

## Writing: A Requirement for Math Success

### Presenter:

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### Inquiry:

How can I teach in a way that reduces math anxiety and increases math comprehension?

### Context of Teaching:

My teaching philosophy is that the teacher must believe in the student's ability to learn. The teacher is a partner in the learning process as described in the Constructivist philosophy. By observing the student, gaining knowledge of his interests, learning styles, and present knowledge, the teacher is able to participate in and guide the learning experiences. A teacher's role is to ask questions, hypothesize and theorize with the student, provide opportunities for discovery, provide constructive feedback and help the student learn how to learn so that deeper understanding might occur. The teacher must also understand that learning happens in the student, not to the student. Thus, the teacher's purpose is to help the student find pathways to grapple with the content so that the student can come to own it and make sense of it for himself.

My school opened in 2007 and combined three other elementary schools for a total of 1,121 students. In 2009, data collected showed 19% of the students were economically disadvantaged, 11% were students with disabilities, and 4% were English language learners.

As a fourth grade teacher, I only teach mathematics. I am teamed with three other teachers, thus I am teaching four groups of approximately 30 students, each class period lasting for 60 minutes. Three of the classes I teach will be gifted cluster classes this coming year and one will be a special education inclusion class.

I am a gifted endorsed teacher as well as a Teach 21 technology graduate from the Cherokee County school district. I provide differentiation in all my lessons and include technology integration on a daily basis. I also provide math tutoring in ASP for students in need of extra math help from 2:30 to 4:30 p.m. each day.

#### Readings and Research:

Austin, S. and E. Wadlington. "Effect of beliefs about mathematics on math anxiety and math self-concept in elementary teachers." *Education* 112.3. Web. 23 June, 2004.

The authors present experimental analysis of how mathematics beliefs affect math anxiety and math self-concept in preservice teachers. They conclude that no significant differences were found in levels of math anxiety based on agreement or disagreement with any specific mathematical beliefs. The belief that math is not creative was the only belief that showed an effect on math self-concept. The authors note that teachers who are creative may feel their creativity will not help them with math or that it requires skills they do not possess. They offer interesting research explaining reasons elementary teachers have mathematics anxiety and

the relationship between teachers with math anxiety and students with math anxiety. The authors note that preservice teachers' beliefs about mathematics were created from their elementary school experiences.

Baxter, Juliet, John Woodward, and Deborah Olson. "Writing in Mathematics: An Alternative Form of communication for Academically Low-Achieving Students." *Learning Disabilities Research & Practice* 20.2 119-135. 7 June 2010.

Baxter, Woodward, and Olson provide an in-depth research article about the benefits of writing in the math classroom for low-achieving students. Most insightful was the thought that low-achieving students who are typically quiet during discussion class time can and will get involved in math communication necessary for development of processing skills through writing activities. This article was very informative.

Brandenburg, Sister M. Luka. "Advanced math? Write!" *Educational Leadership* November (2002). Web. 7 June 2010.

Sister Brandenburg writes a delightful perspective of attempting to include writing in her math classroom. While her writing is insightful and informative, it is also very honest as she discusses the struggles when a math teacher asks students to write in the math classroom. This was one of my favorite articles.

Burns, Marilyn. "Writing in Math Class? Absolutely!" *Instructor Magazine* April (1995): 40-47. Web. 7 June 2010.

Burns discusses enhancing students math understanding at the same time reinforcing their writing skills. She provides nine important strategies to commonly answers to commonly asked questions, and offers four different types of writing math activities. Her ideas are rich and insightful.

---. *About Teaching Mathematics: A K-8 Resource*. 3<sup>rd</sup> ed. CA: Math Solutions Pub. 2007.

Print.

In this book, Burns provides an in-depth discussion about how to go about teaching mathematics on a conceptual level. In one section she discusses incorporating writing into math instruction. There are many examples of math lessons and ideas given for how to incorporate writing in math classes. Another invaluable book I could not live without as a math teacher.

---. *Writing In Math Class*. CA: Math Solutions Pub. 1995. Print.

In this book, Burns covers three major sections. Part 1 discusses why students should write in math class. Part 2 discusses types of writing assignments. Part 3 discusses tips and suggestions for adding writing to the math class. This book has been invaluable to me as a math teacher.

---. "Writing in Math." *Educational Leadership* October (2004): 30-33. Web. 7 June 2010.

