

Promote Problem Solving Skills in the Elementary Grades

<http://teachingtoday.glencoe.com/howtoarticles/promoting-problem-solving-skills-in-elementary-mathematics>

Problem solving is an essential, if sometimes neglected, skill that demands attention from the earliest grades. Students must learn to question and apply mathematical concepts to problem-solving situations on a regular basis. To support students in this goal, teachers need to

- create a classroom environment that embraces discourse
- bridge the gap between students' ordinary language and the formal language of mathematics
- focus on teaching strategies and conceptual understanding

Promote Discourse

Essential techniques for promoting discourse include *modeling* and *think-alouds*. Through the use of think-alouds, teachers model each stage of the problem-solving process, which can be best understood as following four steps:

1. understanding the question
2. selecting a strategy
3. applying the strategy
4. checking your answer

It is essential to talk through each step of the process. While it is easy to forget to verbalize some of your thinking, keep in mind that students may have little context to understand why a step is taken. Keep your language simple, but be sure your think-aloud is thorough. Use visuals and manipulatives to demonstrate processes when applicable,

The following activities can be used to support this process.

- **Problem of the Day** Give students a problem daily. Instead of solving the problem, break down the task. This makes it easier to model all steps in the problem-solving process. Students can
 - tell what the question is asking them to do
 - underline key words in the question that indicate the mathematical operation to be performed
 - delete extraneous information
 - identify the parts in the question
 - find the best problem-solving strategy and explain why it is the best
 - describe two different ways a problem could have been solved
 - have students develop questions from graphic information
 - share student-generated questions
 - ask other students to solve the problem and justify their answers

- **Sharing Solutions** Choose two to four students who have chosen alternate paths to a problem to share their work. Or, chose one student to share his or her work, and then ask if anyone solved the problem in a different way.
- **Summarizing and Paraphrasing** As each student shares his or her solution, teachers should summarize or paraphrase. This allows the teacher to distill, clarify, and illuminate ideas that students have presented, as well as to link everyday language and mathematical terms to the process.

Focus on Language

Many teachers use word walls to help students communicate their thinking and to understand and use mathematical language. The word wall should be composed of three types of language:

- **Symbolic** This refers to mathematical notation, such as $+$, $-$, $=$, $\%$.
- **Content-specific** These are technical words associated with abstract mathematical concepts and skills, such as *sum*, *addend*, *product*, *denominator*.
- **Academic** These terms includes test and discourse language, such as *determine*, *simplify*, *predict*, as well as words students use to describe a concept or activity, such as *add*, *take away*.

The following activities can be used to encourage students to use mathematical language and to support their understanding of the three different types.

- **Word Sort** Make or brainstorm a list of words, associated with one or two related concepts, i.e. addition and subtraction. Write these terms on cards and together with students categorize them. Numerous sorts could be done, i.e. by concept (subtraction/addition); by similar properties, by ordinary language and mathematic language (take away/subtraction). This activity could also be done independently at a math center.
- **Guess My Word Game** Play "guess my word." Give students a clue and have them guess the word (i.e. you use this word when you separate sets). This activity could be adapted for independent math center work. To adapt it for independent learning, make a list of sentence clues and have students work individually or with a partner to try to find the correct word wall term.
- **In Your Own Words** Give students a number of terms from the word wall and have them write a definition, or explain the words meaning in their own words. Research indicates that when students use their own language to define words, they are more likely to retain them.
- **Write a Word Problem** Have the students write problems using the appropriate terminology. Problems can be given to other students to be solved.

Use Whole Group and Small Group Teaching Strategies

Many teachers use a mix of small and whole group instruction, as well as heterogeneous and homogenous groupings to promote strategic thinking. Consider incorporating the following strategies and activities to encourage problem-solving skills.

Whole Group Learning

The most common problem-solving strategies should be modeled initially for the whole group. As strategies are taught or discussed, make a list and keep it on a chart that can be easily referred to. A list could include

- acting it out
- drawing a picture
- making a table
- looking for a pattern
- making a list
- making a model
- breaking the problem down into smaller parts

When students share their solutions ask other students to identify what strategy they used.

Small Group and Independent Strategies

- **Use heterogeneous groups.** For cooperative work, pair weaker students with stronger students for selected activities. Research has shown that this grouping benefits both partners, not just the weaker partner. Stronger students solidify their understandings as they verbalize their understanding and try to communicate it to their peer.
- **Offer options to homogenous groups.** Students benefit from being in same- or similar-ability groups as well. Provide options for skill practice that include leveled activities or problems. Students can self-select an activity appropriate to their level. Consider creating a color-coded “math menu” of leveled activities focused on the skills and concepts introduced with direct instruction in the whole group.
- **Include teacher-led and student-led groups.** A three-day process that rotates all students at least once through the teacher-led group and provides small group practice could include the following:
 - Day 1: Assign students to work independently from the math menu. The teacher will work with a target group and after instruction will assign follow-up work.
 - Day 2: The teacher works with a new target group—one group of students works at the ‘teacher follow up center’ and the third group works from the math menu.
 - Day 3: The teacher works with the last group of students and a three day/3 group rotating system has been established.