Math Counts:
Issues That Matter

A Professional Series, Volume 3

WRITING IN MATHEMATICS: A POWERFUL TOOL TO SUPPORT MATH LEARNING

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Why Write in Mathematics?

In mathematics, writing can help teachers understand student thinking as well as broaden student understanding of mathematical concepts. Writing in mathematics, however, is not used as often as more traditional practice sets to enhance student learning. Writing has generally been categorized as a task to pursue in other subject areas such as language arts and reading, but "teachers in every discipline have discovered that the writing process, which emphasizes brainstorming, clarifying, and revising, is a useful tool for learning anything" (Rab). Through mathematical writing students are able to clarify their thinking, communicate ideas or questions they were not able to address in class, summarize and connect ideas, and justify or prove their mathematical ideas and conclusions. Teachers can use writing to collect information about student understanding of mathematics which can inform further instruction. Further, recent research shows that writing can help students more fully understand mathematical concepts and in turn improve their progress and increase their test scores. Researchers have shown that "students who wrote journal entries on topics related to…test questions were more likely to correctly answer those…test questions than students who did not write on the topic" (Croxton). Fitting writing into an already busy math schedule may seem like a challenge, but there are several writing activities that can compliment and support your math instruction rather than be burdensome.

Types of Mathematical Writing

There are several ways mathematical writing may be implemented in the classroom. Writing in the mathematics classroom can serve as a tool to aid in assessment and broaden students' mathematical knowledge. Mathematical journals, when properly used, can be a natural part of any lesson.

Summing Up Daily Instruction

Summing up daily instruction with a journal question before children practice enables students to process and reflect on the lesson content while providing teachers with a way to monitor overall student understanding and correct erroneous thinking before children practice. Journal questions also may be included on occasion in practice sets to allow students to justify and explain their mathematical ideas. One key to integrating journal writing into the mathematics class is to provide students with insightful questions that allow students to summarize the lesson.

Examples of questions to sum up a daily lesson:

- What strategy would you use first to add 8 + 4 + 2? Why?
- Make up a subtraction problem in which you subtract two 3-digit numbers and must regroup the tens and the hundreds. Explain how to solve the problem.
- How are addition and subtraction fact families like multiplication and division fact families?
- Explain the different ways you can express _. Write each method and explain when it would be used.
- Explain how to find 5/6 of 42.

Creating Math Word Problems

Creating math word problems is another powerful writing tool to support mathematical learning. Practicing algorithms does provide an efficient and often effective route to finding correct answers in mathematics, but research has found that when children write about the algorithms, they are able to make greater sense and have a stronger understanding of the meaning behind the algorithm itself (Whitin 161). As is known, students with a stronger understanding of the meanings of algorithms are more successful as they continue to pursue mathematical goals. Writing mathematical problems, or stories, allows "students to relate mathematical operations to real-world situations, communicate mathematical concepts in writing, share their ideas with the peers…" (Golembo 574). For the teacher, student-created word problems provide insight into the depth of student understanding of mathematical processes and helps teachers detect what concepts need reinforcement.

"When children write about the algorithms, they are able to make greater sense and have a stronger understanding of the meaning behind the algorithm itself"

Example of a Create a Problem question:

Create a problem that can be solved using this algorithm.

$$(11 + 1) \div 2 = 6$$

Problem: There were eleven children playing tag in the park. Another child came and joined them. Now there where twelve children playing tag in the park. Everyone then decided to play softball instead and the twelve children broke up into two teams. Then there were six children on each team.

Answering Open-Ended Math Problems

Students also need to learn how to answer open-ended mathematical problems since these types of questions often appear on tests. Textbooks should provide test-taking tips for teachers to use to help students learn how to answer such problems. Finding and explaining answers can be difficult for students since students need to be sure to both find the answer to the problem and correctly explain how they calculated the answer using complete sentences. A strong mathematics program will address these issues and teach students how to formulate and explain a good solution to open-ended problems.

Examples of open-ended questions

Carly and Bailey paid $11.00 for movie tickets. Carly paid the adult price of $7.75 for her ticket. Bailey paid the child's price for his. How much is the child's price for a movie ticket? Explain how you solved this problem.

A piece of cloth is 2 feet 8 inches long. What fraction of a foot is this length? Explain how you found your answer.

Improving Student's Mathematical Writing

To improve upon their mathematical writing abilities students need instruction on how to write clearly and concisely using mathematical language. Students need to develop "mathematical language deliberately…to make the particular meanings they intend" (Burton and Morgan 430). Students need to have feedback on their journals that informs them of errors in understanding or use of mathematical skills, concepts, and procedures. In order to give students such feedback, there are six writing traits to consider when evaluating mathematical journals:

These traits are used to determine students' understanding of mathematics.

1. **Ideas and Content:** Is the math content accurate based on the information given?

2. **Word Choice:** Is math vocabulary accurately and appropriately used to explain the mathematics?

These traits are used to judge students' writing style and grammar.

3. **Organization:** Do the words, phrases, and sentences tie the ideas together?

4. **Voice:** Is the writing clearly the student's own reaction?

5. **Fluency:** How does the writing sound together?

6. **Conventions:** Is the grammar and spelling correct?

Summary

Writing benefits all students by allowing them to reflect back upon what they have learned and gain a deeper understanding of the mathematics. In practice, it has been shown that students who write in mathematics extend their mathematics skills beyond where they would reach by practice alone. One teacher wrote "I found that students with the lowest entering math skills who write journals score as well as many higher-level, but nonjournal writing students" (Rab). Writing is an activity that can naturally be added into a math lesson and will support and improve student understanding. Writing is a effective tool for students and teachers, that helps students to explain and reflect on their own mathematical thinking while giving teachers insight into student's mathematical thinking.

"Students who write in mathematics extend their mathematics skills beyond where they would reach by practice alone."

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