Writing in Math Classes

BY SHIRLEY FREED

Teachers on all levels are realizing the value of writing across the curriculum. William Zinsser[1] declared that "writing is how we think our way into a subject and make it our own." Traditionally, writing has been used for communicating ideas, but it is increasingly being seen as a way to learn. Through writing, students can clarify their ideas, make connections with prior learning, and gain greater understanding. Writing makes students think and helps them construct their own sense of what they are studying. But while writing is often integrated into science, history, and religion classes, it is not often considered as a way to teach mathematics.

Why Add Writing to Math Class?

Writing helps students develop a conceptual understanding of math. It helps them focus on the "why" of math as well as the "how." When they can write clearly about a concept, it is likely that they understand it. Also, writing allows students to express mathematical ideas in a way that may be more comfortable for them. I remember several years ago watching a statistics teacher deal with an angry, anxious student. The student said, "You go so fast, and all those symbols confuse me. Can you write it another way?"

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After a dumbfounded look, the teacher said, "Sure," and wrote the explanation using words only—no symbols. The student visibly relaxed, and throughout the rest of the term was allowed to use written text whenever she chose.

In math classes, the communication skill most often used is listening. Students are not encouraged to talk, and when they are asked to explain a problem verbally or work it on the chalkboard, they often feel panic stricken. Writing allows students to express their ideas

in a less public forum, and to develop their own "voices."

Students' writing gives the teacher a window on their thinking. This can help teachers adjust their instruction. One student's description of how to factor the polynomial $6b^2 + 7b$ is revealing:

First find the number that could go into both the number 6 and 7. And there is no number that goes into 6 or 7 so now go to the letter. Second find the letter that is the lowest and the letter is b because b^2 is higher than b subtract b from b^2 and the answer is b so put 6b next because $6b + b - 6b^2$. Then put 7 because $7 + b = 7b$ and work out to check [the] problem.[2]

While this student could probably factor most polynomials correctly, the writing indicates a misconception of the process. Reading the explanation, a teacher would realize that the expression "take out" had caused a confusion with subtraction.

What Can Students Write About?

1. Students can explain a process, which may help clarify it in their minds. Sometimes another student's explanation makes more sense than the way the teacher explained the problem. When students share with peers, they often learn more than one way to solve a problem. Following are some students' explanations of multiplying:

3 x 4 = 12 I put two fours together and join another four on the end.

3 x 4 = 12 I counted it on my fingers.

5 x 4 = 20 Put two 5's together and add a ten.

4 x 4 = 16 Well, if two fours are eight, four fours must be sixteen.[3]

2. Students can use writing to define a concept. Putting the terms in their own writing takes the fear out of some of those big words. For example, they can write about the following: What is a trapezoid? What is regrouping? What is a transformation? A function?

3. Students can share their feelings through writing. Math anxiety diminishes as they gain greater opportunities for expression. The most anxious math students are usually afraid to share. They lack confidence and feel threatened by those who "know" math. Writing starters like *Mathematics makes me feel . . .* or *A good experience I had in math was . . .* or *When I learned fractions, I . . .* can help students sort out their feelings about math. Since cognition and emotion are directly connected,[4] this can help decrease students' anxiety.

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4. Students can explain why they made a mistake or what confused them. "I am priety [sic] sure I understand about whole numbers, but decimals, I'm a bit confused about them. I understand about place-value. I don't understand about the base-ten system,"[5] wrote one student in a personal journal.

5. Students can identify what they know about a topic before beginning a lesson or unit. This helps the teacher know what to emphasize and saves time. If the level of understanding is identified before teaching, students can be led to deeper understanding. In their analysis of a popular math series, Engelmann, Carnine, and Steely wrote "that 76% of the material in grade 6 is review, 80% in grade 7, and 82% in grade 8."[6] Time spent on review is wasted if students have a good working knowledge of the topic.

6. After a lesson, students can summarize what they learned and tell how to apply it.

7. Students can make suggestions for the teacher. Following are some journal entries by students:

"What would really help me is if you could just go a little slower."

"I'm having problems understanding. You are teaching me too much stuff and I'm getting confused."[7]

Some Formats and Strategies

1. *Poems* require a creative process that adds interest and humor to math classes.

