

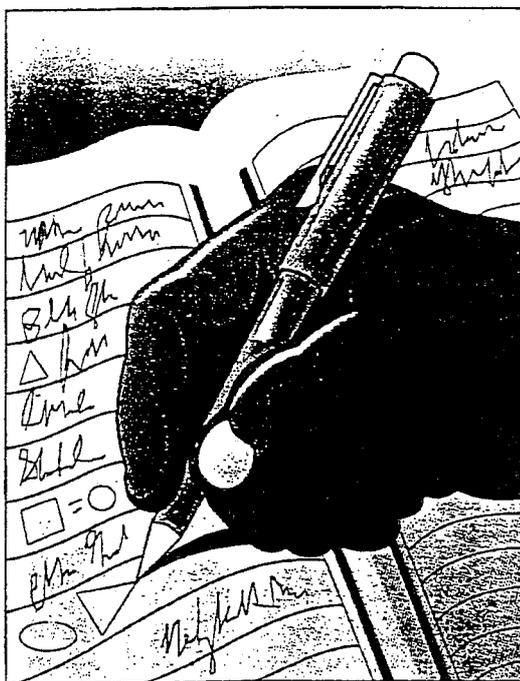
Patricia Pokay
and
Carla Tayeh

Jim
F-11

PRESERVICE ELEMENTARY TEACHERS: BUILDING PORTFOLIOS AROUND STUDENTS' WRITINGS

Traditionally, college mathematics courses have rarely asked students to write or to reflect on their learning, concentrating instead on textbook exercises and problem sets in a lecture format. The intent of this study was to model the use of portfolio assessment in a college mathematics course for preservice teachers while focusing on the contributions of the students' writing in the mathematics classroom. In the study, portfolios were the vehicle for organizing the students' writings.

The release of the NCTM's *Curriculum and Evaluation Standards for School Mathematics* (1989) spurred a reform movement that calls for instructional practices to shift from "teaching by telling," memorizing rules, and relying on follow-the-example exercises to emphasizing open-ended problems, written and oral communication, active engagement, and mathematical connections. Evaluation is redefined as an integral part of teaching and of improving instruction. The inability of past assessment measures to reflect students' understanding of mathematical concepts and procedures has led to a push toward



alternative assessments in mathematics, including open-ended questions, projects, self-evaluation and peer evaluation, performance assessment, observation, interviews, and portfolios (Clarke, Clarke, and Lovitt 1990; NCTM 1989; Stenmark 1989). Implementing the *Curriculum and Evaluation Standards* will require that teachers be receptive to these alternative approaches to teaching and to assessing students' learning. The reform movement focuses on learning and teaching K-12 mathematics, and the education of preservice teachers affords an

ideal place for intervention. If future teachers are to implement these recommendations in K-12 classrooms, they first need to see these practices modeled during their training.

A growing body of evidence suggests that writing in the mathematics classroom facilitates learning and serves to improve communication between student and teacher (Azzolino 1990; Geeslin 1977; Johnson 1983; McIntosh 1991; Mett 1987; Miller 1991; Nahrgang and Petersen 1986). Writing is a unique tool in mathematics classrooms because it allows students to record, reflect on, and modify their ideas about mathematics. In this way, it helps to clarify relationships and make connections among concepts (Emig 1977; Rose 1989, 1991). This type of reflection and modification is important in developing thinking and reasoning skills, skills the *Curriculum and Evaluation Standards* has articulated

