

Math Literacy News



Volume 8 A math newsletter of the Ohio Literacy Resource Center Winter 1999

Math Anxiety: Impediment to Success

by Nancy L. Markus

Mathematics is a conceptual framework that can be used as a tool for analysis and discovery. Mathematics is a language to describe patterns and structures, to describe numerical and geometric relationships, and to help people state clearly what they mean. Mathematics is beautiful and exciting. Mathematics is a gateway to higher learning, better jobs, and self-esteem.

Competence in mathematics can change one's life. Mathematics can give a new perspective when looking at architecture, music, plants, and sculpture. Mathematics is the gateway to many educational experiences and professions. However, math is a stumbling block for many people. It is a subject that evokes more fear and anxiety than any other. It causes sweaty palms, shortness of breath, and panic. Math anxiety is real and is something that every adult education teacher needs to deal with.

Math anxiety manifests itself in many forms. Some people may feel uneasy when doing math problems; others may go blank when

faced with a math test. Sweaty palms and shortness of breath are physical changes that accompany feelings of helplessness and fear. Math anxiety is not limited to uneducated persons. It is found in people at all levels of education and society. What causes it? Why is it so evident in our society? More importantly, what can be done to alleviate it?

Math anxiety is not genetic; no one is born with it and no one dies from it, so where does it come from and how does it begin to pervade people's lives? Math anxiety usually begins in childhood; it may be traced back to one or more incidents in the early school years. In addition to early traumas, math anxiety is reinforced by many mathematical myths that pervade our culture. As long as people believe these myths, they have excuses for not succeeding in math. Adult education teachers need to help eliminate these myths. Some of these myths deal with perceptions about ability, some with effort and thinking processes, and some with the best procedures for learning math and validating the results.

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MATH LITERACY NEWS, A PUBLICATION OF THE OHIO LITERACY RESOURCE CENTER

Typeset by Georgia Gallagher.

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Myths about mathematical abilities include the following:

• **Math performance mirrors intelligence.**

Math performance is often connected to what we believe is intelligence. Intelligence is often equated with an ability to reason abstractly. In reality, math competence requires intuition and imagination. Intelligence is more complex than just reasoning ability. Yet our culture leans toward left-brained, sequential, analytical thinking, undervaluing artistic, practical, and commonsense intelligence. Math problems can be approached in many different ways. Many different learning styles mean that people process information in many different ways. While a visual learning style is an advantage in learning math, it is not the only way to learn math. It does, however, help to visualize or imagine a situation and draw pictures. It helps to see numbers clearly in one's mind.

The "intelligence myth" is peculiar to Western culture. Americans think that math ability is something that is either there or not. People in China and Japan believe that math ability is evenly distributed among all children, and that hard work is what makes the difference between math competence and failure. Could this be why Asian children outperform Americans on international tests?

Students need to hear about different ways of looking at math competence.

• **If you are creative, math will spoil your talent.**

Creative people, such as writers, artists, dancers, and musicians, often attribute their success to the way their brains function. Math is seen as pedantic, gray, dull, and boring, something that can kill a creative spirit. History shows that many people have excelled in both artistic and mathematical endeavors. Leonardo da Vinci is one such person. It is an injustice to think that our mental activity is limited; that mathematical thinking somehow subtracts from creativity. New ways of thinking, seeing, and reasoning can enhance talent in all areas. Again, teachers and students must be careful of this fallacy.

• **Math is for men.**

Studies "prove" over and over again that men are better at math than women. Trying to show gender-related differences in a field that is full of gender-related prejudices is easy. Developmental theory has established men's experience and competence as a baseline against which both men's and women's development is then judged, often to the detriment or misreading of women.

"Nowhere is the pattern of using male experience to define the human experience seen more clearly than in models of intellectual development. The mental processes that are involved in considering the abstract and the impersonal have been labeled 'thinking' and are attributed primarily to men, while those that deal with the personal and interpersonal fall under the rubric of 'emotions' and are largely relegated to women."¹

Women have had trouble overcoming age-old pressure that tries to keep them from succeeding in the workplace and in knowledge. Women have traditionally had little part in the development of math. Hypatia of Alexandria, the most famous woman mathematician of ancient times, was murdered by an envious male. During the middle ages, women of knowledge were often persecuted as witches and executed.

