



SOLVE IT!

TEACHING MATHEMATICAL
PROBLEM SOLVING IN INCLUSIVE
CLASSROOMS — GRADES 7-12



MARJORIE MONTAGUE



Solve It! Teaching Mathematical Problem Solving in Inclusive Classrooms

Copyright © 2013 Exceptional Innovations

P.O. Box 3853

Reston, VA 20195

(703) 709-0136

www.exinn.net

ISBN 1-931311-11-0





INTRO I

Introduction to Solve It!

- Did I receive the correct change at the market?
- How much gasoline will I need to drive to the amusement park?
- How much is a 15% tip on \$13.85?
- If I save \$3.00 per week, when will I have enough money to buy the new video game?
- If we split the bill three ways, how much do Janice and Sean each owe me?
- How many dozen cookies will we need if every person at the party eats four?

These are typical, everyday questions that require mathematical problem-solving skills. Even though these problems seem simple, many students have not acquired the skills and strategies they need to solve them. In some cases, students may have developed the skills but they have not learned how to apply them outside the classroom.

Mathematical problem-solving skills are essential for success in school, on the job, and in the community. How can we ensure that students develop these lifelong skills? One proven way is to teach problem solving directly.

Solve It! is an instructional program designed to improve the mathematical problem-solving skills of students in middle and secondary school grades—including those students who are





having difficulties in mathematics or have learning disabilities. **Solve It!** is designed for students who are developmentally ready to engage in complex, higher order skills that require metacognitive processing.

The purpose of **Solve It!** is to teach students to be successful problem solvers. Successful problem solvers:

- Comprehend linguistic and numerical information in math problems.
- Translate and transform that information into mathematical notations, algorithms, and equations.
- Observe relationships among the elements in the math problems.
- Formulate plans to solve the problems.
- Predict outcomes.
- Regulate the solution paths as they are executed.
- Detect and correct errors while solving the math problems.

Using **Solve It!**, teachers can help students understand, analyze, solve, and evaluate mathematical problems. They do this by helping students develop the processes and self-regulation strategies used by good problem solvers. Cognitive processes enable the problem solver to represent the problem and then solve it. Problem representation is important to successful problem solving. Students who are not successful problem solvers need explicit instruction in representing problems. The cognitive processes (see textbox, *Solve It! Cognitive Processes*) that make up the **Solve It!** problem-solving routine were identified through a review of problem-solving research and later validated in a series of studies conducted in special education and general education settings.

What the Research Says About **Solve It!**

Solve It! was first validated and refined in three separate intervention studies with a total of 84 students with mathematical learning disabilities between 12 and 18 years of age (Montague, 1992; Montague, Applegate, & Marquard, 1993; Montague & Bos, 1986). In these intervention studies, Scripted Lessons were sequenced to ensure that students learned and understood the math cognitive processes and self-regulation strategies associated with effective problem solving. Results indicated that, following instruction, students with learning disabilities performed similarly to the average achievers who were not given instruction but who had demonstrated problem-solving ability. Generally, across studies, students maintained strategy use and problem-solving performance for several weeks

Solve It! Cognitive Processes

Read (for understanding)

Paraphrase (your own words)

Visualize (a picture or a diagram)

Hypothesize (a plan to solve the problem)

Estimate (predict the answer)

Compute (do the arithmetic)

Check (make sure everything is right)





following instruction. After several weeks, student performance tended to decline; however, a Booster Session consisting of review and practice helped students return to their previous level of performance.

More recently, **Solve It!** was validated in two large intervention studies conducted in general education math classes with average-achieving students, low-achieving students, and students with learning disabilities (Montague, Enders, & Dietz, in press; Montague, Enders, & Dietz, 2011). In these studies, instruction consisted of three initial Scripted Lessons and weekly Practice Sessions that used word problems drawn directly from the district curriculum. Student progress was monitored using curriculum-based measures consisting of 10 one-, two-, and three-step word problems. Results indicated that **Solve It!** students significantly outperformed students who received typical classroom instruction on these curriculum-based measures and demonstrated greater growth on the state math assessment.

