# Identifying and Reducing Math Anxiety

**CTLA 704 Workshop**

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Introduction

Mathematics Anxiety (MA) is one of the most serious limitations to education. It can be thought of as either an aversion or a fear of working with numbers or equations for purposes of understanding the mathematical theories behind them or simply using mathematics to solve practical problems in everyday life. Many children and young adults develop a fear of mathematics while they are in school. This often is a result of inappropriate methods of teaching, such as using rote memory to learn things and hard and fast rules to apply the knowledge. This results in many cases to what may be thought of as a rebellion on the part of students who don’t grasp the principles of correct mathematical manipulation and thought. There are multiple solutions to these problems, including, but not limited to:

1. An introduction at a young age to using mathematics to learn neat things and to solve fun problems. This introduction should take place in an environment that encourages diverse methods for manipulating numbers and solving problems.
2. Continuous exposure to mathematical subjects through elementary and high school, so that by the time students reach the university level, they are thoroughly grounded in the use of mathematical techniques to solve problems and are comfortable with doing so.
3. Mathematics should be taught as though it is a tool used to solve practical problems that occur in everyday life. Students who develop a genuine interest in mathematics and science generally don’t have problems with MA anyway, whereas students who major in liberal arts, humanities, and other non-mathematical subjects are more likely to have mathematical phobias. Thus, they should be taught that it is useful to learn and use mathematics for application to everyday problems that come up in everyday situations. Teaching methods should concentrate on helping students to use mathematics to solve these everyday problems.
4. Mathematical methods should be flexible enough to allow students to find their preferred ways of solving problems. Emphasis should be placed on mathematical principles rather than on hard-wired ways of memorizing and tackling problems. If students are given flexibility in identifying their own favorite methods, they will develop a fondness for using numbers and mathematical techniques for solving problems and will never develop MA.

This document, which is part of a UMUC workshop on Identifying and Reducing Math Anxiety (IRMA) will explore ways of helping students to overcome the difficulties associated with learning and applying mathematics throughout life.
The document is divided into sections covering various areas of the topic. First, we discuss identifying and reducing MA in the nontraditional student. This group includes handicapped persons, the adult student who has returned to school following a hiatus in the educational process, and other miscellaneous categories of learners. Next, we discuss techniques for identifying and reducing MA for the visual learner; i.e., students who learn from seeing things demonstrated visually. We then move on to students who learn primarily by audio techniques, which include hearing explanations and orally descriptive procedures. Finally, we concentrate on kinesthetic learner; i.e., the person who learns best by doing things his or her own way.

Being an astronomer as the writer of this introduction is, I really like and appreciate the following quote from Galileo Galilei:

The Universe is a grand book that cannot be read until one first learns to comprehend the language and become familiar with the characters in which it is composed. It is written in the language of mathematics.
Math Anxiety and the Non Traditional Student

A. Views of Andreas Rambow

In my research for this topic, I have come across some old literature. I liked the two pieces that I found below. The first one was written in 1981 by Jean Burr Smith in an article addressing “Math anxiety and the student of the 80s.” The second article is by Ronald L. Bohuslov describing “A Method for Dealing with Attitudes and Anxieties in Mathematics.”

Colleges and universities are taking on an increasing number of nontraditional students, which at UMUC is mostly defined as someone who is not a recent high school graduate, and/or someone who has perhaps been in the workforce for many years and is now coming back to continue his/her education; this might also be someone who dropped out of school earlier and now comes back to finish a degree.

Oftentimes, these students have minimal background in math. To this extent, UMUC offers placement tests to its students and, if necessary, provides the foundation courses that enable students to become successful.

As a starting point, all instructors teaching quantitative courses should alleviate patterns of math anxiety and math avoidance that hinder academic success, and, in a technological society, limit career opportunities.

The author, Smith, describes several causes of math anxiety:
   1. Instructors' insistence on the right answer;
   2. The need to perform math skills with speed, and;
   3. The fact that math knowledge is cumulative.

However, there are also some less obvious factors:
   1. The defeat experienced when a student cannot master the next highest level of math skills;
   2. The myth that some people are not “mathematically minded”, and;
   3. The inability of some students to handle frustration.
Another dimension of math anxiety is the low math self-esteem of many women. Research that has been conducted shows that, while statistically, there is no significant difference between men's and women's math ability, many women believe that men are more mathematically capable.

Given these anxiety patterns, math instructors must concentrate more on enhancing students' self-confidence. While some may argue that the introduction of anxiety-reduction techniques may water down course content, a study at Middlesex Community College (CT) has demonstrated that students experiencing such instruction continue to higher-level math courses more often than students in traditional courses. (JP) (Smith 1981)

The lesson to be learned from this essay is that we instructors can do a lot to alleviate our students from much of the math anxiety by a process called reassurance. Reassuring our students of their ability is a perpetual process in our daily activities to make our students better math students.

In another study, the College of Alameda tried to assess the factors contributing to math anxiety and to determine methods of fostering positive attitudes toward math among women and nontraditional students.

During the study, 150 students in three introductory algebra sections were administered a series of attitude scales designed to measure their level of math anxiety and to assess personal feelings toward success in math, the role of the teacher in student success, the sex appropriateness of math, and the usefulness of math in later life.