This myth of math as a male territory is being eroded every day. Math has become a golden road to opportunity. Teachers and students need to be careful of offhand comments that give women and minorities an excuse for failure.

• **Women (and minorities) can't think straight.**

Many women have the idea that women aren't very bright and/or lack the ability to think analytically. The so-called lack of thinking ability may be the result of subtle discrimination, derogatory remarks, and constant sexist drivel that the media perpetuates. People with math anxiety need to change self-image and realize that most of the self-doubts and feelings of stupidity have been induced from the outside. Teachers and students need to be careful of this myth, too.

- **Math requires a good memory.**

A good memory is useful but not critical to mathematics success. More important is concentration. Any strategy that helps a person focus can also lead to mathematics success. Time spent on memorization in math class is better spent on problem solving and sense making.

Some myths deal with the effort and thinking processes required in approaching and learning math:

- **Math is done by working intensely until the problem is solved.**

Math concentration is beneficial for a half hour or so, but then a five or ten minute break is helpful. Sometimes the rest allows the brain to rest and sort out information that has been processed. Sometimes when a problem is left alone, the solution appears unexpectedly later. Not all math problems can be solved in a math period. Sometimes problems can continue to the following class period or beyond. Ideas often come when least expected!

- **Math has to be approached with cold logic.**

Much of math that is needed in daily life requires few sophisticated skills and little cold logic. What is needed is common sense and intuition. By fourth grade, school math and real math diverge. People forget that mathematics expresses concrete situations. Teachers and students need to step back when looking at problems and first discuss *what makes sense*.

- **All mathematicians rely exclusively on abstract thinking.**

Competent math students and teachers use every tool possible for assistance. Mathematics is a representation of concrete things. Using manipulatives, using computer graphics, making models, drawing, imagining and personalizing math help make it concrete and real. Concrete objects should be used in all levels of mathematics, not just in the primary grades! Looking at "square" numbers, "cubic" numbers, "factors," etc. using square tiles and cubes helps students make the jump to abstract thinking.

Finally, some myths deal with the procedures of learning math and validating results:

- **There is one best way to do each math problem.**

There are many ways to do any math problem and how it is done depends on learning style and how information is processed. When right-brained methods are emphasized, anxiety, narrowness, and rote memory are eliminated in favor of common sense, intuition, and humor. Traditional math and science often disparage personalized process or the relational mode, but these are often the best ways for some people to do math. Neither right-brain nor left-brain processing is best all the time.

Instead of modeling a process, teachers can ask for different methods. The idea that "this way is good for me, but you might have a better way for you" must be repeated and reinforced.

- **There is a formula to be remembered for each problem.**

There are many ways to approach and solve each problem. Someone competent in math knows that the answer will be obtained sooner or later. One doesn't have to come up with an answer immediately. Questions that might be explored include:

- "How can I explain it?"
- "Can I draw it?"
- "Can I do it another way?"
- "What else can I do?"
- "Can I skip part of it?"
- "Can I do the first part?"
- "Have I seen anything like this before?"

Being successful in math doesn't mean being able to pick out a correct formula. Memorizing formulas makes no sense unless the reason for the formula is understood! Half-remembered rules such as "turn a fraction upside down and multiply" do damage when they are unconnected with reality.

- **It's bad to count on your fingers.**

Fingers provide a concrete access to our base ten system and fingers help keep math concrete and exact. Confident math students and teachers often use their fingers to help in math calculations. As a teacher, modeling this technique during problems such as those involving time helps students see that fingers are a quick and accurate tool for mathematics.

- **It's always important to get the answer exactly right.**

Persons often perceived as math "whizzes" aren't those persons looking at exact answers, but rather are those persons who look at the "big picture" by estimating rough numbers, trends, and relationships using math. By encouraging this "big picture," teachers can help increase number sense and thinking skills. Sometimes just estimating answers is good enough.

