Solve It! A Mathematical Problem Solving Instructional Program

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 necessary skills and strategies for solving them. In some cases, students may have developed the skills, but they have not learned how to apply them outside of the classroom.
Mathematical problem solving is 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 skills directly.

**About Solve It!**

_Solve It!_ is a curriculum designed to improve the mathematical problem solving skills of students in the upper elementary, middle, and secondary school grades—including those students who are having difficulties in mathematics. _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 good problem solvers. Good 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 help students understand, analyze, solve, and evaluate mathematical problems. They do this by helping students develop the processes and strategies used by good problem solvers.

The cognitive processes and strategies (see the sidebar, _Solve It!_ Processes) that make up the _Solve It!_ program were identified through a review of problem solving research and later validated in a series of studies (Montague & Warger, 2000). Cognitive processes enable the problem solver first to represent and then to solve problems.

_Solve It!_ was 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, 1997). In these intervention studies, scripted lessons were sequenced to ensure that students learned and understood the 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 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. [See the sidebar, *Read More About Solve It!*, for a listing of publications that attest to the success of _Solve It!_]
This research-based program is designed for easy inclusion in a standard mathematics curriculum. Explicit instruction in mathematical problem solving is provided in lessons that:

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

*Solve It!* lessons also 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.

**Getting Started**

Everything you need to use *Solve It!* is contained in this instructional guide. The program provides:

- Guidelines for teaching mathematical problem solving and related mathematics skills.
- Methods to assess the problem solving performance of students.
- 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.
- Materials and techniques to evaluate student progress and program effectiveness.

The videotape located in the inside cover


of the notebook provides an overview of the Solve It! approach. It features Solve It! developer Marjorie Montague conducting Solve It! lessons in both a general education and a special education middle school classroom setting. In addition to providing an excellent visual of how the Solve It! approach looks in action, the videotape also can be used in orientation sessions with teachers, administrators, and family members.

The instructional guide is organized into two sections. First-time users are encouraged to read through Section One prior to moving to Section Two.

Section One provides background information and materials for the program. It is organized as follows:

- Chapter 1 presents a rationale for teaching mathematical problem solving. The Solve It! program purpose and content are described here.
- Chapter 2 presents the instructional components, procedures, and materials. Detailed directions for organizing and leading groups during the instructional sessions are found here.
- Chapter 3 provides several useful approaches to assessing students’ mathematics performance. An informal assessment procedure for determining students’ mathematical problem solving strengths and weaknesses is presented here.
- Chapter 4 offers suggestions for strategy and performance maintenance and generalization.

Section Two presents scripted Solve It! mathematical problem solving lessons. The section also includes:

- An overview of the instructional approach.
- Discussion of the role of assessment. Solve It! encourages teachers to conduct both pretests and posttests.
- Directions for facilitating individual and group instruction. The lessons are designed for explicit instruction of the cognitive and metacognitive processes and strategies necessary for effective problem solving.
- Booster lessons for ensuring that students maintain improved performance.
- Application exercises, error monitoring activities, and extension activities.

You will find Appendices at the back of the Solve It! manual:

- Section 3: Assessment Tools.
- Section 4: Instructional Tools.
- Section 5: Student Activity Sheets.

Appendices contain blackline masters of instructional tools. Included are:

- Assessment tools, including pretests, posttests, and the Mathematical Problem Solving Assessment-Short Form (in both English and Spanish) used to determine students’ understanding of problem solving processes (Section 3).
- Master class charts that list the processes and strategies that students learn. These charts are used for group recitation and cueing (Section 4).
- Individual student cue cards that can be sent home with students. Students can use them to study and practice the
problem solving strategies and processes (Section 4).

- Practice math word problems to be used during instruction (Section 4).
- Student activity sheets that contain math word problems (Section 5).

The tools found in the Appendices may be duplicated for classroom use. Any other duplication is strictly prohibited.

References