Burns discusses how she used to think writing and math were like oil and water, yet today she cannot imagine not making writing an integral part of her math

instruction. She introduces four categories for writing in the math classroom. Her ideas are practical and informative.

---. "10 Big Math Ideas." *Instructor Magazine* April (2004): 16-19. Web. 7 June 2010.

Burns provides 10 big math ideas discussing how to make writing a part of the math learning experience. She says that writing helps student reflect on their thinking and helps teachers assess students understandings and misunderstanding. Moreover, she discusses the importance of having a safe classroom culture for learning. Her ideas are practical and informative.

Burns, Marilyn , and Robyn Silbey. "Math Journals Boost Real Learning." *Instructor* April 110.7 (2001): 18-21. Web. 7 June, 2010.

Burns and Silbey discuss that journaling is one of the best ways to introduce writing into the math classroom. Journaling helps students keep track of their reasoning and helps teachers evaluate student progress. The article also reviews problem solving, process prompts, and responding to writing. The article is informative and offers practical advice.

Furner, Joseph. "Equity for all students in the new millennium: Disabling math anxiety."

*Invention in School and Clinic* 38.2 (2002): 67-73. Web. 19 June 2009.

The authors note that 7% of American have positive mathematics experiences from kindergarten through college, leaving 93% with fear and

loathing for math resulting from negative mathematics experiences. They also state that US students' math scores decline from grade 4 to grade 12. They thoroughly review covert and overt behaviors exhibited by math instructors as as teaching practices that may cause mathematics anxiety in students. Finally, they offer many ideas that teachers can implement to help prevent mathematics anxiety.

Herbert, T and Joseph Furner. "Helping High Ability Students Overcome Math Anxiety Through Bibliotherapy." *Journal of Secondary Gifted Education* 8.4. (1997).

Web. 29 February, 2003.

The author thoroughly discusses how bibliotherapy, a therapeutic experience involving the use of guided reading and discussion, can lead math anxious students through stages of identification, catharsis, and insight into dealing effectively with mathematics anxiety. Moreover, he reviews mathematics anxiety research making statements such as: teachers and parents can pass on their anxiety to the next generation through modeling behaviors of discomfort; ineffective teaching techniques are responsible for increasing math anxiety; and ineffective mathematics testing contribute to math anxiety. The author also discusses enlightening research relating to gifted students with math anxiety.

Marshall, John. "Math Wars 2: It's the Teaching, Stupid!" *PHI DELTA KAPAN* January (2006): 356-363. Web. 7 June, 2010.

Marshall provides an exceptionally insightful article about how abstract math concepts are and the ways in which to go about and not to go about teaching such concepts to children. For example, he discusses the meaning of the number two in great detail, leading the reader through a process that demonstrates how abstract the number two really is! A very enjoyable article with valuable information.

Sloan, T. "Mathematics Anxiety: Causes and Treatments." *Prescription for Learning: An Education Column Web Site*: [http://home.hiwaay.net/~kenth/dian/column/p\\_040500.htm](http://home.hiwaay.net/~kenth/dian/column/p_040500.htm)  
5 April (2000).

The author, Assistant Professor of Elementary Education at Athens State University, reviews enlightening research related to mathematics anxiety. Interesting comments include: teaching strategies such as memorization of algorithms with little conceptual understanding are associated with the onset of mathematics anxiety; mathematics anxious teachers spend little time teaching conceptual problem solving strategies; mathematics anxious teachers pass their anxieties on to their students; preservice teachers have the highest incidence of mathematics anxiety compared to other college majors; systematic desensitization (behavioral approaches) and cognitive methods (remedial math instruction) successfully treat mathematics anxiety; methods courses

significantly reduce mathematics anxiety in preservice teachers because concrete manipulatives facilitate their understanding of mathematics from a conceptual viewpoint as opposed to practice-memorize methodology.

Stolpa, Jennifer. "Math and Writing Anxieties." *PHI KAPPA PHI FORUM* 34.3. Web. 7 June 2010.

Stolpa discusses how math anxiety is developed through unintentional comments by math anxious adults such as teachers and parents in an attempt to reduce bad feelings in math struggling students. Unfortunately, comments such as "Math was never my strong suit in school," are interpreted by students as an indication they will never be good in math, thus they give up on themselves and learning math. The article was an eye-opener.

