

# Problem Solving

Problem solving is an integral part of mathematics learning at all grade levels. It is a powerful teaching tool that enables students to use their own creativity and innovation to apply strategies and seek solutions. This empowers them to explore alternatives and become confident, cognitive mathematical risk-takers.

## Types of Problems

### Routine

With routine problems, the path to a solution is immediately evident. It generally involves arithmetic operations.

*Example: Liz has 13 fewer chapter books than Jim. Liz has 37 chapter books. How many chapter books does Jim have?*

### Non-routine

Non-routine problems, such as puzzles, are more challenging for students. Upon first reading, the path to a solution is not immediately evident. Students draw on a bank of strategies (teacher-presented and student-developed) to solve the problem.

*Example: Carol numbered the pages in her journal. There were 1000 pages. How many times did Carol write the digit 6?*

Strategies for non-routine problems often include (but are not limited to) drawing a picture/diagram, looking for a pattern, acting it out, using materials, using logical reasoning, guessing and checking, making an organized list, making a table, working backwards, using an equation, and using simpler numbers.

### What is a good problem?

Problem-solving activities require students to use their prior knowledge in new ways and contexts to determine a path from what is known to what is sought. This helps them develop their conceptual understanding and their overall engagement.

Self-differentiating problems are effective because all students can approach them and experience success, regardless of their current developmental level. These problems have varied entry points, involve the use of multiple strategies, and often have multiple solutions. This provides students with an opportunity to solidify and extend their knowledge. Solving the problems requires persistence and provides a challenge for all students.



## Approaches to Teaching Problem Solving

### Teaching *through* Problem Solving

Teaching *through* problem solving involves providing students with a focused task and allowing them time to work through to a solution. By sharing their findings, students come to understand a particular math concept or skill. The teacher supports (rather than disseminates) the learning.

### Teaching *about* Problem Solving

Teaching *about* problem solving focuses on helping students develop processes and strategies for solving problems.

It is important to note that research does not support teaching problem solving as a separate topic in mathematics. Research shows that teaching isolated strategies has little effect on student success in problem solving.

## Questions for Reflection

1. What are some of the issues you face when teaching problem solving?
2. What challenges do you see in trying to move from mainly teaching *about* problem solving to teaching *through* problem solving?
3. What resources/supports might be needed?

## Resources

### ***Inside Mathematics: Performance Assessment Tasks***

This resource provides grade-level formative performance assessment tasks, as well as scoring rubrics and discussions of student work samples.

[www.insidemathematics.org/performance-assessment-tasks](http://www.insidemathematics.org/performance-assessment-tasks)

### ***Nzmaths: Problem Solving***

This section of nzmaths, the New Zealand government's "home of mathematics education in New Zealand," provides helpful problem-solving lessons that teachers can use.

<http://nzmaths.co.nz/problem-solving>

### ***The Math Forum @ Drexel: People Learning Math Together***

The Drexel University School of Education in Philadelphia maintains the Math Forum, which provides resources, materials, activities, person-to-person interactions, and educational products and services for math teachers and learners.

<http://mathforum.org/pows/>

### ***NRICH: enriching mathematics***

This site, created by the University of Cambridge, provides portals for mathematics students of different ages, as well as their teachers.

<http://nrich.maths.org>

### ***A Guide to Effective Instruction in Mathematics—Kindergarten to Grade 6: A Resource in Five Volumes from the Ministry of Education. Volume Two: Problem Solving and Communication***

This guide "focuses on the most effective method for developing and consolidating students' understanding of mathematical concepts in the primary and junior grades—that of teaching both through problem solving and about problem solving." It also "emphasizes the importance of promoting oral communication about mathematics in the primary and junior grades, and describes a number of cross-curricular literacy strategies that foster 'math talk' and, later, math writing in the classroom."

[http://eworkshop.on.ca/edu/resources/guides/Guide\\_Math\\_K\\_6\\_Volume\\_2.pdf](http://eworkshop.on.ca/edu/resources/guides/Guide_Math_K_6_Volume_2.pdf) (English)

[http://atelier.on.ca/edu/resources/guides/GEE\\_math\\_M\\_6\\_fasc2.pdf](http://atelier.on.ca/edu/resources/guides/GEE_math_M_6_fasc2.pdf) (French)

### ***Powerful Problem Solving: Activities for Sense Making with the Mathematical Practices***

by Max Ray-Riek (Heinemann, 2013)

This book explains how to prevent students from dropping out of math because they don't understand the procedures they are using or the mathematics behind them.