

Project CRISS Addresses the Need for Changing Mathematics Instruction

By Lynn Havens

Stephen S. Willoughby in his ASCD publication, *Mathematics Education for a Changing World*, states, *"Change in the teaching of mathematics is needed, not because it has recently deteriorated, nor even because it has always been bad (thought it probably has been), but, rather, because the world is changing. The people who are going to solve the problems of the present and future - or even understand and evaluate those problems and solutions - must have a far better grasp of mathematics than most people have at present, or have ever had in the past."* (p. 4)

As I look back on my careers as a mathematics student and as a mathematics teacher, I don't see much progress made in the field of mathematics instruction. Both now and then, the math class typically began with the teacher correcting the homework from the day before, doing any problems where questions arose, continued with the teacher telling how to do the next type of problem, and ended with the students practicing with the problems in the book. The goal for instruction was having students master a set of basic skills. The process was generally drill and practice. Where this process may have met the demands of the past, as Willoughby points out, it falls short of meeting the demands of today and the future.

With a technology barely imagined when I was in school and with the foreseeable problems of environment, communication, and industry, the students of today and the future will need to be learners and problem solvers. As Eric Hoffer states, *"In times of change the learners inherit the earth while the learned find themselves beautifully equipped to deal with a world that no longer exists."* The duty of mathematics teachers is not to be the sole dispenser of knowledge in a classroom, but rather to be the guide, the encourager, the cheerleader. Their role is to help students learn how to learn and apply that skill to problem solving.

Project CRISS (CReating Independence through Student-owned Strategies) was developed over twenty years ago with the goal of empowering students to learn content independently. Based on learning theory, the project works with teachers so they can help their students learn independently from their textbooks, organize, take notes, write, deal with difficult vocabulary, and study. These skills are important in all content areas, but have probably been most ignored in the area of mathematics.

CRISS teachers incorporate three concepts from cognitive psychology. First, knowing that students learn by integrating new information with prior knowledge, they start each new lesson by finding out what their students already know about the topic. Through writing, brainstorming, questioning, drawing pictures, or working in small groups, the teacher determines what the students know and helps them set purposes for upcoming learning or reading activities. Second, the CRISS teacher keeps the students actively involved in their learning. While they are reading or listening, they are also organizing and recording information or reactions. They are thinking about and testing the new information; they are verifying that they are meeting the purposes set up prior to the learning experience. Finally, the CRISS teacher helps students be metacognitive,

or aware of how they are learning or solving mathematics problems. This can be done by having students write journal entries, discuss in small groups or pairs, or share with the whole class.

CRISS teachers emphasize the importance of modeling or thinking out loud during a problem-solving session. Students need to SEE and HEAR how problems are solved, including what one does if the solution is incorrect. The National Council of Teachers of Mathematics (NCTM) Professional Standards for Teaching Mathematics says, "*Teachers must help students realize that mathematical thinking involves dead ends and detours and encourage them to persevere when confronted with a puzzling problem and to develop the self-confidence and interest to do so.*" (p. 21). It is important for students to model for each other. They need to share with each other the different, yet correct, processes and/or solutions to problems presented in class. Students need to think through the process out loud (metacognition) to clarify the procedure for themselves and for others.

Traditionally, mathematics teachers do not expect their students to learn from the information printed in math texts. We tell what a word means or how to do a process or operation. Recently, while working with a group of high school mathematics teachers in Vancouver, British Columbia, I asked them to raise their hands if they used their texts regularly for information, not just problems to be practiced. Not one hand was raised. No wonder when a student is sick or misses class that he or she is automatically behind and needs personal help from the teacher to catch up.

CRISS encourages teachers to search out the strengths and weaknesses of a text and then share that information with the students. The teacher needs to model how one reads and learns from a math text. Most likely the process requires reading and re-reading, making sketches, self-questioning, and applying to personal experience.

When a student knows how a text is organized, the organization can be used to take notes on information that needs to be remembered. CRISS provides teachers and students with a variety of note-taking strategies from graphic organizers to two-column notes, frames to power outlines. We suggest that students use the organizational method that is most effective for them. With teacher modeling and guidance, students eventually become comfortable with a variety of organizational formats. These can be used to record information from text, lectures, labs and manipulative activities, field trips, and audiovisuals.

