

*"It boils down to this—  
if you can't talk about  
math, you are unlikely  
to do it well."*

National Council of  
Supervisors of  
Mathematics, 1997

# MATH AND SCIENCE

## INCORPORATING ORAL AND WRITTEN COMMUNICATION

Learning is a social process. It involves checking against personal experience and negotiating with peers and teachers. Ideas must be shared, respected, and available for reflection, discussion, and revision. Writing tasks are a necessary part of math and science learning. They require students to reflect on, analyze, and synthesize the material being studied in a thoughtful and precise way.<sup>1</sup>

Conversations and writing exercises influence students' reasoning ability, construction of mathematical knowledge, problem-solving abilities, self-confidence, and acquisition of social skills.<sup>2</sup> By responding to student communications, either individually or before the whole class, teachers engage in a unique and continuous dialogue that contributes to the process of teaching and learning.<sup>3</sup>

### Issues

- Student communication positively influences learning. Time spent in content-oriented interactions with peers and teachers enhances classroom performance and achievement. As students talk about their classroom experiences, they don't merely add new knowledge; what they already know changes.<sup>4</sup>
- Research confirms that increased levels of "on-task" student talk are related to increased achievement. Achievement was significantly higher for groups in which the amount of student talk time was equal to or half as much as teacher talk compared to groups with no student talk.<sup>5</sup>
- Research on problem solving has shown that expository writing is an effective and practical tool for enhancing learning of mathematics concepts and skills.<sup>6</sup>

### Gaps and Obstacles

- Facilitating discussions about students' mathematical ideas requires skill and patience. Teachers generally assume responsibility for initiating discussion and maintaining focus, especially with younger children. Thus, it is very important that teachers strengthen their skills in facilitating student discourse. This topic is neglected in many teacher preparation sequences.
- Creating environments in which students can safely communicate their own mathematical thinking is a crucial element in developing students' mathematical power.
- In a survey of Ohio science teachers, about half reported that they ask students to write explanations about what they observed in most or every lesson, while half report they do so in some or none of the lessons.<sup>7</sup>
- Oral and written communication about math is critical for learning to do math well. Communication and discourse do not take the place of learning the basics of mathematics, however. Basic facts must be mastered and computational fluency achieved. Students must have methods they can use well

and that produce correct answers. This skill is an essential underpinning of being able to communicate mathematically.<sup>8</sup>

## Routes and Destinations

- Teachers can reinforce classroom communication skills and help students understand the value of focused conversation and writing when they:
  - Teach what is expected by sharing the norms and routines of communication.
  - Pose questions and tasks that elicit, engage, and challenge each student's thinking.
  - Listen carefully to students' ideas.
  - Arrange seating so that students can easily see classmates as they speak.
  - Encourage and monitor each student's communication and participation.
- Promoting classroom discourse demands that teachers be able to think quickly on their feet and make minute-by-minute decisions regarding:
  - When to join a group quietly without comment.
  - When to elaborate, provide information, clarify an issue, or model a problem.
  - When to let a student or group struggle with a difficulty.
  - When and how to attach appropriate mathematical notation and language to students' ideas.
- Students in the classroom should be involved in communication in which they:
  - Clarify and justify their ideas orally and in writing.
  - Think about a focus question individually before discussing it in class.
  - Provide an audience for their peers by speaking to, questioning, and listening to one another.
  - Write or discuss ideas with a partner before sharing with the whole group.
  - Seek clarification when they don't understand a question or statement.

Students develop proficiency in the language of mathematics through active use of that language in meaningful contexts.<sup>9</sup> Math teachers must promote students' ability to ask questions, share ideas, and communicate thinking in a dynamic environment of learning. Students who talk and write about mathematics as a way of making sense of the world are more likely to be able to use their own questions in the future to direct their learning and their work.

## Endnotes

1. D. Davison and D. Pearce, "Using Writing to Reinforce Mathematics Instruction," *Arithmetic Teacher*, 35(8), 1988, pp. 42-45.
2. G. Lappan and P. W. Schram, "Communication and Reasoning: Critical Dimensions of Sense-Making in Mathematics," in P. Trafton and A. Schulte (Eds.), *New Directions for Elementary School Mathematics: 1989 Yearbook*, National Council of Teachers of Mathematics, Reston, VA, 1989.
3. L. D. Miller, "Teacher Benefits from Using Impromptu Writing Prompts in Algebra Class," *Journal for Research in Mathematics Education*, 23(4), 1992, pp. 329-340.
4. C. Dudley-Marling and D. Searle, *When Students Have Time to Talk: Creating Contexts for Learning Language*, Heinemann, Portsmouth, NH, 1991.
5. D. Dessart and M. Suydam, *Classroom Ideas from Research on Secondary School Mathematics*, National Council of Teachers of Mathematics, Reston, VA, 1983.
6. L. D. Miller, "Writing to Learn Mathematics," *Mathematics Teacher*, 84(7), 1991, pp. 516-521.
7. NCREL analysis of OMSC-sponsored teacher survey, fall 1999.
8. *Principles and Standards for School Mathematics: Discussion Draft*, National Council of Teachers of Mathematics, Reston, VA, October 1998.
9. F. Santiago and G. Spanos, "Meeting the NCTM Communication Standards for All Students," in G. Cuevas and M. Driscoll (Eds.), *Reaching All Students with Mathematics*, National Council of Teachers of Mathematics, 1993, p. 134. Note: The value of math discourse is that it supports and enhances the learning of math content and facts. Math discourse is of little value without acquiring mastery of math content.



Copyright © 2000 by the North Central Regional Educational Laboratory. Copying is permitted for educational purposes.

This work was produced in whole or in part with funds from the U.S. Department of Education under Eisenhower grant number R168R50003. The content does not necessarily reflect the position or policy of the Department of Education, nor does mention or visual representation of trade names, commercial products, or organizations imply endorsement by the federal government.