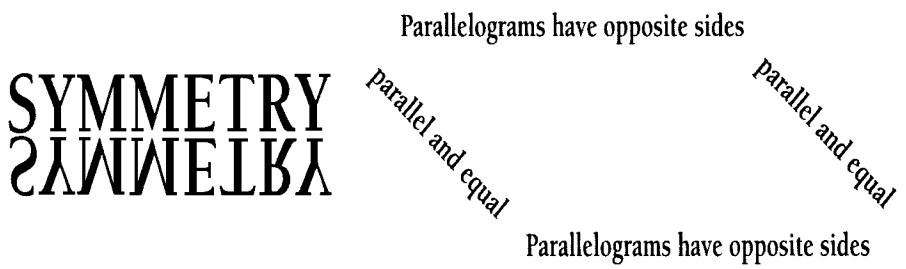
a. *Limericks*: a light humorous or nonsensical verse of five anapestic lines, usually with the rhyme scheme *aabba*. Following is an example from a seventh-grade class:

There once was a little red hen,
Who couldn't multiply by 10.
"Move the decimal," I said,
"To the right, Little Red.
One place, then you're done." The end.[8]

b. *Concrete poems*: lines and words in the shape of the subject. (See Figure 1.)

c. *Cinquains*: short, simple poems that provide a creative outlet for thinking about a concept.

Figure 1



Fractions
Simple, Difficult
Reducing, Inverting, Multiplying
Take too much time
Portions

Cinquains have a definite form. The first line is a one-word title (usually a

noun). The second line is a two-word *description* of the topic (usually two adjectives). The third line is three words that express *action* about the topic (usually three "ing" words). The fourth line is a four-word phrase showing *feeling* for the topic. The last line, which is a one-word synonym, *restates the essence* of the topic.[9]

2. *Rap:* a poem with a strong sense of beat or rhythm.

When you spin a spinner,
Which number is best?
Will one come up
More than all the rest?

When you toss a coin,
Which side do you call?
Is "heads" or "tails"
Most likely to fall?

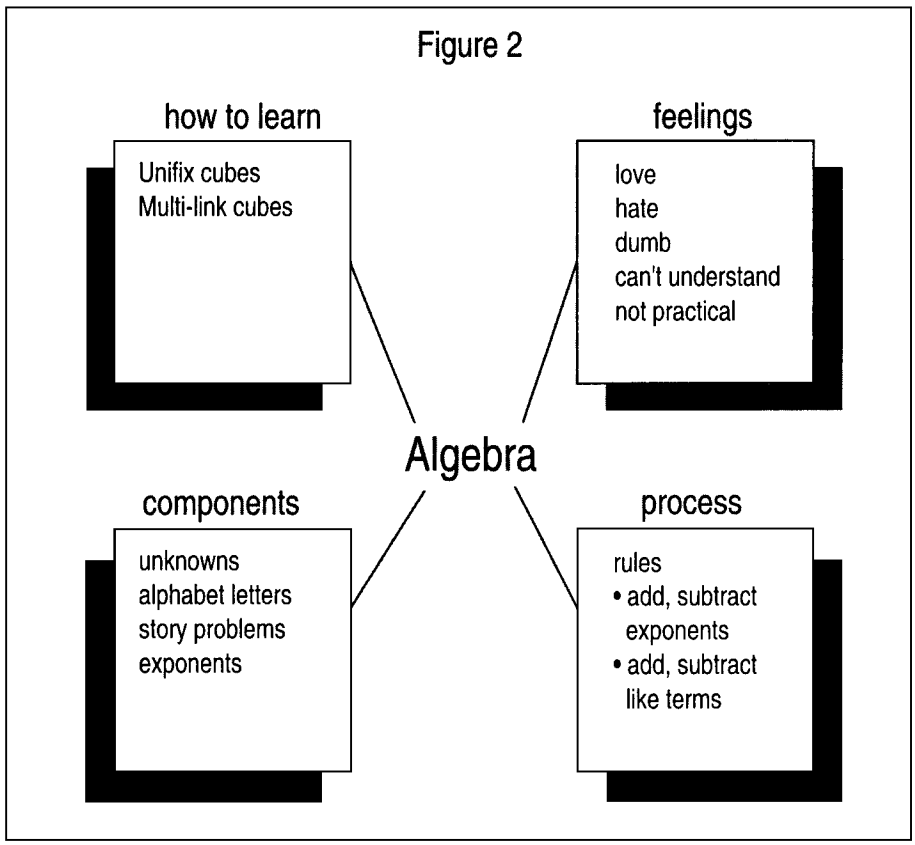
Is it all just luck?
Is it nothing but chance?
Or is there a way
To tell in advance?[10]

Following are guidelines for writing a rap: Establish a beat! (clap, snap fingers, tape a beat from a portable keyboard, use a drum machine, etc.) Brainstorm a list of key concept words that you want your students to learn about a particular subject (include concepts, setting, facts, events, descriptive words, etc.). From the list, choose specific concept words and establish possible rhymers for them. Write your rhyme. When it's put to a beat, it becomes a rap!

