, might be adapted to train faculty on identifying math anxiety and strategies for addressing it. See the appendix for a sample outline for a faculty workshop entitled, “What Faculty Need to Know about Math Anxiety.”

Additional Resources and Services

For those students who may not have the time or inclination to work with the center over an extended period of time, a library of additional resources could be available. These could include handouts, textbooks, and videos, or online presentations for students to use in the center or at home. For example, there are a number of YouTube videos on math anxiety such as http://www.youtube.com/watch?v=0w3_7xytvmU that can help identify math anxiety and how to go about reducing it [15].

7 Conclusions

QMaSC directors need to understand that math anxiety is a legitimate concern. It is beneficial for directors, tutoring staff, and faculty to become more informed about math anxiety, its causes, and its effect on student learning, such as preventing students from demonstrating their math ability on some forms of assessment. A QMaSC needs to be able to assess math anxiety in students and provide a variety of strategies and programs to address this student concern.

8 Bibliography

- [1] S. Chinn, *The Trouble with Maths*. New York: RoutledgeFalmer, 2004.
- [2] D. Shields, “Taking math anxiety out of math instruction,” *National Association for Developmental Education Digest*, vol. 1, no. 1, pp. 55–64, 2007.
- [3] W. H. Smith and B. S. Smith, “Coping with math anxiety.” <http://www.mathacademy.com/pr/minitext/anxiety/>. Accessed November 2009.
- [4] C. D. Jackson and R. J. Leffingwell, “The role of instructors in creating math anxiety in students from kindergarten through college.,” *The Mathematics Teacher*, vol. 92, no. 7, pp. 583–586, 1999.
- [5] Beyond Crossroads Writing Team, “Student learning and the learning environment,” in *Beyond Crossroads: Implementing mathematics standards in the first two years of college* (R. Blair, ed.), pp. 17–28, American Mathematical Association of Two-Year College, 2006. <http://beyondcrossroads.matyc.org/doc/PDFs/BCA11.pdf>.
- [6] E. Marchewka, “Math anxiety with adult learners.” <http://www.imagine-america.org/online-journal/math-anxiety-adult-learners>, 2010.
- [7] T. Woodard, “The effects of math anxiety on post-secondary developmental students as related to achievement, gender, and age,” *Inquiry*, vol. 9, no. 1, 2004.

- [8] D. L. Smith, "Personal characteristics related to developmental math courses." <http://www.webclearinghouse.net/volume/1/SMITH-PersonalCh.php>, 1998.
- [9] H. Guevara, *Achieving The Dream: Success Of Hispanic Students In Developmental Math Courses In A Texas Community College*. PhD thesis, Baylor University, 2007.
- [10] A. Sembera and M. Hovis, *Math! A Four Letter Word*. Wimberley, Texas: The Wimberley Press, 1990.
- [11] S. Kogelman and J. Warren, *Mind Over Math*. New York: McGraw-Hill Paperbacks, 1978.
- [12] R. M. Smith, *Mastering Mathematics*. Pacific Grove, CA: Brooks/Cole Publishing, 3rd edition ed., 1988.
- [13] P. Nolting, *Winning at Math*. Bradenton, Florida: Academic Success Press, 1997.
- [14] S. Tobias, *Overcoming Math Anxiety*. Boston: Houghton Mifflin, 1978.
- [15] Community Colleges of Spokane, "Math anxiety." http://www.youtube.com/watch?v=0w3_7xytvmU, 2011.

9 Appendix A

Sample Instrument to Determine Math Anxiety

Name: _____

Date: _____

Please answer questions as honestly as possible:

1. Do you have math anxiety? *Please circle* YES or NO or Uncertain
2. How do you know when you are experiencing math anxiety?
3. Can you recall any negative experiences in your prior education, please describe?
4. If you had to measure your level of math anxiety on a scale from 1 to 10 where 10 is the highest, what would be your level, please circle.