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FIGURE 1

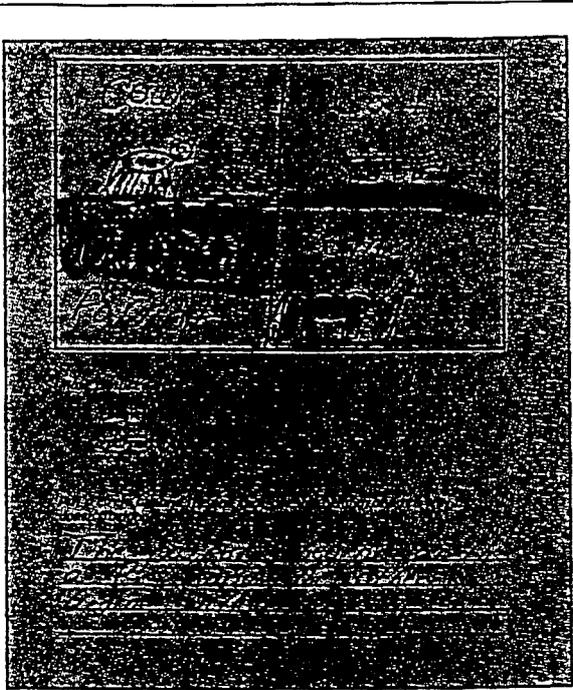


FIGURE 2

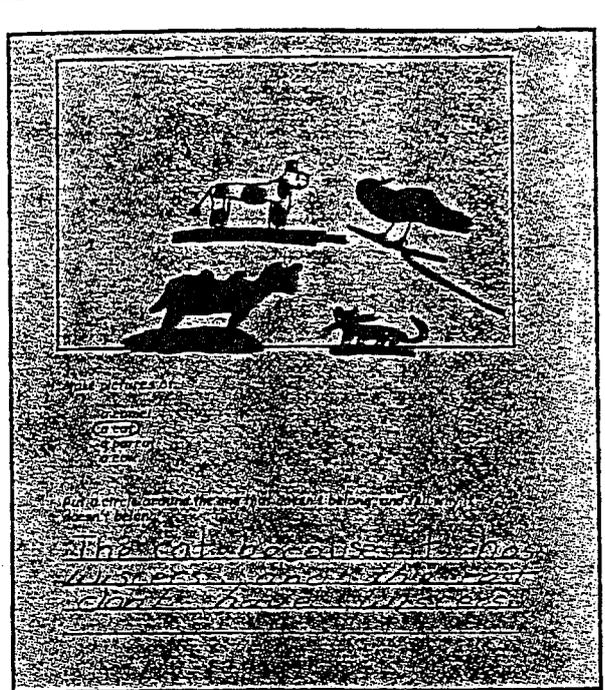
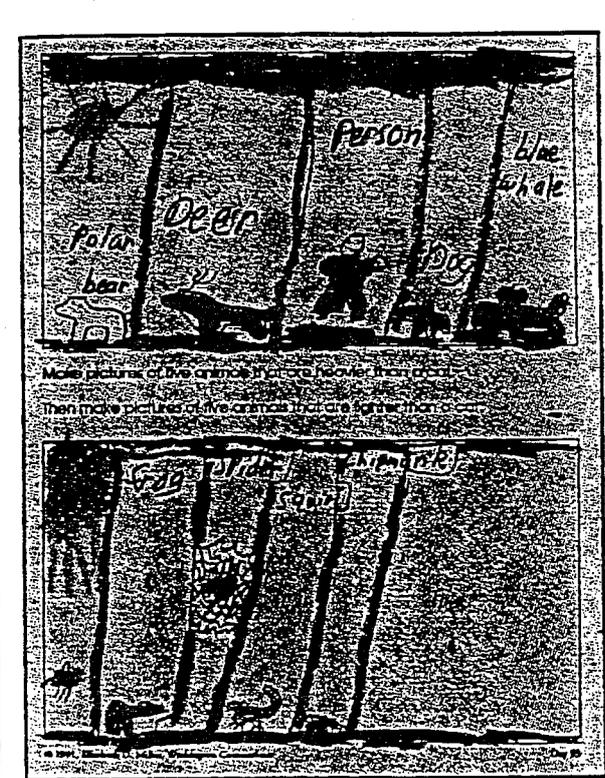


FIGURE 3



FIGURE 4



Reasoning and justifying solutions are part of their everyday lessons, and students are not intimidated when they encounter new concepts. I have seen this attitude spill over into all areas of the curriculum.

At the time this article was written, these materials were not commercially available. They are the sole work of the author. For additional information on this program and a sample of the materials, send a self-addressed stamped envelope to Elizabeth Miller, 49 South Street, Washington, CT 06793. ▲

as being important in mathematics. An argument can be made that writing is even more important in mathematics classroom for preservice elementary teachers (Burton 1985; White and Dunn 1989). Ideally, these students should learn the mathematics content while reflecting on themselves as learners of mathematics and as classroom teachers.

This goal of encouraging preservice elementary teachers to reflect on the mathematics and on the learning process prompted the initial use of portfolios built around students' writings. Portfolios help students develop the ability to assess their own work as well as help them visualize the learning that has taken place during the semester (Wolf 1989). Most studies on student portfolios have, however, focused on elementary and secondary classrooms or have been found in college courses in the arts and humanities. The focus of this study was on using portfolios with preservice elementary teachers to encourage them to reflect on themselves as learners of mathematics and to begin to reassess their role as a classroom teacher.

The purpose of this article is to share what was learned about using portfolios and writing with preservice teachers. Specifically, the procedure that was used and information about what was learned from student self-evaluations about the students and teaching will be presented.

Project Background

To explore the use of mathematics portfolios with preservice elementary teachers, a geometry class was chosen that is required of all elementary education students majoring or minoring in mathematics and that is usually taken during the sophomore or junior year. Thirty-six students, thirty-two females and four males, enrolled in the course, which focused on topics in informal geometry. Instruction emphasized group work. Students were to develop their own theories and discover connections among geometric concepts and express these connections in writing. For example, students were given a word bank—*transformation, isometry, rotation, reflection, translation, congruent, and similar*—and were told to write a paragraph that showed how these concepts were related. The instructor overtly focused on (a) mathematics as a process, such as the ability to invent procedures and make generalizations and the ability to reason and problem solve, and (b) the importance of motivational factors, such as self-confidence and perseverance. Class procedures included problem-solving activities, active involvement in learning mathematics concepts, open-ended problems, and cooperative groups.

Out-of-class activities involved reflection papers and journal entries in addition to the more tradi-

tional homework assignments. Reflection papers consisted of weekly essays in which the students wrote about what they learned and how they felt about the material for that week. Some students summarized key ideas, and other students discussed pertinent questions that they had with respect to the material. Journal entries were also written on a weekly basis. These entries were different from the open-ended, free-writing nature of the reflection papers because they included responses to specific prompts. The prompts were often related to mathematics content—for example, Explain why five and only five Platonic solids exist—and to student attitudes—for example, What have you accomplished in this class over the last two weeks that has made you most proud of yourself?

