

Teaching Mathematics the “Write” Way

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### **Introduction**

Data: stanines, bell curves, benchmark scores, cut scores, pre-tests, post-tests... These are all words that echo the hallways of schools today. When looking at our state test scores and district wide assessments, data shows that our students continue to struggle with writing. Knowing that written expression is a weakness for our students and an area where the Common Core State Standards are taking us, our district initiative for the 2012-2013 school year is to incorporate more writing across *all* contents. Yes, all contents, including math. Mathematics teachers are comfortable with numbers and data, but writing? Wondering how to teach, incorporate, and assess student writing in mathematics has been perplexing to say the least. This action research project is an attempt to ease the minds of mathematics teachers and address why writing in mathematics can be beneficial to both the teacher and students as well as how writing can be incorporated into the classroom.

### **Math Question**

Once the math development and curriculum team shared with department that writing would be a focus area moving forward to improve students' writing scores overall, I began to think about how this would affect my teaching and more importantly, my students. I then began to analyze how my planning would need to be adjusted as well as previous lessons in order to incorporate the writing component. As the changes ran through my mind I could not help but question the benefits. “Why is writing in mathematics beneficial and how can it be implemented effectively into the classroom?”

### **Literature Review**

In an article by Marilyn Burns titled, “Writing in Math Class? Absolutely!” (1995), Marilyn shares how she always considered writing and mathematics to be two separate domains.

It was not until after her first 20 years of teaching that she came to the realization that the two combined made teaching and learning mathematics cohesive. She communicates that the two subjects combined provide two major benefits, it supports students' learning and it benefits the teacher because it allows for better assessment of student understanding (pg. 40). The article includes helpful resources that can help any mathematics teacher to begin implementing writing into their classroom. I was appreciative to now have access to these resources which include: nine math and writing strategies, four ways to have students write in math class, answers to questions about incorporating writing in math, and math activities to write about (pgs. 41-47). In the article it was quoted that students agree with Marilyn, that writing helps improve their understanding of math (pg. 43).

Silbey (2003) is a school-based math specialist who agrees with the importance of writing in the mathematics classroom, however, he claims that it begins with talking. “Ensure your students are comprehending their math lessons— talking in the classroom helps ensure math retention in a big way!” Silbey continues to support his argument by stating that communication is so important it is even one of the five NCTM process standards of mathematics, one I feel is commonly ignored or forgotten. He also shares how a new student to his class, a nonnative speaker, was able to pick up mathematics problem solving as he did the basic steps and heard his peers talk their way through the problem solving process. Since conversations are prerequisites to showing thinking on paper, Sibley shares strategies for creating discussion opportunities for students. The strategies mentioned are for creating small-group discussions, every pupil response strategies, the actual writing process, and questions to ask as the teacher, to assess student responses so you can adjust your instruction as necessary. In assessing students' written work, Sibley echoes Burns in that writing in math is a powerful tool

for not only understanding your students’ knowledge but also guiding future instruction. This was the first article I came across that addressed the idea of talking first, so simple yet so novel.

Speaking and writing in mathematics became a popular result as I continued to research ideas for incorporating writing into the mathematics classroom. Kawas (2006) writes that introducing the practice may not be easy but “it is well worth the effort.” Kawas provides a simple way for getting started with math writing which begins by using Think-Pair-Shares and then graduating on to Think-Write-Pair-Shares. This strategy allows students to make the connection between speaking and writing. It also allows the opportunity to capitalize on the oral strength that most students have, especially those that struggle with going immediately to the writing. The “pair” portion also allows students that are more reluctant to share in a large group setting a safe setting to practice before having to speak to a larger group. It also allows students to expand their ideas or create new understandings by hearing what their peers have to say. For the “write” portion, students are presented with options in which they can respond to. The prompts may include making a web, drawing and labeling a picture, creating a K-W-L, or reflecting on personal understanding. These strategies provided by Kawas capitalize on the speaking and writing in math class as well as lends itself nicely to the student population I work with, resource students, due to its scaffolded approach.

### **Data Collection**

I teach an eighth grade resource math class at Lakeshore Middle School in Grand Haven, Michigan. I have a total of 15 students with varying abilities and skill sets. The students in this class receive special education services due to the educational impact of learning disabilities, emotional impairments, autism, speech and language impairments and/or ADHD. Due to the students educational and behavioral needs, the students experience success in a smaller class

with the flexibility of slower pacing to allow for repetition and more hands on activities. Students are interested in learning the same content that their general education peers do, but desire the real-world relevancy, projects, and games to make a difficult subject manageable.

