NCTM Standards in Action

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This year, every issue of *delta-K* will devote a section to the NCTM standards. In this issue the focus will be on Curriculum Standard 1: Mathematics as Problem Solving. The NCTM's Standards documents, *Curriculum and Evaluation Standards for School Mathematics* (1989), *Professional Standards for Teaching Mathematics* (1991) and *Assessment Standards for School Mathematics* (1995), had a significant effect on the development of *The Common Curriculum Framework for K–12 Mathematics* (Alberta Education 1995).

Problem solving is a process that should pervade all mathematics instruction and should be modeled by the teacher in each lesson. However, teaching mathematics from the problem solving perspective entails more than just solving nonroutine problems. It is important that students experience mathematics through exploring, conjecturing, examining and problem solving. In short, teachers should engage students in mathematical discourse about problem solving.

When mathematics evolves naturally from real problem situations that have meaning and relevance to students and that are related to students' environment, students then see not only the interconnection of their knowledge but also the power and usefulness of mathematics in the world around them.

While problem solving is important at all levels, the *Curriculum and Evaluation Standards for School Mathematics* (1989) have made age-appropriate adjustments in the degree of emphasis between the elementary, middle school and high school levels as follows:

- From Kindergarten to Grade 4, the study of mathematics should emphasize problem solving so that students can
  - use problem solving approaches to investigate and understand mathematical content;
  - formulate problems from everyday and mathematical situations;
  - develop and apply strategies to solve a wide variety of problems;
  - verify and interpret results with respect to the original problem; and
  - acquire confidence in using mathematics meaningfully.
- In Grades 5–8, the mathematics curriculum should include numerous and varied experiences with problem solving as a method of inquiry and application so that students can
  - use problem solving approaches to investigate and understand mathematical content;
  - formulate problems from situations within and outside mathematics;
  - develop and apply a variety of strategies to solve problems, with emphasis on multistep and nonroutine problems;
  - verify and interpret results with respect to the original problem situation;
  - generalize solutions and strategies to the new problem situation; and
  - acquire confidence in using mathematics meaningfully.
- In Grades 9–12, the mathematics curriculum should include the refinement and extension of methods of mathematical problem solving so that all students can
  - use, with increasing confidence, problem solving approaches to investigate and understand mathematical content;
  - apply integrated mathematical problem-solving strategies to solve problems from within and outside mathematics;
  - recognize and formulate problems from situations within and outside mathematics; and
  - apply the process of mathematical modeling to real-world problem situations.

The three articles that follow provide useful information as well as insight into areas that can enhance the presence of problem solving in our classrooms. Ruth M. McClintock's article "The Pyramid Question: A Problem-Solving Adventure" points out that a good question can launch a discovery journey through conjecture, research, serendipitous

encounters, proof, answers and new questions. This article shares a good question, reports some discoveries and suggests ways to incorporate the adventure into the classroom.

"Increasing Mathematics Confidence by Using Worked Examples" by William M. Carroll suggests that by studying already worked examples of problems, students can effectively recognize underlying similarities between problems, mathematical principles and classes of problem situations. However, he argues that worked examples are not always used effectively in instruction and he shows us how.

The third article, "Let's Solve the Problem Before We Find the Answer," by Carolyn F. Talton identifies areas that are troublesome for students when engaged in problem solving. Her useful analysis not only identifies the areas but also provides advice that allows teachers to address these problem areas.

References

Alberta Education. *The Common Curriculum Framework for K–12 Mathematics: Western Canadian Protocol for Collaboration in Basic Education.* Edmonton: Author, 1995.

National Council of Teachers of Mathematics (NCTM). *Curriculum and Evaluation Standards for School Mathematics.* Reston, Va.: NCTM, 1989.

——. *Professional Standards for Teaching Mathematics.* Reston, Va.: NCTM, 1991.

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Mathematics from Ancient Rome

The law in ancient Rome required that a widow was compelled to divide 3,500 denar with the child she expected in the following way: If it is a boy, the widow would receive one half the amount of the son. If it is a daughter, the widow receives twice the amount of the daughter. However, the mother gave birth to twins—a boy and a girl. How should the inherited amount of 3,500 denar be divided so that the law of Rome is not violated?