In summary, **Solve It!** is a research-based program designed for inclusion in a standard mathematics curriculum. Explicit instruction in mathematical problem solving is provided in lessons that:

- Teach critical cognitive processes and metacognitive strategies.
- Improve students' motivation to solve problems.

Why Is **Solve It!** Effective for Students?

Solve It! lessons are designed to address factors associated with successful mathematical problem solving. They include:

- A positive attitude toward mathematics and problem solving.
- Interest in solving problems.
- Independence.
- Confidence in the ability to solve problems.

Everything middle or secondary school general education math teachers need to use **Solve It!** in their math classes is contained in this Instructional Manual and accompanying CD. The program provides:

- Guidelines for teaching mathematical problem solving and related mathematics skills.
- Methods to assess the problem-solving performance of students.
- Materials and techniques to evaluate student progress and program effectiveness.
- Directions for individual and group instruction in specified components of the program.
- Techniques to promote strategy and performance maintenance and generalization.
- Extension activities to promote transfer to novel and real-life problems.





The Instructional Manual

In addition to this introduction, the Instructional Manual is organized around five topics. More specifically:

Solve It! Instructional Guide

- **Chapter 1: Overview of Solve It! Instruction.** Reviews the theoretical and research base for **Solve It!**
- **Chapter 2: Solve It! Instructional Components.** Detailed directions for organizing and leading groups during the instructional sessions are given.

Solve It! Instructional Materials

- **Chapter 3: Solve It! Class Charts.** These Class Charts list the math cognitive processes and self-regulation strategies and are used as prompts in the classroom. They are important for group recitation and individual cueing.
- **Chapter 4: Solve It! Student Cue Cards.** The Student Cue Cards are given to students on the first day of instruction. Students use the Cue Cards to study the cognitive routine and then to use as personal prompts during Practice Sessions. The Student Cue Cards can be sent home with students so they can study the routine and practice the problem-solving strategies and processes outside the classroom.
- **Chapter 5: Solve It! Scripted Lessons and Implementation Calendar.** The three Scripted Lessons introduce the math problem-solving cognitive routine to students during the initial three days of instruction. The Scripted Lessons provide explicit instruction to teach students about the cognitive and

processes and metacognitive strategies necessary for effective problem solving and how to apply the processes and strategies when solving problems.

Solve It! Practice Sessions

- **Chapter 6: Guidelines to Embed Solve It! in the Curriculum.** Practice Sessions should be provided weekly to give students consistent opportunities to solve problems as they become more effective and efficient problem solvers.
- **Chapter 7: Organizing Solve It! Practice Sessions.** Presents how to manage Practice Sessions.

Solve It! Monitoring Student Progress

- **Chapter 8: Monitoring Progress Using Curriculum-Based Measures.** Student progress should be monitored over time to ensure that students are making progress and maintaining improved performance when solving math problems.
- **Chapter 9: CBM Administration, Scoring, and Graphing Procedures.** Presents how to use a graph to visually represent an individual student's progress.

Solve It! Maintaining and Generalizing Skills and Strategies

- **Chapter 10: Techniques to Foster Skill Maintenance and Generalization.** The techniques help reinforce the **Solve It!** routine when solving math problems.





- **Chapter 11: Solve It! Booster Sessions.** These are to assist students whose performance declines over time.
- **Chapter 12: Solve It! Problem-Solving Extension Activities.** This chapter presents authentic problem-solving extension activities.

The **Solve It! CD** contains the instructional materials and directions for printing and duplicating the materials. The materials may be duplicated for classroom use. Any other duplication of the materials on the CD is prohibited. Copy the files to your computer, or double-click the RunSolveIt!.PDF file on the CD to navigate through the files using the displayed menu.