Each portfolio comprised two parts. The first part, usually referred to as a *working portfolio*, consisted of a collection of student work that included reflection papers, journal entries, homework, and tests. At the end of the course, students were asked to use their working portfolio to develop an evaluation portfolio by analyzing their learning throughout the semester. In the evaluation portfolio, students were asked to select items that gave proof or evidence of (1) their problem-solving ability, (2) their confidence in their mathematics ability, (3) their determination to stick with a problem, (4) their most valuable experience in the class, and (5) an activity in which writing helped them to learn. For each item selected, students wrote letters explaining why they made that selection.

When students turned in their evaluation portfolios at the end of the semester, the instructors read through the students' writing looking for themes and noting general impressions. Students obviously had learned a lot from this procedure. In addition, their work revealed insights about teaching methods and students that would not have been gained through more traditional methods of evaluation.

Learning about Students

As students' responses were read, the instructors were struck by the realization that much of what students chose to write about would have remained unsaid had they not been asked to write. These topics included (1) feelings concerning mathematics, (2) reflections on processes used to solve problems, (3) activities that took place outside of class, (4) students' expressions about themselves as learners, and (5) students' expectation of themselves as future teachers.

1. *Students' writings expressed their feelings about mathematics.* Although group work and activities in the classroom allow instructors to observe

The journal included responses to specific prompts

students' interaction with the material, recognizing when an experience makes a long-lasting impression on a student is less clear. Students' writings, however, demonstrated clearly how specific topics and activities touched the students in ways not usually observable. For example, following a lesson on tessellations, one student wrote the following:

My brother has a shirt with an Escher drawing on it. When I first saw it, I thought it was a different kind of strange-looking picture. But once I found out what the whole picture was made of, I began to look at it quite differently. It seems strange that you can look at something 100 times and see the same picture, but when you begin to learn more about it, you look at it in an entirely different manner.

Another student similarly expressed her awe of mathematics in this statement:

Patterns have been around for a long time. They are not theories, they are facts. Patterns are some of the few things that have always existed without doubt. How can you not appreciate that?

Not only did writing allow students to express positive emotions concerning mathematics, but it made the teacher aware of students' recognitions. Another type of emotion was also represented in the writings of students:

I chose this problem because I have never been more determined to stick with a problem in my life! I will remember this hideous, horrendous . . . problem forever, because I was determined I would get this tangram puzzle if it killed me. I don't think I've ever been more frustrated!

Such emotions would likely not have been expressed in a class full of students. In each situation, writing allowed the student a chance to express feelings and the teacher a chance to recognize, and possibly respond to, the student in a private way.

2. Students' writings helped illustrate how students were processing information and solving problems. Often, students are asked to "show their work" to demonstrate their understanding. In this study, students' explanations of their problem solving allowed the instructors to see more clearly how they were going about doing their work. For example, one student gave the following explanation:

I spent almost the whole entire hour trying to figure out how I was going to solve that problem. (I still got it wrong!) I tried to imagine it folded up, tried to come up with different equations, tried to break it up into separate sections and many other techniques. I do it [problem solve] to the best of my ability or until I exhaust all other possibilities.

Another student wrote the following:

I didn't know an easy formula to solve these problems, so I broke them down into smaller problems I know how to do. I then combined the knowledge and answers I gained and came up with the answers for the larger, original problem.

Thus, not only can students become more aware of their own procedures by explaining them on paper, but the instructors are able to monitor the processes that students use and help them with study skills needed.

3. Students' writing informed the instructors about activities outside the classroom. Another aspect of students' learning that became evident through students' writings focused on learning and activities that took place outside the classrooms. Often, students are observed working in class, but their activities in the days between class sessions remain unknown. Students' writings gave a glimpse into the student's life between those class sessions. For example, when asked to explain why she chose to discuss a certain problem, one student responded thus:

I chose this problem because I worked on it for several days. I even went to the mathematics tutor in the library, and she couldn't do it. It took me about two days to find the answer. I learned that the problem was a combination of two problems. I knew that I was patient but to work on the problem for two days and come up with the correct answer was a wonderful feeling.

This example not only showed persistence on the part of the student but also how she felt about her effort. Another student voiced a similar process:

Even though I knew how to do this problem, my answer never came out even. I searched and searched geometry books and other mathematics books to see if I was doing it wrong. I came to find out I had done the problem correctly.

A third student gave this explanation:

I had done all my other studying for the test and was left with figuring out this sphere problem. I read the section about it over and over in the book. I studied my notes over and over, too. I had read it so many times, I had it memorized. I wasn't happy with just memorizing the process, though. I wanted to understand it. I had been in my kitchen working on it. I got frustrated and left the room to do something else. When I came back I studied it again and finally something clicked.

All these examples furnish information about students' learning that would not have been apparent had course activities included only the traditional chapter problems and assignments. These examples demonstrate the persistence that students exhibit but teachers do not usually know about.

4. Students' writings revealed how students felt about themselves as learners. As has already been suggested in some of the previous examples, insights were gained into how the students viewed themselves as learners of mathematics. One student wrote this response:

I felt more confident knowing I could derive a formula instead of just using a formula to plug numbers into.

Although this example focused on the student's realization of the importance of the process in mathematics, other responses offered insights into the emotional impact of mathematics and of classroom learning in general. Probably no example is as telling as that of a student who wrote the following:

I didn't know the formula for the problem, and I panicked. When I panic, I always feel like a failure in mathematics. I kept trying different ways to derive a formula, and I kept looking at the clock, which didn't help. Finally I got an "ah ha!" moment and came up with a formula for the problem. I felt so relieved and a little smarter and not so much a failure. In fact, I realized I could do these problems and I wasn't stupid after all.