Tobias, Sheila. *Overcoming Math Anxiety*. New York: Norton, 1993. Print.

The author, a leading feminist and activist, helped bring mathematics anxiety into social consciousness through the women's movement of the 1970s under the premise that women disproportionately suffered from mathematics anxiety mediated by lower self-efficacy in math achievement, thus women were limited in their vocational choices. She thoroughly reviews research in an attempt to find a relationship between mathematics anxiety and gender and finds only one valid difference: generally males are more skilled when tested in areas of spatial visualization. The author addresses

mathematics anxiety reduction by challenging myths associated with mathematics and offering information associated to conceptual understanding of mathematics. She claims that teachers could reduce mathematics anxiety by abolishing timed tests, letting children use calculators, teaching spatial visualization skills, and teaching word problem solving techniques.

Urquhart, Vicki. "Using Writing to Improve Math Learning." *Middle Ground* 12.4 (2009): 17-19. Web 7 June, 2010.

Urquhart provides information about metacognitive processes relating to writing in the math classroom. She includes ideas about non-threatening writing prompts, rubrics, and improving math literacy. Her information was informative.

Instructions for Writing Activity:

"How Smart Are YOU With Money?"

Objectives: **M4N5. Students will further develop their understanding of the meaning of decimal fractions and use them in computations.**

- a. Understand decimal fractions are a part of the base-ten system.
- b. Understand the relative size of numbers and order two digit decimal fractions.
- c. Add and subtract both one and two digit decimal fractions.

**M4P3. Students will communicate mathematically.**

- a. Organize and consolidate their mathematical thinking through communication.
- b. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.
- c. Analyze and evaluate the mathematical thinking and strategies of others.
- d. Use the language of mathematics to express mathematical ideas precisely.

Grade: Fourth Grade

## Materials Needed:

A copy of the poem, *Smart*, by Shel Silverstein

Play coins for student to use as manipulatives

## Procedures:

Students read and act out the poem in small groups. They are asked to create a written response to the question: “Did the boy in the poem make a good deal?” In their response, students must tell how much money the boy loses or gains in each transaction and how his thinking was flawed.

An extension activity might be to have the students re-write the poem so that the boy gains a specific amount of money at the end of the poem.

## Narrative

I didn't attend college until I was 40 years old because I was convinced I would never be able to pass a college math course. I longed to be a high school writing teacher, dreamed of what it would be like, and felt defeated by my lack of ability to make my dream come true. Math! Just the thought of it made my heart pound, eyes fill with tears, and brain totally shut down! Fortunately, my husband and son suspected I was more afraid of math than lacking. They believed in me when I didn't believe in myself. And, they offered to help me make it through the math classes I'd have to take if I'd commit to facing my fear of math. In 2006, I graduated from KSU with a 4.0 GPA, and today, I am a successful fourth grade *math* teacher. That's correct, I said *math* teacher! More importantly, I love my job and I love teaching math.

The journey I took from facing my math fears to becoming a successful math teacher led me to question what had caused my math anxiety and feelings of inadequacy. While reading research about these topics, I began to understand what had happened to me, how to re-teach myself, and how help my students not only become competent in math, but also attain math efficacy in the process. As a result, I decided to pursue the following research question: How can I teach in a way that reduces math anxiety and increases math comprehension? I discovered two empowering truths: one, writing activities in the math classroom are required to reduce math anxiety; and two, writing activities in the math classroom are required to improve math comprehension.

When researching information about mathematics anxiety I was stunned to find that I was not the only person suffering from this type of math experience. In 1989, the National Council of Teachers of Mathematics (NCTM) recognized mathematics anxiety as a problem (Furner & Duffy ¶ 5). Shockingly, only 7% of Americans report having had positive experiences with mathematics from kindergarten through college, leaving 93% who have had negative math experiences. Included in this large percentage of people with negative math experiences are teachers. Interestingly, reports indicate that a disproportionately large percentage of elementary teachers dislike and avoid math. Moreover, an abundance of research connects teachers, especially elementary teachers, with the development of mathematics anxiety. There appear to be two major areas of concern. First, studies show that ineffective teaching techniques and styles can create environments that breed the development of mathematics anxiety or increase already existing mathematics anxiety in students. Second, studies show that teachers can consciously and unconsciously pass on a variety of mathematics anxiety provoking beliefs and attitudes to their students (Furner & Duffy ¶ 8).