Those test results reflecting high anxiety and/or poor, negative, or conflicting attitudes were selected as the basis for class discussions, during which students were challenged to find answers to the math anxiety problem.
Major test and discussion findings indicate that:

1. Though most students wanted to do well in math, many female students indicated that they would rather their peers not know if they were successful in math;

2. While the majority of students did not see math as a male domain, more men than women felt that they would have an occasion to use math both on and off the job;

3. Most instructors were regarded as somewhat aloof, with negative attitudes being more pronounced among the women; and

4. Math anxiety seemed to be induced more by testing than by the math itself.

The study concluded with a report that included a literature review, twenty recommendations for the amelioration of math anxiety, and the attitude scales. (JP) (Bohuslov 1980).

Although these studies are more than 20 years old, I believe the information they contain is still valuable and valid. We can do much in our efforts to relieve students of their math anxiety, for example, by means of two very simple strategies:

1. Continuous reassurance; and

2. A positive attitude.

B. Views of Joseph Pascarella

I will endeavor to compare and contrast traditional students from nontraditional students regarding math anxiety by utilizing the Math Anxiety Rating Scale (MARS) as developed by Suinn, Edie, Nicoleti, and Spineli, (1972).

The MARS is a questionnaire that attempts to gauge the level and type (s) of math anxiety. I will attempt to determine if there are any unusual Math anxiety characteristics in the non-traditional student.

Math anxiety is found at all levels of student grades (Woodard 2004). Is Math Anxiety the effect of age, or is age not a factor? This is an important concept in that it will be important to test if math anxiety increases with age.
Techniques Concerning the Visual Learner

Based on my reading of Felder’s research related to learning styles of college-level engineering and science students, I suggest the following techniques be considered:

1. Faculty, TAs, and students should all be encouraged to use a learning-styles instrument (such as Felder’s below) to obtain self-knowledge about their preferences on the visual/verbal domain, as well as in other areas of learning-style diversity. Results should be discussed as early as practicable in the semester;

2. Instructors should present written/verbal information in a graphical/visual manner whenever possible. Examples include: diagrams, flow charts, sequential slide presentations, time lines, etc. Videos or animated media should be made available to students or played in class.

3. Students should be assigned the task of converting written material or their personal lecture notes into graphic form. Even the exercise of using different colored highlighters to organize similar ideas in the written materials would benefit visual learners.

Felder’s instrument is available at:
http://www.ncsu.edu/felder-public/ILSpage.html
Techniques Concerning the Auditory learner

Definition/Identification of Auditory Learner

Briefly stated, the auditory learner:

* Tends to remember and repeat ideas that are verbally presented
* Learns well through lectures
* Is an excellent listener
* Can reproduce symbols, letters or words by hearing them
* Likes to talk
* Enjoys plays, dialogues, dramas
* Can learn concepts by listening to tapes
* Enjoys music
* Can repeat or fulfill verbal instructions


According to another Learning Styles website: ([http://192.107.108.56/porfolios/m/murray_k/final/learning.html#learning](http://192.107.108.56/porfolios/m/murray_k/final/learning.html#learning)), which cites two separate researchers, only two of ten school age (K-12) students are auditory learners. The site also laments the fact that “90% of teaching is auditory” and asserts that 50% of teachers (presumably school teachers) are auditory learners who replicate the way they learn.

Indeed, it is easy to see how research regarding learning styles criticizes the over reliance on auditory approaches in the traditional classroom. But how does this transfer to the online classroom? How many of our classrooms are basically ‘silent’— relying on printed text in books and on the screen in discussion conferences and online documents? While auditory learners were perhaps at an advantage in the traditional lecture type university setting, it is important not to neglect their needs in the online environment.

Suggestions for Teaching the Auditory Learner include:

* Sounds often distract them
* They are usually very good at memorization
* They often learn well in groups
* Reading aloud and using a tape recorder are often helpful
Specific suggestions for online teaching:

*Consider supplementing textual lessons with a short audio section (The National Public Radio website at npr.org is a great resource for short reports on a wide variety of topics)
*Consider recording a lecture and posting the resulting mp3 file to the WebTycho site. Options also exist to add audio to PowerPoint presentations using Impatica (and there is a CTL workshop nearly every semester to show you how to do it!)
*Investigate options for online chat with audio using popular and readily available free software
*Allow students to prepare a speech/presentation as a replacement for or alternative to a formal paper. Of course, this may require the purchase of a computer microphone (less than $10 for a basic model), but the student would be learning additional computer-related skills in the process
*Encourage students who have self-identified as auditory learners to use techniques such as reading aloud when studying
Techniques Concerning the Kinesthetic Learner

Or, three techniques that will help the kinesthetic learner and/or reduce math anxiety for the kinesthetic learner.

Well, the first thing to do here is define who is a kinesthetic learner. For the purpose of this section, the kinesthetic learner is one who learns best by doing – being actively involved in the process.

So, what are three ways to help this type of learner?

1. Give the learner something to do. Don’t just lecture (either in audio or textual files) – give examples to try out. For example, give a problem and tell the student to try to get the first step; then they can click to see if they match, and then try the next step. Rather than simply showing the steps, invite the student to try and work along. A simple invitation can make all the difference.

2. Another way to help this type of student, especially if they are also an interpersonal learner (one who learns best when interacting) is to set them up with a study partner. Whether it is assigned or optional, give the student someone to ‘teach’ to. Sometimes a kinesthetic learner will learn best by teaching the technique to someone else, rather than learning about it from someone.

3. Besides helping to present the material in a way more suitable to the learning style of a student, it helps to try to reduce the math anxiety for the learner as well. A kinesthetic learner might be scared – after all, most math is taught by showing examples or by reading – rarely is it taught ‘hands on.’ Give ideas for using manipulatives, and showing how these manipulatives can help with gaining the knowledge. If they have problems with ones versus tens versus hundreds, suggest using pennies, dimes and dollars, for example.
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