The anxiety evinced in this student's statement, and the fact that the student making the statement was majoring in mathematics, gives some insight into what many "average" students must be feeling when confronted with similar situations.

5. Finally, students made comments that afforded a glimpse into their feelings about becoming teachers. Some of these comments were realizations about themselves as teachers, whereas others focused on techniques that they would carry with them in the future. For example, one student made this comment:

I've learned that I have a hard time explaining concepts. There were a couple of times when I understood something better because of writing it, but the biggest observation is that I can't explain things very well.

In a content area in which so much information can be communicated symbolically, this thought probably would not have been realized had students not been asked to write about and explain their understandings. A second student relayed an experience that demonstrated her recognition that all students might not learn as quickly and easily as she did:

We were working on geoboards with rubber bands—my very first time. I'm thinking, "Piece of cake." Could I, who pride myself on quick mind skills, see a formula brewing? No—I was "blind," "dumb," "not trying hard enough. . . ." Now all these filtered through my mind . . . and I defeated myself, and literally gave up. Valuable experience to me? Yes . . . and it gave me a real insight to others' [students'] experience.

Finally, other students made direct connections to the importance of mathematical processes for their future students:

I think that this [focusing on the process] was important because not only did we find areas but demonstrated how we got the area. For kids, to find an area is great, but to understand where the formula came from is very important.

Perhaps when this student becomes a teacher, she will be more likely to recognize the need for students to understand the "why" of mathematics as well as the "how to."

Learning about Teaching

Although student's responses in evaluation portfolios give their teachers insights into students' learning and motivation, these responses also furnish information that can be used to improve teaching: (1) students' understandings and misunderstandings, (2) the effect of various teaching techniques, and (3) the effects of different types of writing.

1. *Students' writing demonstrated students' misconceptions and understandings.* Insights into students' understandings of mathematics concepts can often be more easily detected through their writing. Several themes emerged when students were asked to write about, and give evidence of, their problem-solving ability. After reading students' responses, the instructors learned that students often attached their own meaning to such terms or concepts as problem solving—a meaning that often conflicted with the spirit of the *Curriculum and Evaluation Standards* (NCTM 1989). Some students identified problem-solving ability in terms of how quickly the problem was solved:

I chose this problem because I found the formula very quickly.

Other students discussed successes in areas with which they normally had problems:

I have not done very well in these types of problems, when I have to generalize, but I succeeded at this one.

In contrast, other students showed their understanding of problem solving by focusing on traits that they believed characterized good problem solvers:

I enjoy thinking about why something is done and how it could be done differently. I like to look at problems in different ways to come up with similar answers and justifications.

Once misconceptions have been identified through students' writing, the teacher is in a position to clarify and be more explicit so that students understand the terminology presently being used in the literature.

2. *Students' responses can be used to improve instruction and evaluation in the classroom.* Whether students were asked to identify something that they found particularly valuable or difficult or that builds confidence, certain instructional topics were mentioned across categories. A surprising amount of agreement occurred in the topics chosen. For example, many students chose to write about Platonic solids and tessellations. This similarity of choice indicated which topics students found enjoyable and which ones they had difficulty understanding. In this way, future lessons can be manipulated to

We value
problem
solving,
communi-
cation, and
confidence

take account of this input.

In addition, students' explanations provided insights into which facets of an activity students thought worthwhile:

I believe the most valuable part of this class was the relationships to three-dimensional qualities. Every time we covered something in two dimensions it was then presented in three-dimensional form. Two- and three-dimensional subject matter was addressed side by side. I never realized how much more beneficial this approach could be [to learning].

Although the instructor can often tell when students like an activity, only students' writing presents a window for observing the connections students are making within a topic.

A final theme that dealt with teaching pertained to students' evaluation. Although no questions were asked that specifically focused on evaluation, students' comments often drew on these experiences in response to other questions. When they were asked to write about, and produce evidence of, their confidence in their mathematics ability, many students cited an evaluation experience in which they received a "good grade" or a time they did better, or got a better grade, than they expected:

I chose our last exam [as an example of my confidence] because I was the third person done with the exam and . . . because I received an 89% . . . no one I talked to received anything above a 77%.

Although not surprising, the fact that students focused solely on teacher evaluation as a means to validate their mathematics ability is unfortunate. The instructors had hoped for examples of students' validating their own ability instead of depending on the grade as evidence. This type of finding makes it clear that if teachers expect students to internalize confidence and not depend on external signs like grades, they may need to take a more active role and help them develop confidence in class.

3. *Different types of writing assignments yielded different benefits and effects on students' learning.* Students were asked to respond in writing in several different ways both in class and outside of class. When students were asked to write a reflection paper, they reported that this process helped them to monitor and "keep track of" their learning better. Some students chose to summarize what they learned during the week, whereas others chose to write about a specific topic or experience:

My writing has allowed me to stop and think about what I have done in class, organize my thoughts, and summarize them. This gives me time to think about what I've learned and the way I've learned it.

Such in-class activities as writing a paragraph using a word bank helped students to see connections between and among concepts:

By writing a paragraph with all of the terms, I saw how these terms were related. I made a connection between them all rather than memorizing one term at a time and failing to see a relationship.