In March of 1989, the NCTM published its Curriculum and Evaluation Standards for School Mathematics. For all grade levels, K-12, Standard 2 is "Mathematics as Communication." In the middle grades section of Standard 2, the authors state, "*The ability to read, write, listen, think creatively, and communicate about problems will develop and deepen students' understanding of mathematics. . . . Unless students frequently and explicitly discuss relationships between concepts and symbols, they are likely to view symbols as disparate objects to be memorized.*" (p. 78) In the high school section of Standard 2, the authors continue with, "*It is not enough for students to write the answer to an exercise or even to show all their steps. It is equally important that students be able to describe how they reached an answer or the difficulties they encountered while trying to solve a problem.*" (p. 140)

To address the standard of communication, the CRISS project emphasizes the use of writing and speaking to learn. The project provides teachers and students with explicit strategies for

processing content through writing. Included among the strategies are journaling, summarizing, one-sentence summaries, power writing, framed paragraphs, opinion/proof papers, spool papers, and the RAFT assignment. In the NCTM Standards for Teaching Mathematics, part of the "Teacher's role in discourse" is *"asking students to clarify and justify their ideas orally and in writing."* (p. 35) We encourage students to use writing to explain how a problem is solved, to define a concept, to argue for a solution or process, or to explain why they made a mistake or error in reasoning.

Writing and talking are emphasized as metacognitive tools. Students analyze their thought process in solving a problem; and, through thinking aloud or writing, they tell other students the steps involved. Manipulatives and hands-on activities are an important ingredient in the new mathematics instruction, but in themselves may not be enough. Writing and talking about the activity, relating through words to real world topics can be powerful tools in making the lab experiences more meaningful. Writing in a mathematics class can be formal or informal, graded or non-graded, done as a group or individually, published or saved as a private journal entry. Another important area in the "Mathematics as Communication" standard is vocabulary. The high school standard states, *". . . facility with the language of mathematics is an integral part of thinking mathematically, solving problems, and reflecting on one's own mathematical experiences."* (p. 140) CRISS devotes a great deal of time to concept understanding. Through writing, graphic organizers, pictures, and lab experiences paired with writing, the project aims to help students understand vocabulary concepts instead of the usual memorization of definitions. Since many mathematics terms have common English definitions as well as their mathematical meanings, CRISS emphasizes the importance of building on this prior knowledge where appropriate. A tenth grade geometry student in Kalispell, Montana writes, *"A kite to me was something that was flown in the wind, but in geometry a kite is a quadrilateral with two pairs of congruent adjacent sides. . . . A cone is commonly known as a edible container for ice cream. The geometric definition of a cone is three dimensional object determined by a circle and a point not in the plane of the circle."* The student's background information about kites and cones will help her remember the mathematical definitions.

As the world around us changes so must our mathematics instructional strategies. In the book, *Everybody Counts, A Report to the Nation on the Future of Mathematics Education*, the authors present the myth and reality of learning mathematics. *"Myth: Learning mathematics means mastering an immutable set of basic skills. Reality: Skills are to mathematics what scales are to music or spelling is to writing. The objective of learning is to write, to play music, or to solve problems - not just to master skills. Practice with skills is just one of many strategies used by good teachers to help students achieve the broader goals of learning."* (p. 57) Project CRISS provides those "good teachers" with a wide range of strategies in the areas of reading, organizing, taking notes, understanding concepts, writing, and talking about mathematics. Project CRISS will help both teachers and students meet the changing challenges of the 90s.

REFERENCES

- Mathematical Sciences Education Board. (1989). *Everybody Counts*. Washington, D.C., National Academy Press.
- National Council of Teachers of Mathematics. (1989). *Curriculum and Evaluation Standards for School Mathematics*. Reston, VA, NCTM.

- National Council of Teachers of Mathematics. (1991). *Professional Standards for Teaching Mathematics*. Reston, VA, NCTM.
- Willoughby, Stephen S. (1990). *Mathematics Education for a Changing World*. Alexandria, VA, Association for Supervision and Curriculum Development.

About the Author: Lynn Havens is currently Director of Project CRISS. Prior to her involvement with the project, Lynn was a junior and senior high school mathematics and science teacher with the Kalispell, Montana, Public Schools.

NOTE: All material is copyrighted. Permission is granted to photocopy or print this article in its entirety, as long as all credits remain intact with the article and the Project CRISS® copyright appears on the materials. This article may not be used in any other publication in any medium, without the express, written permission of Project CRISS®.

©Project CRISS