Children are not born believing they are incapable of doing math (Stolpa 3) . Negative math beliefs are learned, sometimes from statements made by math anxious teachers. Statements such as, “I was never good at math either!” and “Maybe math just isn’t your thing,” are often said by well intentioned teachers as a means of comforting students who are struggling with math. Unfortunately, statements like these promote the thought that struggling students will never find math success (Stolpa 3).

However, by providing students with writing assignments that help them discover the roots of their mathematics anxiety, teachers can be very helpful in reducing math anxiety (Tobias 240). One math writing assignment that helps students recognize and reduce math anxiety is writing a math autobiography. This activity helps anxiety victims by re-experiencing what went wrong in their past so they can determine what exactly is causing the anxiety. The goal is not to place blame so much as to recognize the triggers and causes of the anxiety. Sometimes “victims were young when they first were embarrassed or intimidated in math class. It is inappropriate for children, particularly girl children, to demonstrate anger. Hence, anger frequently becomes transmuted into fear” (Tobias 240). Once the source is discovered, routes to recovery and re-teaching are options.

Another writing assignment that helps students effectively deal with mathematics anxiety is connected to a process called Bibliotherapy. Bibliotherapy involves students reading books with characters that are experiencing similar emotions as the student. Identification with the character in the book creates a sense of tension relief or catharsis and helps the reader know they are not alone (Herbert and Furner ¶18). Providing students with writing assignments following the reading of these types of books offers students the chance, in a private way, to communicate

their feelings to their teacher so that the teacher and student can look for ways to reduce the mathematics anxiety.

The other area of concern relating to mathematics anxiety is ineffective teaching techniques and styles. (Herbert & Furner ¶8). Ineffective math teaching techniques focus on lecture, practice, and memorization while devoting less time to teaching math concepts and problem solving strategies (As cited in Sloan ¶3). Math anxious teachers often teach in this manner because they have a history of math avoidance that inhibited them from acquiring math skills and processes needed to understand math or teach math on a deeper, conceptual level (As cited in Austin & Wadlington ¶4). However, in order to create, math proficiency, the National Research Council, states:

[M]athematical proficiency includes five interrelated strands: (1) conceptual understanding; (2) procedural fluency; (3) strategic competence, the ability to formulate and represent problems; (4) adaptive reasoning, the capacity for logical thought, explanation, and justification; and (5) productive disposition, the belief that mathematics makes sense and is useful. Baxter, Woodward, and Olson 119

If students are to develop all five strands, they need to be engaged in communication in the math classroom. Teachers may achieve this communication by integrating writing assignments that encourage mathematically meaningful communication, which will provide avenues for reducing mathematics anxiety and increasing math comprehension. (Tobias 240). The research also supports that writing increases math comprehension. I found that “[w]riting is a way to work yourself into a subject and make it your own” (As cited in Burns 38). Writing requires students to “organize, clarify, and reflect on their ideas—all useful process for making sense of

mathematics” (Burns 38). Moreover, writing is a useful assessment for teachers giving them a window into the understandings and misconceptions of their students (Burns 38). Once misunderstandings and misconceptions are known, the teacher is able to re-teach and scaffold the students toward understanding, thus increase math comprehension.

There appear to be six major categories for ways to use writing in the math classroom that help students increase math comprehension: (1) writing in journals, (2) writing explanations for how math problems were solved, (3) writing about math concepts, (4) writing math essays, (5) writing a response to literature, and (6) writing as a means of math assessment. A brief explanation of each category will follow.

The first, most informal way to engage students in writing for the purpose of increasing math comprehension is by asking students to keep a math journal. Journal writing provides teachers with a picture of what students are thinking and offers a vehicle for students and teachers to communicate privately (Baxter, Woodward, and Olson 120). Writing prompts can be geared toward how students feel about the math they are learning. It can be a means for the teacher to continue monitoring the anxiety levels of the students or an extension of the math autobiography. Prompts geared for this type of journal writing might request students to describe how they felt during and after they solved a problem or to describe when they felt confused or unsure in class. Other prompts can be geared toward student understandings and misconceptions to help guide the teacher’s lessons and scaffolding of individual students. Prompts geared for student understandings and misconceptions might request students to describe what they know so far or what they are still not sure about. Journaling can also be used to keep a chronological log of student learning. In this case, students would be encouraged to

respond to prompts explaining what that learned or discovered as a means of recording their daily learning in the classroom. All journal entries are a window into the thinking of the students' minds that would otherwise not be available to the teacher without writing being part of the math classroom.