When students were asked to write journal entries, they reported that the activity helped them to find flaws in their learning. Finally, the letters written in the evaluation portfolio allowed students to review their own work and reflect on their learning across time:

By completing these six letters, I had to go back through the whole semester's work. I was amazed at all of the different things we had done and what I had learned.

Conclusion

The intent of this article is to share what can be learned from using portfolios coupled with writing in the mathematics classroom. Portfolios have been the focus of much attention recently in areas as diverse as writing and science. Proponents have recognized student self-evaluation as the major advantage of this type of assessment. However, some teachers may interpret *mathematics* portfolios as a collection of assignments, often with little or no writing required. With the NCTM's emphasis on alternative assessments and more open-ended activities, the merging of writing and portfolios is a natural way to move toward implementing the curriculum and evaluation standards (NCTM 1989).

Although portfolios afford an excellent way for students to monitor their own learning, they also serve several purposes for teachers. First, portfolios are an excellent tool for communicating to preservice teachers the value of problem solving, communication, and confidence. In addition, as shown in this article, teachers can learn a great deal about both their students and their teaching by reading what students have to say about their learning.

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Writing in Math Class?

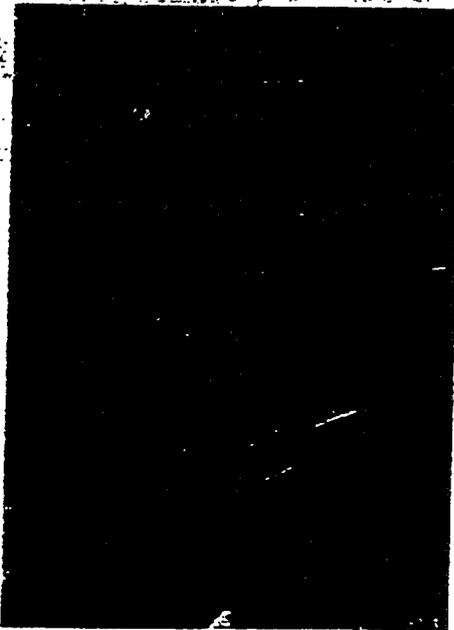
Absolutely!

How to enhance students' mathematical understanding while reinforcing their writing skills

By Marilyn Burns

For my first 20 years as an educator, I separated math and writing into opposing camps, convinced that they went together like oil and water. Now I can't imagine teaching math without making writing an integral part of it.

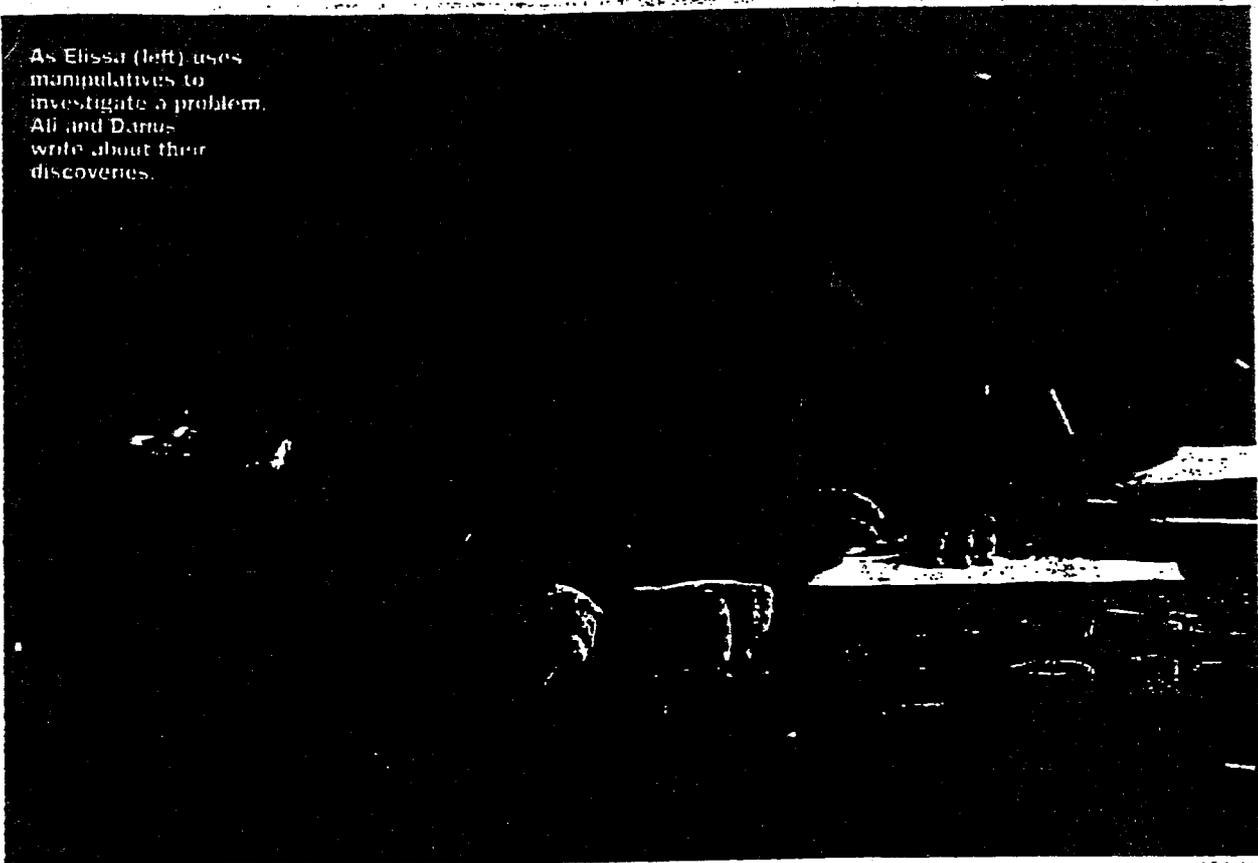
I've found that writing in math class has two major benefits. It supports students' learning because, in order to get their ideas on paper, children must organize, clarify, and reflect on their thinking. Writing also benefits teachers because stu-



