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Writing in Math

Dena M. Downey

"Writing across the curriculum" has become a common buzz phrase in education. Have you heard the saying, "What goes around comes around"? In the field of education I've discovered that it means, "We did that fifteen years ago!" I strongly believe that writing across the curriculum is more than just another fad revival, and it is here to stay because it works. The more students write, the more they learn. I had the opportunity to teach mathematics last year and at first was disappointed that I would not be able to teach writing, but I soon discovered that I could incorporate meaningful writing into the class. Writing in math was an excellent way for students to explore their thinking processes and to unleash the hidden realities behind their learning.

I had just completed my sixth year of teaching primarily language arts and social studies to sixth-grade students at the middle school level. When I was assigned my most recent mathematics position, I wasn't really sure where I was going with writing. I began the year by informing students that it would not be a traditional math class and we would be doing a lot of writing throughout the year in a variety of ways. At first I don't think they believed me, but they soon learned differently!

My very first assignment for the year was a math autobiography. I instructed my students to write a paper about their experiences in math, including how they felt about it and why. This

paper allowed students the opportunity to write about themselves, a topic they knew a lot about. It was also important to validate their feelings about math and let them know that it was "ok" not to like it; however, I wanted them to explore why they had those negative feelings. We began to talk about metacognition and how it was a valuable learning tool, especially when combined with writing. This writing assignment became a great foundation for self-evaluations throughout the school year.

Self-evaluation was a continuous process. It was helpful for students to reflect not only on subject matter but also on personal accomplishments and stumbling blocks. Some evaluations were informal with prompts to help the students reflect on how hard they had been working, what goals they had accomplished, and what had been working well for them or not so well, as well as help them set new goals for improvement. Others were more formal: I had specific questions I wanted them to think about such as their confidence level in math, whether or not they felt their math skills had improved, and what they enjoyed the most/least about math concepts and the class. These evaluations were an excellent way for students to further their metacognitive skills at a much higher thinking level.

Learning logs were used for daily writing assignments. This was a great way to ease the students into writing in math without worrying

about a right or wrong answer. It was simply a place for them to record what we had done in class that day, reflections, and any questions they might still have. I collected these once a week and would comment on their thoughts, not their grammar. Students wanted me to read their entries and, in fact, would question whether or not I had read their learning log if I didn't make a written response. Student responses in their learning logs varied. Some used it to record strengths and weaknesses for each new concept that it taught, others for self reflection, i.e., "I thought that when progress reports came out I had low self-esteem, because I wasn't sure about my grades but either they stayed the same and a few got better! After that my self-esteem level is high because I realize I'm keeping up, which is what I wanna do and the top is where I want to be." Another student used her learning log to reflect and ask questions: "I would like to experiment with Euler's formula...the only thing I am stuck on for Euler's formula is that why do we add faces and vertices - 2? Does that mean no matter what the shape?" It became a comfortable way to communicate about math and created a safe atmosphere for students who were too shy or scared to ask questions in the classroom.

Besides writing for the teacher, students dialogued to one another about math in their logs. Again, this was a great way for students to practice using math terms for clear communication in a written format. Dialoguing gave students the opportunity to see that they were not the only ones who struggled at times, and also provided a chance for a student to consult with others about their thinking processes in computing the answer. In the following example, Dana explains how she got her answer and Julia offers great support. "I learned how I can change a fraction into a decimal. At first I didn't get it because I kept dividing the denominator by the numerator. Then I switched it around." Julia wrote, "Don't forget, you always divide the numerator by the denominator. Good idea you switched it around or you would have them all wrong. I thought it was pretty easy too."

Journals were a weekly activity that I assigned on Mondays and collected on Fridays. They usually involved some exploration at home

and a written summary of their findings although the journal activities varied a great deal. My objective with the journals was to help show students how math was all around them, a part of their "real world." It wasn't just a subject in school. In one activity I asked students to estimate how much they thought it would cost their family to go to the movies and have pizza on the way home. They had to choose their family's favorite restaurant and the theater they normally attended. Then they researched prices, recorded them, computed the total cost, and wrote a written summary of their experience reflecting on their predictions compared to the actual cost. It was interesting to read that many were shocked by how much it cost, and they now understood why their families couldn't go to the movies and dinner all the time. This activity was meaningful for students because they were able to use real things in their world in contrast to conventional story problems with hypothetical situations.