3. *Letters*: A letter written to a friend, relative, or teacher can combine reflective and communicative writing. "The letter can describe what they have learned or what is causing them difficulty, what they would like to learn about, or how they feel about a particular topic or mathematics in general."[11]

4. *Story Problems:* Students love to write story problems. Writing in pairs is often more effective than writing alone, as partners stimulate and challenge each other's thinking. Exchanging questions with another pair of students and then returning them to the original pair for grading can be fun. To increase students' ability in writing story problems, Mayotte and Moore[12] suggest that they evaluate each other's problems for originality, level of difficulty, and logic.

5. *Word Webs*: This is a visual, thought-organizing, and clarifying strategy. Students generate words associated with a topic and then organize them in a web that connects related ideas. This approach works well for use by pairs of students. (See figure 2.)



6. *Possible Sentences:*[13] This strategy activates prior knowledge and introduces or verifies vocabulary skills. Following are guidelines to writing Possible Sentences:

a. Identify important terms.

b. List the terms on the chalkboard and pronounce them as needed.

c. Have students create a sentence using two of the terms in a way that they think the text might use them.

d. Record students' sentences on the chalkboard.

e. Read the text to verify students' use of the terms.

f. Revise sentences and have students copy corrected sentences into their notes.

Steps c and f could easily be done by pairs of students.

7. *Questions*: Having students write their own questions is a way to check for conceptual understanding.

a. Give students the answers and ask them to write the questions. (e.g. Write a question whose answer is 1,328. Write an equation with roots of +2 and -3.)

b. Another way to use questions is called "Top It Off."[14] Ask the students to write questions *pertaining* to the example given. For example, if you give students the coordinates 0 and -5, they might create these questions: On which axis will the ordered pair be graphed? Which number is the Y-coordinate?

c. Many children's books lend themselves to student-constructed questions. One such book is *Will We Miss Them: Endangered Species*, by Alexander Wright. The text is rich with numerical information, e.g. "A newborn blue whale calf weighs 2,000 pounds and gains 200 pounds a day every day for the first year." The question automatically arises, "How much will it weigh on its first birthday?"

8. *Books*: Students can write and il-

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lustrate books on almost any mathematics topic. A selected bibliography of books and topics is included at the end of this article. After reading these books, students will want to write their own.

9. *Journals*: Students can use these for a variety of writing-to-learn activities. Some "how-to use" suggestions:

a. First, decide on the purpose of the journal. Will it function as a means of communication between the teacher and student? Between a pair of students? As a diary for personal reflection? Who will read the journals? Will someone respond to the entries?

b. Communication of thoughts, ideas, and feeling should be the emphasis, rather than perfect grammar or spelling.

c. Plan for journal use to be flexible. Sometimes have students do free writing, other times give prompts as in 1-7 in the "What students can write about" section.

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d. Experiment with different formats: (1) Divide the page in half vertically; have students write in the left-hand column, and you can respond in the right-hand column. (2) Divide each page in half horizontally. Students are to write thoughts and feelings in the top half, and describe problem areas in the bottom half of the page.[15]

In summary, the *Curriculum and Evaluation Standards for School Mathematics* lists five general goals for all students: that they (1) learn to value mathematics, (2) become confident in their ability to do mathematics, (3) become mathematical problem solvers, (4) learn to communicate mathematically, and (5) learn to reason mathematically. Using writing in mathematics class can make these goals more achievable.

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ADDITIONAL READING

Children's Literature

Aker, Suzanne, *What Comes in 2's, 3's, and 4's?* New York: Simon & Schuster, 1990. (multiplication)

Anno, Mitumasa, *Anno's Counting Book.* New York: Harper Collins Children's Books, 1986. (counting)

Anno, Masaichiro and Mitsumasa Anno, *Anno's Mysterious Multiplying Jar.* New York: Philomel Books, 1983. (factorials)

Aylesworth, Jim, *One Crow: A Counting Rhyme.* New York: Harper and Row, 1988.