A window on students' learning: Marilyn offers Lindsey feedback on her paper.

dents' papers are invaluable assessment resources. Their writing is a window into what they understand, how they approach ideas, what misconceptions they harbor, and how they feel about what they're discovering. Over the decade that I've been asking students to write about math, I've learned a great deal. In this article, I present nine important strategies, the answers to commonly asked questions, four different types of writing assignments for math, and math activities that lead to writing.

As Elissa (left) uses manipulatives to investigate a problem, Ali and Darius write about their discoveries.



9 Math and Writing Strategies

1 **Talk with students about the purpose of their writing.** Make sure students understand the two basic reasons for writing in math class—to enhance and support their learning and to help you assess their progress.

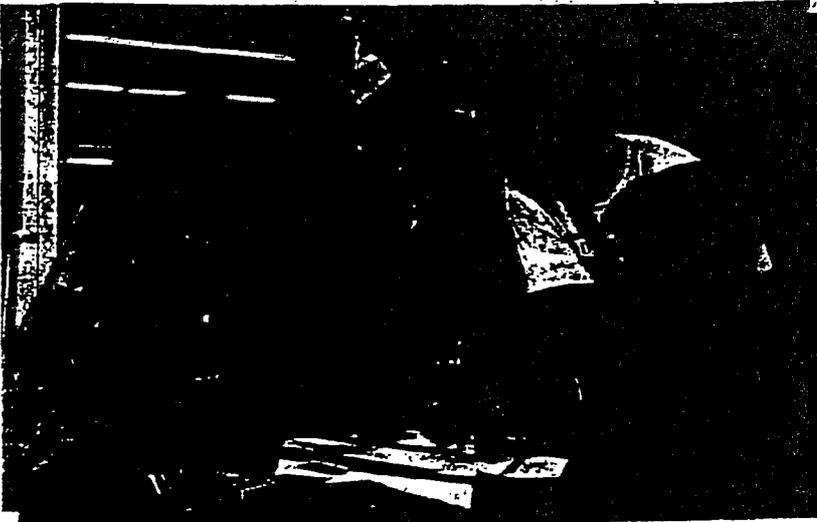
2 **Establish yourself as the audience.** Explain to students how their writing helps you. Tell them, “What you write shows me what you’re learning and what you understand. It helps me think about how to better teach you.” During class it’s hard to listen to all students describe their thinking, so point out that their

writing should include as much detail as possible.

3 **Use students’ writing in classroom instruction.** Children’s papers are effective springboards for class discussions and activities. Using them in this way reinforces to the students that you value their writing. Hearing others’ ideas shows children different ways to approach problems. Ask children to read their papers aloud. For example, when I asked fifth graders to trace one of their feet on centimeter-squared graph paper, figure out its area, and then describe the process they used, Nelson wrote that he had

counted whole squares, added up partial squares that equaled whole ones, and used these numbers to calculate the area. Amy wrote that she had drawn a rectangle around the outline she’d traced and found its area. By listening to what others wrote, students learned about different methods they could have used. This inspired a few to revise their work.

4 **Have students discuss their ideas before writing them.** For most children, talking is easier than writing, and class discussions allow students to express their ideas and hear others. After a discussion, remind children that they may write about any idea they heard, as long as it makes sense to them and they can explain it.



When this group of students got stuck, Marilyn talked with them to prompt their thinking.

For example, when a third-grade class read a book written in 1979, I asked, "How long ago was that?" (It was 1992 at the time.) Before having students write their responses, I had them share their thinking. Lisa said she counted from 1980 to 1992 and came up with 13 years. Leif started counting at 1979, and got 14. James said he knew it was 13 because his sister was born in 1979 and she was 13. Lauren argued that it depended on when in 1979 the book was written and when in 1992 we were reading it. After a 15-minute discussion, children wrote about the problem.

5 **Provide prompts.** To help students get started writing, put a prompt on the board, such as, "I think the answer is _____. I think this because _____." (Don't demand that students use the prompts: What's important is that their writing, no matter how they express it, relates to the problem and makes sense.)

Sometimes prompts may be more specific to the assignment. For example, I had fourth graders each take a handful of cubes, record the number of cubes they grabbed on a class graph, and use the graph to figure out how many cubes there

were in all of the handfuls. I wrote: "We have _____ altogether. We figured this out by _____."

After I write a prompt, I remind students to describe their thinking with words, numbers, and, if they like, pictures.