- **You must know how you got the answer.**

Often people with a right-brained, intuitive way of doing math remember having numbers and pictures dancing around in their heads, only to fall into place with a correct answer. Insisting on a formula when intuition and visualization were the processes inhibits this style of learning. Students looking at the ceiling for the answer may be visually-oriented, trying to recall the image in their minds. Arriving at the answer in an unorthodox way is still a valid method for many people. Guess and check is a strategy that is often used, but seldom credited. Teachers need to encourage intuitive thinking and visualization.

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These myths play with our minds and increase our anxiety about math. We are often unaware that they are presented again and again by people, teachers, television, and even by each and every one of us in our own conversations. Math myths provide excuses for math deficiencies. As long as we believe them, math success will be elusive.

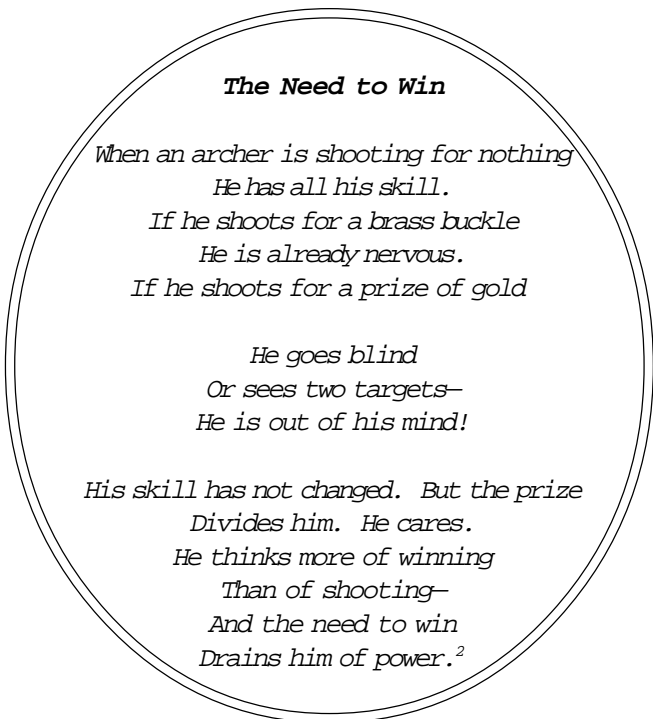
OK, so I "know" the myths aren't true. But how can I help my students who still feel sick when approaching a math problem?

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Techniques for Overcoming Math Anxiety

Math anxiety will not disappear overnight. Reducing anxiety takes both competence in math

and confidence in one's abilities. Thousands of years ago, the Chinese poet Chuang Tzu wrote this:



Confidence-building techniques can help decrease math anxiety. Adult education teachers need to help students learn some **relaxation techniques**. A few that can be explored in the classroom are:

Breathing for relaxation.

Proper breathing can help a student achieve physical relaxation. Some people use meditation or yoga. "Square breathing" may help in panicky situations. Square breathing uses four phases of breathing: exhalation, hold, inhalation, hold. It slows down a worry-filled mind and provides more oxygen. Counting keeps the mind busy while systems are slowing down. Four counts for each phase is the rhythm.

Affirmations.

Affirmations are important in dealing with negative feelings. When affirmations are practiced, it's as if powerful new music is played over old scratchy records. It's not bragging or egotistical. Picking an affirmation that feels pleasant and comfortable and repeating it daily until it becomes true is something that all students can do. Brainstorming seemingly outrageous affirmations can be a classroom activity. Some affirmations might be:

- *I can learn the math; I just need to take my time.*

- *I have learned a lot of math and I deserve credit for my efforts.*
- *I can allow myself to learn math.*
- *I'm a genius when it comes to math.*
- *I am getting better and better at math.*
- *I am smart enough to learn anything I want to learn.*
- *Math is another way of saying things.*
- *I can try the impossible.*
- *I am brilliant in math.*
- *I am allowed to succeed in math.*

Affirmations can be recorded and played back several times before bedtime. They can be said aloud every day for a few days. Students can close their eyes and say them. They can be written across the top of a page or in a daily agenda or math book. Affirmations may be hard to say at first, and there may be self-effacing laughter when they are first introduced. However, affirmations can help change attitudes. Attitude is more important than almost anything else for success. Students need to start believing in the possibility of mathematical success!

