

# Advanced Math? Write!

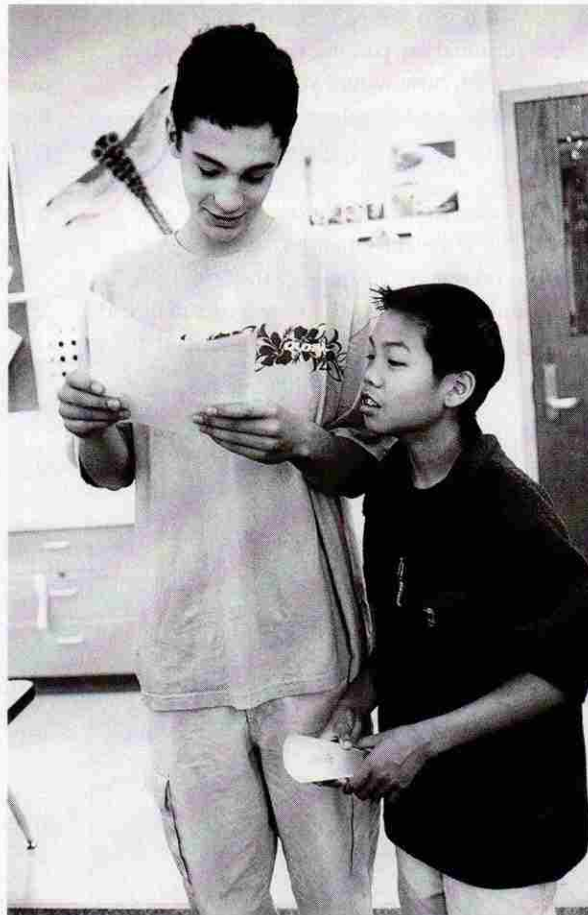
*Writing is an excellent tool for extending and deepening student understanding, especially in math class. Introducing writing into the math curriculum is a long but worthwhile fight.*

**Sister M. Luka Brandenburg**

**S**ister, this is math class, not English!" exclaimed my students as I began to use reading and writing to teach precalculus and calculus. They could not fathom the idea of keeping journals, taking essay tests, and submitting portfolios in mathematics class. I deemed it necessary.

I had learned that students in these upper-level classes could work the problems when I taught the material, but "putting it all together" seemed incredibly difficult. Students found it hard to combine or apply techniques. In addition, they couldn't use the material in unfamiliar situations. When talking to other math teachers, I discovered that these were common problems. Initially, I was not sure what caused the difficulties. Was it the teaching? Were we missing something? Were the students lazy or inattentive?

After doing some research, I decided to try a variety of writing activities in class to see whether the students could think at a higher level and make meaningful connections (Brandenburg, 2001). I, like most other mathematics teachers at the secondary level, was not trained to grade writing assignments, but I persevered, hoping that the assignments would help



## The Battle Plan *Start Small*

If you desire to incorporate writing assignments into your curriculum, I suggest that you start small. At first, I didn't realize how long it would take to grade student writing. Even one journal entry a week can cause grading nightmares when you have more than 100 students and regular assignments, quizzes, exams, and other projects to grade. Start with one class or use a journal for one specific unit. Experiment.

Also, create a specific rubric for your writing assignments before you assign them. Keep the rubric as simple as possible. The best idea is to ask for and grade on one or two points. The more complicated the assignment, the longer it will take to grade.

For information on journal writing in math, I synthesized recent information and came up with my own ideas (see fig. 1). I require students to write in their journal every week on the topics

students understand the concepts more fully and retain the material longer.

In the end, I saw a tremendous increase in students' comprehension and their ability to explain what they knew, but I caution any enthusiastic teacher that the battle is a long one, and you must have a plan.

being covered in class. Keith (1989) suggests brief exploratory writing assignments in which students formally describe their understanding. They may explain a concept, create a formal definition or theorem, generalize a concept, translate a visual image into words, summarize problem-solving tactics,

communicate with a specific audience, integrate reading and writing, or evaluate their own or others' understanding of a topic. Talman (1990) suggests that students summarize the coursework for the week, describe their out-of-class mathematical work, and analyze their mathematical experiences for that week.

### **Be Firm**

My students did not like writing in math class. They griped; they whined; they protested. It was not a pleasant experience. Know this upfront and go in prepared to be firm.

After the first week, I remember meeting an English teacher in the faculty room and asking, "Do they really not know how to write a sentence? Is their spelling really that bad?" I was informed that they were taking advantage of my ignorance. Although it was not my job to grade for their English usage, I found that requiring the following solved a number of problems and cleaned up their work:

- Your writing must be legible.
- You must use correct spelling.
- Your grammar must be correct.
- If you break any of the rules, I won't grade your work.

### **Make It Count**

I require students in all of my classes to create a semester portfolio. (I learned about semester portfolios at a workshop many years ago. I cannot give credit where credit is due because I took the idea and tossed the handout, but somewhere in the United States, a group of teachers has my gratitude.) This assignment is not the typical portfolio; it is not a collection of student work. Rather, students are obliged to take each topic covered during the semester, explain it in words, and demonstrate it mathematically. The written part of the portfolio must be typed, and the end product must be bound and presented in a professional manner. The portfolio is worth half of their semester exam grade.

Every three weeks, I give my students an essay exam that I call a "Critical Thinking Test." I allow students to bring

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a page of notes on which they may write whatever information they choose. The exam consists of three to five essay questions, such as

- What are three methods for solving the sides and angles of a triangle? What information do you need for each? How can you tell which method to use?
- If you were given an angle with a terminal ray passing through the point  $(-3, 8)$ , how would you find the six trigonometric values for the angle? Don't do any calculations.

### **Forewarn Colleagues**

The semester portfolio, in particular, requires long-term organization, thorough understanding of the material, and a lot of hard work. I tell students that the project takes a minimum of 40

### **Journal Prompts in My Arsenal**

- Summarize the material. What confused you? What do you understand better?
- Write a letter to an Algebra II student explaining—without using numbers or symbols—how to do a problem. The recipient must be able to solve the problem using just your letter as a guide. Summarize the results.
- Rank topics covered in class in order of least to greatest importance. Explain why you ranked them that way.
- Analyze three problems completed by the teacher in which the solutions contain an error. Show the error and explain how you found it.

hours to complete, and I strongly encourage an early start. By this point, most of them know that this is no idle threat. Those who start the night before find themselves still hard at work the following morning. The first year that the project was required in all of my courses, attendance at school dropped drastically on the due date. In fact, I found it necessary to forewarn my colleagues of the due date and impose stiff penalties for late work to ward off massive absences.

### **The Aftermath**

My students learned to formulate and express their mathematical thinking in a clear-cut and substantive manner using correct vocabulary. They became mathematically literate. By forcing them to demonstrate their comprehension through writing, they learned to pinpoint any confusion, compare and contrast mathematical methods, and ultimately deepen their understanding and retention (Brandenburg, 2001).

I learned, too. I made discoveries about how students learn mathematics that I never would have without the writing assignments. Was the struggle worth it? Yes! ■

### **References**

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