6 **Give individual help to students who don't know what to write.**

First, talk to students to make sure they understand the assignment. Then try additional prompts, such as: "What do you think?", "What idea do you have?", or "What do you remember about what others said?" Once children offer ideas, suggest that they repeat them in their heads before writing them down. I add: "Let the words go from your brain past your mouth, through your shoulder, down your arm, and out through your pencil onto your paper." It's graphic and it works!

7 **Post math word lists.**

Post a list of the different areas of math you're studying—numbers, geometry, measurement, probability, and so on. Then start a word list that directly relates to each. Encourage students to consult the charts for vocabulary and spelling.

8 **Ask students to revise and edit.** If possible, when children hand in their papers, have them read their work aloud to you. Whenever their papers do not give complete or detailed information—which I find happens more often than not—ask students to revise. You might say, "That's a good beginning," and then give guidance by adding: "Write some more about why you're sure that's correct" or "Give some details or examples to help me better understand your idea."

Depending on the child and the assignment, you might ask a student to make spelling and grammatical corrections. My policy is that students should underline words they don't think they've spelled correctly. Because the purpose of their writing is to give me insights into their understanding—not to be published—sometimes I ask children to correct it and other times I don't. Making a decision in each case is part of the craft of teaching.

9 **Read students' work to evaluate your teaching and to assess progress.**

Reading class sets of assignments gives you an overview of how the class responded to particular lessons and helps you evaluate the effectiveness of your instructional choices. It also gives you information on each child's understanding.

File students' papers in their individual folders. Keep the papers in order so you'll have a chronological set of work. Reading individual student work done over time gives you a sense of the child's progress.

4 Ways to Have Students Write in Math Class



Michelle uses words, numbers, and pictures to explain why $\frac{2}{3}$ is larger than $\frac{1}{4}$.

Writing the solutions to math problems. When writing solution to problems, students should not only present answers, but should also explain their thought processes.

Writing math essays. From time to time, ask students to write about a

students that they're not expected to know everything yet.)

Writing about learning. It's helpful occasionally to give a writing assignment that doesn't focus on a math concept or problem, but instead on some aspect of students' learning processes. For example, you might ask children to write about which was their most and least favorite activity in a unit and why. Or have them write about what makes a good partner or how well they worked with their partner or group. Sometimes you might have students write the directions for an activity or game they can teach to someone at home.

Writing in journals or logs. Journals or logs help students keep ongoing records of what they do in math class. When students begin to write in their logs, give them general reminders, such as, "Write about what you did, what you learned, and what questions you have"; "Include something you learned, you're not sure about, or you're wondering about"; or "Write about what was easy and what was difficult for you in solving this problem."

At times you may give guidelines that are specific to the lesson, such as: "Explain why Elissa's answer made sense," or "Write about why Lindsey and Daniel disagreed." It's helpful to some students if you write these suggestions on the board for them to refer to.

mathematical concept. Their responses are excellent re-sources for assessing what they understand.

During a probability unit, for example, I asked third graders to write about *equally likely*. "Explain what it means," I said, "and give an example." At the end of a unit on division, I asked fourth graders to write about how multiplication and division were alike and different. In the middle of a unit on fractions, I asked fifth graders to write "What I Know About Fractions So Far." (This title conveys to

Math-Writing

What writing does for me is it unlocks my brain and it lets me think. But if I didn't write, I would be getting nowhere. I wouldn't learn anything. I mean I wouldn't think so hard if I didn't write. I would just play the game even if I didn't know how because I wouldn't have to write. But when you write it just makes you think.

Students agree with Marilyn—writing helps them better understand math.

Marilyn Burns Answers Your Math and Writing Questions

What can I do about students who have difficulty writing? I don't want to turn them off to math.

Helping children learn to write is one of the basic responsibilities of school. In order for their writing abilities to improve, students need many different types of experiences, and incorporating writing into math class provides a ready source. What's important is that students understand that part of learning math is learning to communicate ideas.

What about my primary-grade students?

To help support emerging readers and writers, I tell students that what they put on their paper should help them remember their thoughts about a problem. I instruct children to use words, numbers, and pictures to record their ideas, and I make time to have them explain to me what they've written. At times, I'll take dictation for a child.

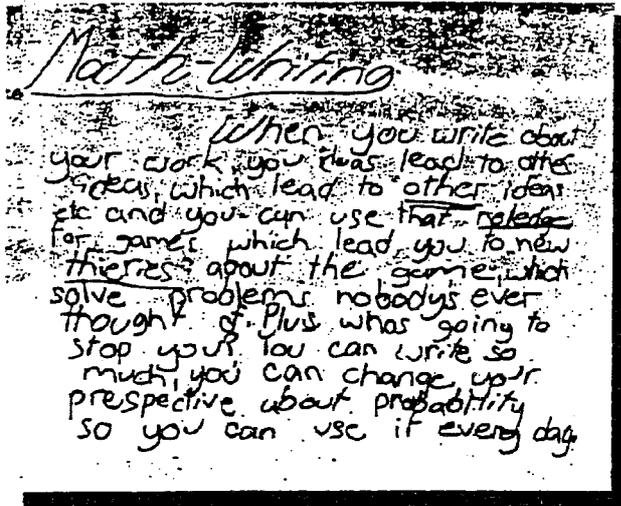
Is it appropriate for children to write in pairs or in small groups?