As a math resource class I am responsible for teaching 70% of the general education content and we use the general education textbook. Only covering 70% gives us the flexibility to go at a slower pace, time for more hands-on activities, and spend time on more basic skill sets as they are needed prior to starting a new unit. The resource math curriculum map is closely aligned to the general education map and all directives from the math development and K-12 team are to be followed by resource classes as well. Hence, the incorporation of writing into the content.

Since several of my students have learning disabilities in both mathematics and reading or written expression I was a bit apprehensive of how to incorporate writing and not lose student interest altogether. Increasing the amount of writing opportunities and student output is a part of my annual evaluation goal. I started to gather evidence of student work and data two months ago. To gather data, I used various forms of student work (think-pair-write-share warm-ups, Collin’s Type I and II writings, journal prompts, the “write about it” question out of the practice sections from the Holt McDougal Course 3 Mathematics textbook) pictures and audio of a short interview with students.

I began the year by incorporating writing prompts (assignments and warm-ups) that were not heavy with math concepts to make them comfortable with just simply writing in math class. One of these assignments was a Math Autobiography (samples included in [YouTube](#) video) which allowed me to get to know the students and their math backgrounds.

Before I began incorporating writing that was heavy in math content, I began to implement think-pair-shares as suggested by Silbey (2003). Once students started to become comfortable with this idea I moved on to the think-pair-write-share and began running warm-ups in this fashion. Student samples were taken of the warm-ups (as seen on my [Glog](#)). Another student sample was a journal prompt where I asked students to write whether or not writing should be incorporated in math class, why or why not (also included in YouTube video). I have also been assigning the “write about it” question out of the textbook every time homework is given. Recently, I gave students a chapter test where I created a question that had a written response. I have been collecting student journals throughout the last two months in order to monitor and observe students’ writing and progress. Lastly, and most recently, I interviewed three willing students in order to get insight as to how talking and writing about math has been helpful to them so far this school year (audio included in [Glog](#)).

To focus my data I am going to use the warm-up question of whether they believe writing should be in math as a pre and post test. Also, I will be tracking all of the students journals to see if the volume of their writing is increasing as well as the clarity of content in their writing. I will also continue to include a written response on all unit tests and see if there is student growth in their writing from the first test to the last. To conclude, I will have students reflect on a few selected written pieces throughout the schoolyear to allow them to see personal growth. Students will then write a final assignment about the value they think writing had on their math understanding while using their writing as evidence to support their response.

### **Data Analysis**

When looking at students sharing personal responses, such as the Math Autobiography, the volume of writing ranged from a few bulleted points to a half page. The students that wrote a

lot were typically describing a moment in their math past that they had an emotional connection to. As I slowly began to approach more content specific writings, I noticed the volume of writing to be less. So when I asked my students to tell me whether they thought writing should be in math and why or why not, I was not surprised that only 29% of the class agreed it should. Some of their reasons were: “because it would help with note-taking which is helpful for preparing for tests and learning vocabulary,” “because we need to work on hand writing,” and one student even added, “I mean would I like to do writing in math, no, but you should.”

The majority of the class, 71%, said that writing should not be happening in math class. They justified their responses by stating: “no, because it’s math class not writing class and it wastes time on learning new methods,” “no, because that’s what ELA is for and we would have no time for homework,” “there shouldn’t be writing in math because math is hard without the writing and because writing doesn’t really have to do much with math.”

It was after this student feedback on writing in math, as well as reviewing the literature, that I knew some different strategies needed to be put into place. The first strategy to implement, as stated by Kawas (2006) and Silbey (2003), was to include more oral communication about our thinking. This began with a discussion on what metacognition was and how that played an important role in communicating our understandings. I also began to implement the think-pair-share during warm-ups and graduated to the think-write-pair-share. This worked very well as I have a very vocal group this year. As one of my students shared in the audio clip, he found this process helpful because he got new ideas from his peers so when it came time to write he had more ideas in which he blended with his in his writing.

I also pushed students with their homework by always assigning the “write about it” question that was in the textbook. This would be a launch for discussion the following day. When I began assigning these in the beginning of October the majority of students would skip the problem and as we corrected said they needed help or they were unsure what exactly to write or they didn’t know how to write about it. As you can see from the images in the video I’ve included in my [Glogster](#), students are now coming to class with the “write about it” question finished with at least a line or more of writing.