The second type of writing in the math classroom that increases math comprehension is writing the solutions to math problems. This type of writing is important because even though some children can follow procedures and calculate right answers easily, without reviewing their writing it is difficult to know if they understand the meaning of the arithmetic they are using so that they can transfer that knowledge to word problems (Burns 13). Asking students to describe using words and pictures how they went about solving a problem, asking students to provide a written response after analyzing problems completed by a pretend student in which the solutions contain errors, or asking students to write a letter to a new student explaining—without using numbers or symbols—how to do a problem are all examples of writing that provides insight into a students' math understanding. Again, this type of writing not only increases the students math comprehension, but provides the teacher an invaluable assessment tool to further guide her teaching and scaffolding.

The third type of writing in the math classroom that increases math comprehension is writing about math concepts. Math concepts are abstract ideas and challenging for children (and adults) to grasp. Take for example the discussion about the meaning of the number two:

number is an abstraction. No one has ever seen a number and no one ever will.

'Twoness' is an idea. We see illustrations of this idea everywhere, but we do not see the idea itself. In a similar way the symbol 2 is used to elicit a whole series of recollections

and experiences that we have entailing the concept of two, but the squiggly line 2 is in and of itself not the concept. (As cited in Marshall 357)

In order for students to learn logical knowledge, they “ must have opportunities to interact with the ideas with the goal of bringing meaning to them—the source of knowledge and the process of developing understanding are internal to the learner” (Burns 32). Children cannot be told conceptual understanding; they must construct that knowledge for themselves. Writing about math concepts provides pathways for social interaction and opportunities for children to think, reason, and make sense of mathematics. (Burns 32). Both of these activities are essential to bring about conceptual understanding. A writing prompt for this type of writing might include: how are multiplication and division alike and different? Even something as open ended as a prompt such as “what is a number?” provides insight into the thinking process of the student and engages them in thinking about their thinking.

The fourth way writing can be used to increase math comprehension offers a little more fun to the classroom. After learning about a concept and providing concrete practice, students are asked to do a creative writing demonstrating their understanding of the math concept. For example, writing an essay entitled, “If I Were One Centimeter Tall”, or creating a haiku poem about the importance of zero are a couple of examples for this type of writing. The purpose is to provide a fun activity for the student to demonstrate his/her knowledge and insight into his/her thinking.

The fifth way writing can be used to increase math comprehension is to have students respond to literature. By engaging in the writing process, students are able to find gaps in their knowledge which provokes questions and creates deeper understanding. An example might be

having students read the poem, “Smart” by Shel Silverstein. Following the reading of the poem, students would give a written response to the prompt: did the boy in the poem get a good deal? They would be required to explain their answer using words and pictures.

The sixth way writing can be used to increase math comprehension is as a means for assessment. Multiple choice or one right answer tests provide limited insight into the depth of knowledge students’ gain when learning math computational skills. However, when students are asked to provide written explanations during assessments, teachers are able to better evaluate the progress students are making in their math learning. A possible writing assignment in this instance would be to have students write about a math concept prior to a unit of study and then write about the same concept again at the end of the unit of study.

The literature supports my two findings: one, writing activities in the math classroom are required to reduce math anxiety; and two, writing activities in the math classroom are required to improve math comprehension. Moreover, I have applied these findings to my own classroom. Since then, I have seen a significant increase in the positive attitude of the students, belief in their ability to be successful at math, and CRCT scores. In 2008, the first year that I taught, I only began including writing in the classroom toward the end of the year. That year 86% of my students passed the CRCT exam. In 2009, I included the writing activities described in this paper from day one and 92% of my students passed the CRCT exam. This last year, in 2010, I also include writing through the year, but I had more confidence and skill at using writing in my classroom. 96% of my students passed the CRCT. Also in 2010, I decided to gather more information and performed a CRCT math score comparison with the same students when they were in third grade and then again when they were in fourth grade. Seven

students did not pass the CRCT exam in third grade. Only one of those students didn't pass the CRCT exam in fourth grade. Of the six who increased from a failing third grade score to a passing fourth grade score, five moved all the way to the exceeded category! The data from my classroom appears to agree with the research I've read. Writing activities in the math classroom are a requirement for math success.