Yes. I often have students work and write cooperatively. Sometimes

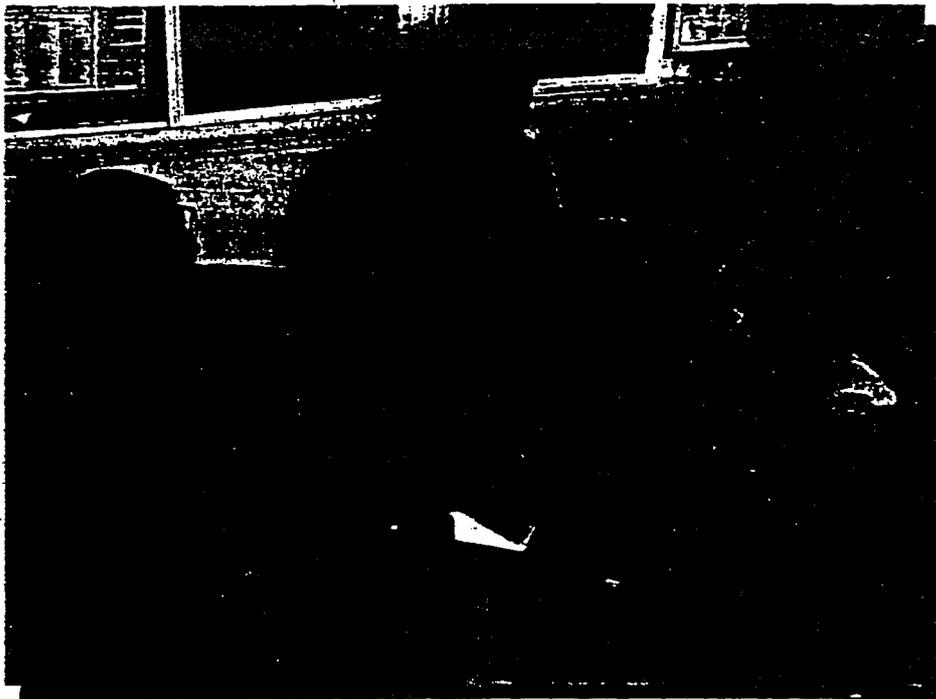
students talk together and then write their own papers. At other times, I have pairs or a small group of children collaborate on one assignment. In that case I make photocopies of the paper to put in the file folder of each child who contributed.

How often should I have students write?

My decision about how often students should write depends on the math they're studying, the purpose of their



writing, and their comfort with writing. Sometimes I have students keep logs and write daily about what they do. Other times I have them write once or twice a week about problems they're solving or to respond to a question I've raised.



Above, Dan explains why writing is beneficial. At right, students talk about their ideas. Later they'll write about them.

Why Should Students Write in a Math Class?

Writing:

- allows students to ask questions without fear
- clarifies students' thoughts about mathematics
- engages all students in the learning process
- gives teachers a better understanding of their effectiveness
- provides one-on-one opportunities without taking away class time
- allows students to express their feelings
- gives teachers another instructional method
- allows students to monitor success through use of portfolios
- benefits students who are tactile learners
- prepares students for open-ended problems
- forces students to use higher-level skills
- emphasizes the process as well as the end-product
- follows the California Mathematics Framework & NCTM Standards
- activities can be FUN

"But I Teach Mathematics. NOT ENGLISH!"

Common Concerns

- Having students write will take away from class time, won't it?
- I will have piles of papers to read and grade.
- I will have to correct errors in spelling and grammar.
- You have never had MY students.
- My writing skills are not very good.
- Must students write every day?
- I am not creative enough to come up with writing activities.

Conclusion

The use of writing as an instructional tool is different for everyone. What works for one class or teacher, may not work well for another. Try all sorts of activities to find the ones that best fit your students' learning styles and needs. If you find an activity that does not work well with a class, move on to another or revise the activity for use later.

Teachers can always find reasons why *not* to try something. The key is to get your feet wet and experience first-hand the benefits writing can have for both you and your students. I am not suggesting that writing is the instructional tool we have all waited for; however, I can say it has helped my students "learn and understand" mathematics.

Tom R. Bennett
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EXAMPLES OF WRITING ACTIVITIES

Writing Prompts

The options here are endless. Writing prompts work exceptionally well at the beginning of the class to focus the students on mathematics or at the end of the period to assess their understanding of the lesson. Any time you need information from your students, a writing prompt will serve as the perfect tool. (See examples)

Compare and Contrast

Students can write a few paragraphs comparing and contrasting two correct ways (or a correct and an incorrect way) of solving a math problem they are given. Comparing and contrasting also works well when there is more than one method to find a solution, and you want the students to be able to determine which method would work best in a given situation. (See example)

Create a Story or Story Problem

Have the students create math story problems relative to the topic being discussed for another student to solve. Once solved, the two can collaborate and discuss the solution.

Give the students a graph or diagram and have them create a story to go along with the given information. One suggestion: tell the students to be creative while accurately describing the graph. (See example)

Descriptive Writing

Descriptive writing is used to have students examine details of objects, figures, or diagrams. For example, a teacher might have the students describe a regular pentagon to a person on the phone using only properties and features of the polygon. This is a great exercise for geometry classes.

Learning Logs

Learning logs are used daily by students to record their thoughts and feelings especially in mathematics. This gives students the opportunity to express themselves on an ongoing basis and vent any frustrations or boast about any accomplishments they have experienced. Students can keep a portion of their notebook for this purpose.

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