"Good luck" pieces.

Concrete objects or "good luck" pieces can help decrease math anxiety. Some trinkets can be always carried. An example might be a lucky pencil, a crystal, or lucky stone in a pocket or purse. One student carried a small metal angel with her coins in order to remind her that she is never really alone.

Other good luck pieces can be worn for special occasions. This lucky piece might remind the wearer that there is power and support in the universe. This lucky piece should be noticeable, like a bracelet given by a loved one. It should not provide comfort, like a security blanket, but should remind the wearer of empowerment! How many of us have "lucky" shirts or pencils? Do we really believe in their power? We have them nonetheless.

Good luck pieces are similar to affirmations in that they are a fun way to believe that one can

succeed in math. Students can discuss or even write about their own experiences with "lucky" pieces.



Students also need to look carefully at how they learn best. Often factors that have little to do with math put roadblocks in front of student success.

Surroundings and environment.

Environment is extremely important in helping to alleviate math anxiety. A successful environment will be different for each person. Students must find what feels comfortable for themselves. A comfortable environment might include a special type of paper, a sharpened pencil or a thick marker. It might be a quiet room or a noisy kitchen. Students need to find what feels right for themselves, not what they were told is the best environment for learning!

Listening to one's body.

There is a natural rhythm for each person during a day. Some people are morning people; some are not. Students often have no idea what time of the day is good for them; but learning this and doing math at the best time can help.

Listening to music.

Baroque music has been shown to have positive effects on thinking and feeling. Math learning and thinking are closely related to music. Instrumental music with steady beats seems to help bodies and minds into a comfortable, focused, and relaxed working mode. Listening to classical music is something to try in the adult education classroom.



Trying a mind dump exercise.

Free-flow writing is an anxiety reduction exercise which may help some students. For five minutes a student writes whatever comes to mind. Writing furiously and fast, with no complete sentences, without analysis or worry helps to make connections outside awareness. The adult education teacher can give a word prompt such as "math," "computer," or "GED test." Students can probably give ideas for a word prompt that causes anxiety. After writing all that can be written about this anxiety-producing word, the writing is put away. It can be read later or not at all. Students may even want to rip the writing into many small pieces. The idea is to simply dump aggressions.

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Keeping a success journal.

Students can keep a short journal about successes in math (or any other topic). Just the act of putting successes in writing can help a student recognize the joy of progress. It is an interesting journey that can be reread at a later time. It is amazing what success does to increase success!

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The relaxation techniques may help students alleviate panic attacks. Using the other techniques can help build confidence and success. Apprehension about numerical information will decrease and a new assertiveness may develop. Students will expect to know math and understand math and be willing to take the steps to get to success. Listening, reading, reading again, and asking questions are all relevant and worth doing and students will begin to believe in this process.

Irreverence toward numbers may develop. Looking at the big picture, students might see that numbers are inflated or skewed. With decreased math anxiety will come increased math confidence. A new attitude and new opportunities can develop. Confidence in math will spill into other areas of life. In our society, rapid technological advances and social changes demand that everyone be open to new information. We need to be able to sort out what mathematical knowledge is important and what isn't, what we need to retain and what to let go.

Tools that will help students meet the challenges of mathematics in our society include:

- *Analyzing the actual problem.*
- *Discovering one's feelings and blocks.*
- *Building confidence through specific techniques that allow one to proceed despite fear and trepidation.*
- *Adopting a down-to-earth approach to new material, translating jargon into everyday language, using drawings and props to get a better look at problems.*
- *Developing problem-solving strategies for math that can carry into other areas of one's life.*

Math anxiety is not a life sentence. Adult education teachers can help students overcome math anxiety and begin the journey to mathematical success.

¹*Women's Ways of Knowing: The Development of Self, Voice, and Mind* by Mary Field Belenky, Blythe McVicker Clinchy, Nancy Rule Goldberger, and Jill Mattuck Tarule. New York: Basic, 1979

²*Where Do I Put the Decimal Point* by Elisabeth Ruedy and Sue Nirenberg. New York: Henry Holt and Company 1990.

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• *Related OLRC publication: "Effective Strategies for Dealing with Text Anxiety,"* January 1999

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