Bang, Molly, *Ten, Nine, Eight.* New York: Greenwillow Books, 1983. (counting)

Carle, Eric, *Rooster's Off to See the World.* Saxonville: Picture Book Studio Limited, 1992. (subtraction)

Carle, Eric, *The Grouchy Ladybug.* New York: Harper Collins Publishers, 1986. (telling time)

Crews, Donald, *Bicycle Race.* New York: Greenwillow Books, 1985. (counting numbers)

Crews, Donald, *Ten Black Dots.* New York: Greenwillow Books, 1986. (counting)

Ehlert, Lois, *Fish Eyes.* San Diego: Harcourt Brace Publishers, 1992. (addition)

Hoban, Tana, *Is It Red? Is It Yellow? Is It Blue?* New York: William Morrow & Company, 1987. (classification)

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Hoban, Tana, *Shadows and Reflections.* New York: Greenwillow Books, 1990. (symmetry)

Hutchins, Pat, *Changes, Changes.* New York: Macmillan, 1971. (attributes)

Jones, Ann, *Round Trip.* New York: Greenwillow Books, 1983. (attributes)

Leodhas, Sorche Nic, *Always Room for One More.* New York: Henry Holt and Co., Inc., 1965. (addition)

Lottridge, Celia Barker, *One Watermelon Seed.* Toronto: Oxford University Press, 1986. (counting, multiples of 10)

Mathews, Louise, *Bunches and Bunches of Bunnies.* New York: Scholastic, Inc., 1978. (multiplication)

McMillian, Bruce, *Eating Fractions.* New York: Scholastic Inc., 1991. (fractions)

Pallotta, Jerry, *The Icky Bug Counting Book.* Watertown, Mass.: Charlesbridge, 1992. (counting)

Reid, Margarette S., *The Button Box.* New York: Dutton Children's Books, 1990. (sorting).

Schwartz, David M., *How Much Is a Million?* New York: Scholastic Inc., 1985. (numbers)

Students can share their feelings through writing.

Schwartz, David M., *If You Made a Million.* New York: Lothrop, Lee & Shepard Books, 1989. (numbers)

Sloat, Teri, *From One to One Hundred.* New York: Dutton Children's Books, 1991. (counting multiples of 10)

Testa, Fulvio, *If You Take a Pencil.* New York: Dial Books for Young Readers, 1982. (counting)

Vioret, Judy, *Alexander, Who Used to Be Rich Last Sunday.* New York: Macmillan Publishing Company, 1978. (subtraction, money)

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1. W. K. Zinsser, *Writing to Learn* (New York: Harper and Row, 1988), p. 16.

2. L. D. Miller, "Writing to Learn Mathematics," *Mathematics Teacher* 84:7 (October 1991), pp. 517.

3. A. Baker and J. Baker, *Maths in the Mind* (Portsmouth, N.H.: Heinemann, 1991), p. 29.

4. R. N. Caine and G. Caine, "Understanding a Brain-Based Approach to Learning and Teaching," *Journal of Developmental Education* 11:3 (1990), pp. 2-7.

5. Christine J. Gordon and Dorothy Macinnis, "Using Journals as a Window on Students' Thinking in Mathematics," *Language Arts* 70:1 (January 1993), p. 41.

6. S. Engelmann, D. Carnine, and D. G. Steely, "Making Connections in Mathematics," *Journal of Learning Disabilities* 24 (1991), p. 292.

7. Gordon and Macinnis, p. 40.

8. G. Mayotte and C. Moore, "Writing, Thinking and Math," *Teaching K-8* 84:7 (October 1991), p. 50.

9. T. Estes and J. Vaughan, *Reading and Learning in the Content Classroom* (Boston, Mass.: Allyn and Bacon, 1985), pp. 184, 185.

10. A. Baker and J. Baker, *Raps & Rhymes in Maths* (Portsmouth, N.H.: Heinemann, 1991), p. 75.

11. A. Baroody, *Problem Solving, Reasoning, and Communicating* (New York: Macmillan, 1993), pp. 2-115.

12. Mayotte and Moore.

13. D. W. Moore and S. A. Moore, "Possible Sentences: an Update." In E. K. Dishner, T. W. Bean, J. E. Readence, and D. W. Moore (eds.), *Reading in the Content Areas: Improving Classroom Instruction* (Dubuque, Iowa: Kendall/Hung, 1992), pp. 196-202.

14. C. Bachman, *Reading, Writing, and Thinking Math Activities.* Presented at the Capital Consortium Reading to Learn Conference, Richmond, Virginia, April 1989.

15. Tobias, 1989 in Baroody.