1 2 3 4 5 6 7 8 9 10

10 Appendix B

Personal Intake Form

Date _____ Time _____ Telephone Number _____

Name _____ Major _____

Address _____

Student Number _____

Affirmative Action (*optional*): Race or Ethnic Identification

_____ Caucasian _____ Native American _____ Black _____ Cape Verde

_____ Spanish-Surname _____ Asian _____ Other

MATH CONCERNS:

Do you like math?

Math Experience (positive or negative)

What math course are you taking this semester, if none, then why?

FOR OFFICE USE ONLY

COMMENTS:

EDUCATIONAL BACKGROUND DATE: _____

	school/college	city	year graduated
HIGH SCHOOL			
COLLEGE			
OTHER			

COURSE	YEAR	GRADE	COURSE	YEAR	GRADE
Algebra I			Business Math		
Algebra II			Other		
Plane Geometry					
Trigonometry					

CHECK THE MATH COURSES COMPLETED (High School or College)

Indicate the problem(s) you have experienced in the past in your study of mathematics

What are your expectations upon the completion of this course?

11 Appendix C

Outline of Math Anxiety Workshop Series for Students

Workshop 1: Introduction to Math Anxiety

1. Explore the nature of math anxiety with students.
2. Have students share their personal stories about math anxiety by writing Math Autobiographies, as described by Shelia Tobias [14].
3. Explore the two common types of anxiety: Cognitive and Somatic
 - Cognitive occurs in the mind.
 - Somatic occurs in the body.
 - a) *Have students identify whether they have experienced one or both of these types of anxieties.*
 - b) *Briefly describe appropriate techniques to reduce these types of anxieties.*

Workshop 2: Strategies for Reducing Math Anxiety

1. Explain that math anxiety is a learned response, which can be unlearned. People are not born with math anxiety.
2. Discuss “The 12 Myths About Test Anxiety.”
3. Have students practice the Short-Term Relaxation Techniques, as described by Paul Nolting [13].
 - *The Tensing and Differential Relaxation Method*
 - *The Palming Method*
4. Advise anxious students to follow up with the professional math tutor who specializes in math anxiety in the QMaSC.

Workshop 3: Developing a Plan of Success

1. Explore the time commitment needed for success in learning math.
2. Investigate proven methods for reading a math textbook.
3. Demonstrate and set-up how to organize a math notebook

12 Appendix D

Sample Faculty Workshop

Workshop on Faculty Training: What Faculty Need to Know about Math Anxiety

- Discuss how an instructor can recognize when a student is experiencing math anxiety.
 1. Students show signs such as sweating, crying, overreacting, breathing change, fidgeting, looking away, breaking out in hives, lacking eye contact, facial expressions, physically tense, emotional, or body language.
 2. Students have shut down, turned off learning, stopped doing homework or are not engaged in classroom activities.
 3. Students show fear or being afraid around quizzes and tests.
 4. Students take longer on quizzes and tests.
 5. Students self disclose, self-identify, or tell you that they have math anxiety or are experiencing math anxiety.
 6. Students avoid class, extra help, and tests.
 7. Students are nervous before and during quizzes or tests. And students do poorly on them.
- Explore what an instructor might do when a student tells the instructor he or she has math anxiety.
 1. Instructors can calm students by listening, giving pep-talks, or by walking them through the problem.
 2. Instructors can offer to spend extra, or one-on-one, time with the student to help the student learn the material.
 3. Instructors can break down material step by step to help the student learn the material.
 4. Instructors can suggest that students use resources and academic support services like the QMaSC.
 5. Instructors can suggest students visit a counselor or the office for that serves students with disabilities.
 6. Instructors might be flexible with assessments such as giving extra time on tests or using an alternate testing place.
 7. Instructors can give students strategies for taking exams and techniques to reduce math anxiety.
 8. Instructors can suggest that student visit during office hours.
 9. Instructors can motivate and encourage students to persist with learning the course material.
 10. Instructors can explore students' past experiences to try to understand their math anxiety better.