I also recently included a written response question on a test. I was not sure what results I would get but I was blown away at some of the students’ responses (again shown in the Glogster slide show video). In September students wrote a few sentences up to a half page about their personal experiences and now they are writing even more than that in regards to a mathematical concept, Pythagorean’s Theorem. Just as Burn’s (1995) had said in her article, I was able to see who could navigate a calculator to find just the answers and who really could articulate the what, how, and why. Reading their writing allowed me to see their thought process, understand what they knew and where there were misconceptions if any.

When I interviewed three of my students to get their input on audio, they were sharing evidence of how writing in math has helped them and what strategies specifically. In past classes they were used to writing notes and in warm-ups but never writing of this frequency and not writing for summative assessment. They are not only beginning to see it as beneficial to them but they are also starting to understand how it helps me as their teacher. As I finished gathering data I couldn’t help but ask students again what they thought about writing in math and whether it should or should not take place in the math classroom. To my delight, it was an even split, 50% said yes, and 50% no.



### **Reflections, Conclusions, and Next Steps**

I am grateful for reading the literature written by Marilyn Burns (1995). I am beginning to see the value of tying writing and math together and instead of waiting 20 years like she did to see the impact it has only taken me four. There is progress being made in my students taking small steps in the right direction for being able to think more deeply about a concept and articulate it with words, both orally and written. However, due to the time it takes for my students to get in the flow and master a new procedure or technique, especially since writing is hard for some, I need to continue to incorporate more opportunities for talking and writing. I have made a conscious effort to incorporate writing strategies, journal prompts, and opportunities for talking about math in my daily lesson plans. I have already seen more growth than I thought I would have. I am very proud of my students and know that it is still a great struggle for some.

This is not the conclusion of my research, this is just the beginning. I look forward to the continuation of documenting student remarks, collecting journals, and summative assessments in written form. I will continue to use the plethora of strategies provided by Burns (1995) and others found on the NCTM website to ensure that students have fresh prompts to respond to. My goal is to have at least 90% of my students agree by the end of the school year that yes, there is value in writing in mathematics. After all, it is the “write” way to teach *and* learn mathematics.

### Works Cited

- Burns, M. (1995, April). Writing in math class? Absolutely! How to enhance students' mathematical understanding while reinforcing their writing skills [Electronic version]. *Instructor*, 40-47.
- Kawas, T. (2006). Writing in mathematics. In *Mathwire.com*. Retrieved November 20, 2012, from <http://mathwire.com/writing/writing1.html>
- Silbey, R. (2003, April). Heard the word? Talking and writing about mathematics boosts understanding in a big way. In *Scholastic: Math Out Loud!*. Retrieved November 19, 2012, from <http://www.scholastic.com/teachers/lesson-plan/math-out-loud>.

Self-Assessment of Action Research Project:

This project provided me the outlet that was needed to give quality time into considering and implementing best practices for writing in mathematics. Writing was something that was going to be done in my classroom this year regardless however with this project and the amount of time I spent researching, collecting, and reviewing student work samples, has made me a better teacher. I know understand the importance of writing in mathematics and that it all begins with safe classroom discussions. I also have a plethora of strategies to incorporate discussions and writing that I myself will use and plan to share with the rest of the math department.

I used the rubric to guide my project and final paper. I always aim for the highest, a 4.0. I read the requirements I needed to meet and I continue to question, re-work, and revise until I think the goals have been met. I do feel that my paper is written in a clear and cohesive manner and each section is thoroughly addressed. I also referred to an example paper that you had emailed me as well as the owl resource for correct APA formatting. My reflection and conclusions were also made based from the student work samples and data that I had collected as well as the literature that I reviewed.

When sharing my project with my house members, I used Glogster, a free web2.0 resource, in which you create a virtual poster. I have seen my students make these before in English class, and I was first introduced to Glogster when taking a technology course, however I am not well versed in creating them. I spent a lot of time on my Glogster and felt as if it was well created and clearly demonstrated a summary of the research that had been done, the data that was collected, as well as where I plan to go from here. I also received positive feedback from my housemates in regards to my Glogster. My housemates were also impressed with my student's audio clips and I explained to them how my class operates, how the writing piece has fit in, and how I continue to incorporate writing into my classroom. They really liked the think-paire-write-share strategy and I got a few ideas from Karen as to how I can incorporate some creative writing ideas into summative assessment that she has incorporated into her class as part of discovery learning. Overall I am happy with the work that was done, the Skype presentations, and I feel confident that the work I am presenting to you is of 4.0 quality.