Another activity included finding a "Help-Wanted" ad in the newspaper for a job they might be interested in. Students had to predict how much they would earn weekly, monthly, and yearly and then compute actual wages. They were also instructed to discuss their findings with their parents, asking about taxes and true take-home pay. Finally, I had them record reflections and thoughts on the activity. What a great real-life experience.

One of the most valuable forms of writing to help with metacognitive skills was writing to explain the thinking processes they used to get their answers. Questions that asked students how they found the answer and why they chose those steps helped them focus in on this skill. It isn't easy and it certainly doesn't matter if you're a math whiz or one who struggles. I was one of those students who could compute the answer but had no clue as to why it worked. If our true objective is for students to understand mathematics, then we can't have one without the other; they have to be able to understand the process and the best way for students to gain this conceptual knowledge is through writing. A good example is when I asked students to explain in writing why we multiply by the reciprocal when dividing fractions. When I wrote this question, I

thought it would be simple, but I had difficulty answering it. Finally, I asked my husband, and after some discussion we were both able to come up with a written explanation. Another key factor came into play here in my own discovery: talking about math and using math terms. I found that it was extremely valuable to give students time to talk about math before they reflected on what they were learning. If it worked for me, maybe it would help them as well.

My all-time favorite writing project would have to be math poetry. I taught a short mini-lesson on kinds of poetry: diamante, limerick, free form, etc. Then I showed a few examples of math poetry written by other students. Each student was responsible for turning in at least one mathematical poem by the end of the week. Students were very creative:

"MATHEMATICS"

*I can spell A-B-C
But even better than
that is the 1-2-3's,
Numbers, digits, fractions and more,
they have uses from...
at home to the store.
Problem solving, mental math,
graphs, charts, and things like
that; things like that you
will see are as easy as
1-2-3."*

by Jill Little

I typed up their poems on our school computer and gave each student a "published" book of math poetry. I also gave copies to other teachers in the building, the administration, and other schools. I couldn't believe what a hot item these books became. In fact, students from other classes wanted one and refused to return lost ones they had found. It was definitely a rewarding project for the students not only for the recognition but also because they had to understand the mathematical terms in order to use them meaningfully in their poems.

Other examples of writing included having students create their own lesson plans for a unit

in the math book: writing the objective, a warm-up, the lesson, and a wrap-up. Even though they didn't teach their lessons to other students, they enjoyed teaching me their concepts, and, in turn, I used many of their ideas in future lessons. Students also wrote creative writing stories using at least ten mathematical terms. It was amazing how creatively many tied in these words: "He considered himself a genius since he was able to measure how long his nostrils were by using a ruler and estimating." Another student wrote, "He would create a black cloud that would be in one equal fraction over the town. The cloud would subtract their happiness and make them turn mean like him..." Using math terms in creative writing stories gave students another chance to make the terms a part of their permanent vocabulary.

I have had teachers ask me if students bought into the concept of writing in math. My answer: they had no choice, it was a part of the class. I also explained to the students why it was important to write in math. It wasn't a big mystery. I showed them research that I had found and shared what I had learned at conferences about writing in other content areas and what they were expected to do for the MEAP. I really believe that they felt I was being honest and sincere with them, and they could accept the writing when they understood the purpose behind it.

There are many reasons to incorporate meaningful writing into mathematics and other subject areas. Students learn more about themselves and are able to explore their thinking processes to help them overcome stumbling blocks. It also encourages a risk-taking environment for students to explore and question in a written format to the teacher or other students. I think Sam sums it up the best in one of her learning log entries when she writes, "...in life education is much more important and that's just another one of the things I've realized." Writing gave Sam the opportunity to reflect on her learning and to discover what was meaningful to her.