

DOINGWHATWORKS



PRESENTATION

5:45 min

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Facilitating Mathematical Problem Solving

February 2012

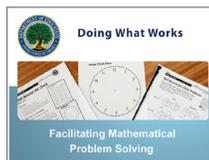
Topic IMPROVING MATHEMATICAL PROBLEM SOLVING IN GRADES 4 THROUGH 8

Highlights

- » Problem-solving skills are essential for students as they progress through the mathematics curriculum. Students who learn early to analyze problems, follow a reasoning process, and construct arguments are better able to handle the complex reasoning involved in advanced mathematics.
- » There are five major teaching practices profiled as recommendations in the IES Practice Guide on problem solving.
- » First, teachers need to prepare problems carefully so that they will be the most effective in helping students understand a key mathematical concept or apply a particular strategy. Problems that are accessible are more likely to engage students.
- » Second, teachers can strategically use visual representations to help students identify relationships among items of relevant information.
- » Third, teachers should encourage students to explore multiple ways to solve problems.
- » Fourth, it is important for teachers to introduce formal mathematical notation, including algebraic notation.

- » Finally, teachers can help students monitor their thinking and reflect on the problem-solving process by using question prompts or a list of problem-solving steps.

Full Transcript



Slide 1: Welcome

Welcome to the overview on Facilitating Mathematical Problem Solving.



Slide 2: Essential skills

Problem-solving skills are essential for students as they progress through the entire mathematics curriculum—from early informal understanding through advanced mathematics.

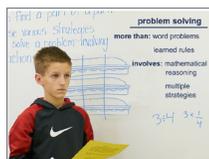
Students who learn early to analyze problems, follow a reasoning process, and construct arguments are better able to handle the complex reasoning involved in advanced mathematics.



Slide 3: Falling behind

Unfortunately, international assessments show that elementary and middle school students in the United States are not as proficient in problem solving as students in many other industrialized nations.

Mathematics textbooks often fall short in providing teachers and students with rich opportunities to practice problem solving. They may offer very limited guidance for teaching process skills and contain too few examples of problems, especially cognitively demanding problems.



Slide 4: Building skills

Problem solving involves more than word problems and means more than applying learned rules. It involves mathematical reasoning and using multiple strategies to solve a wide range of problems.

To build students' skills, teachers should incorporate problem solving into their whole-class instruction on a daily basis—using a variety of both routine and non-routine problems.



Slide 5: Strategies

There are specific teaching practices that experts recommend to help engage students and improve their problem-solving abilities.



Slide 6: Making problems accessible

Teachers need to take special care in selecting and preparing problems that will be the most effective in helping students understand a key mathematical concept or apply a particular strategy.

Students should have the language skills and mathematical background knowledge that will allow them to focus on the reasoning required to solve problems. Teachers may need to rewrite problems by substituting contexts and words that are more familiar to students. Problems that are accessible are more likely to engage students and ensure that they understand what the problem is asking.

Teachers can also focus students' attention on reasoning by reviewing in advance the mathematics concepts and skills that will be required to solve the problem.



Slide 7: Instructional strategies

There are several instructional strategies that teachers can use to guide students as they learn how to tackle mathematics problems.

These include:

- » using thinkalouds to guide students in creating visual representations of relevant information in the problem,
- » encouraging students to explore multiple ways to solve the problem, and
- » demonstrating how to break down the problem into steps that can then be expressed through formal mathematical notation.



Slide 8: Visual representations

Students who learn to create visual representations of a problem's components and steps prior to translating them into equations tend to be more effective problem solvers.

The most useful visuals are those that link the quantities in a problem to the mathematical operations needed to solve the problem.

Teachers can talk students through how to present the problem's essential information in appropriate visuals, such as tables, number lines, graphs, strip diagrams, and so forth.



Slide 9: Multiple approaches

Researchers recommend that students be explicitly taught that problems can be solved in more than one way. Students who practice multiple strategies and share their solutions with each other learn to become more flexible and efficient in problem solving.

Encouraging students to compare different approaches to problems and explain their reasoning to each other strengthens the notion that there are multiple ways to approach problems.



Slide 10: Mathematical notation

Students may prefer a more intuitive approach to problem solving. Teachers can build on that understanding by showing how to express problems through mathematical notation, including algebraic notation. While working through problem solving with students, teachers can take the opportunity to review or explain relevant mathematical concepts.



Slide 11: Self-monitoring and reflection

Finally, teachers can help students monitor their thinking and reflect on the problem-solving process by using question prompts or a list of problem-solving steps.

Students can be encouraged to reflect on their own processes and share them with others. When students discuss their problem-solving strategies with each other, they get valuable practice in explaining their reasoning and reinforce their understanding of the steps in the problem-solving process.

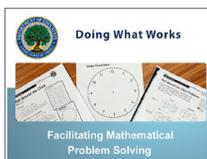


Slide 12: Conclusion

There's a lot involved in helping students become better problem solvers:

- » carefully selecting problems,
- » using visual representations,
- » encouraging multiple approaches to problems,
- » teaching mathematical notation,
- » reflecting on the steps, and
- » debriefing strategies together.

While teachers may not be able to incorporate all these recommendations at one time, they should all be considered when preparing whole-class mathematics lessons.



Slide 13: Learn more

You will find materials on this site to provide information about the teaching of mathematical problem solving. Each recommended practice includes background information, expert explanations of content and pedagogy, and examples of how teachers have implemented the practices. Begin with the multimedia overviews and expert interviews for each practice in the Learn What Works section. Watch teachers using the recommended teaching practices in the See How It Works section. Use the tools in the Do What Works section to conduct your own professional development, develop lessons, and review existing practices.