



Problem Solving Strategies

Definition of a problem:

To truly be a problem, a mathematical quest must contain some effort or thought on the part of the solver.

As teachers, we must remember that what is a problem for some students may not be for others.

Good problems include modifications that may be made for students with varying abilities.



Polya's Four-Step Model

George Polya has had an important influence on problem solving in mathematics education. He noted that good problem solvers tend to forget the details and focus on the structure of the problem, while poor problem solvers do the opposite.

Four-Step Process:

1. Understand the problem (*See*)
2. Devise a plan (*Plan*)
3. Carry out the plan (*Do*)
4. Look back (*Check*)

1. Understand the problem: (See)

Many students are overwhelmed just by reading a problem. At this point group discussion is beneficial.

Questions that may help you lead students to an understanding of the problem:

- What are you asked to find or show?
- What type of answer to you expect?
- What units will be used in the answer?
- Can you give an estimate?
- What information is given?
- If there enough or too little information given?
- Can you restate the problem in your own words?



2. Devise a plan: (Plan)

The plan is usually called a strategy.

Problem-solving strategies include:

- Act is out
- Make a drawing or diagram
- Look for a pattern
- Construct a table
- Identify all possibilities
- Guess and check
- Work backward
- Write an open sentence
- Solve a simpler or similar problem
- Change your point of view/logical reasoning



3. Carry out the plan: (Do)

The original strategy may need to be modified. Students need to understand that not every problem will be solved in the first attempt. Cooperative learning teams can be very beneficial at this point.

4. Look back: (Check)

This is simply checking all steps and calculations. Students should be reminded (and reminded) that they should not assume the problem is complete once a solution has been found. Instead, students should examine the problem to ensure that the solution makes sense.



Problem Solving Strategies

Points to consider:

- Teachers need a plan for introducing strategies; it is not feasible to focus on them all at once.
- While “act it out” may be appropriate for lower elementary, it may not be for middle grades.
- It is rare that a problem can be solved only with one strategy. For this reason, a repertoire of strategies is useful.

What Problem-Solving Strategies Should be Taught?

1. Act It Out:

- Stress that other objects may be used in place of the real thing.
- Simple real-life problems can be posed to “act it out” in the early grades.
- The value of acting it out becomes clearer when the problems are more challenging.



2. Make a Drawing or Diagram:

- Stress that there is no need to draw detailed pictures.
- Encourage them to draw only what is essential to tell about the problem.

3. Look for a Pattern:

- This involves identifying a pattern and predicting what will come next.
- Often students will construct a table, then use it to look for a pattern.



4. Construct a Table or Organized List:

- This is an efficient way to classify or order large amount of data.
- An organized list provides a systematic way to record computations.

5. Identify All the Possibilities:

- This is often used with “look for a pattern” and “construct a table.”



6. Guess and Check:

- This strategy does not include “wild” or “blind” guesses.
- Students should be encouraged to incorporate what they know into their guesses—an educated guess.
- The “Check” portion of this strategy must be stressed.
- When repeated guesses are necessary, using what has been learned from earlier guesses should help make each subsequent guess better and better.



7. Work Backward:

- Some problems are posed in such a way that students are given the final conditions of an action and are asked about something that occurred earlier.

8. Write an Open Sentence:

- Often this is the only strategy taught in textbooks.
- Research indicates that it is useful, but not so useful that it should be taught exclusively.

9. Solve a Simpler or Similar Problem:

- Some solutions are difficult because the problem contains large numbers or complicated patterns.
- Sometimes a simpler representation will show a pattern which can help solve a problem.

10. Change your Point of View/ Logical Reasoning:

- When the first plan (strategy) is unsuccessful, students tend to return to the problem with the same point of view.



Teaching Clue Words for Problem Solving

Clue words for addition:

sum, total, in all, perimeter

Clue words for subtraction:

difference, how much more, exceed

Clue words for multiplication:

product, total, area, times

Clue words for division:

share, distribute, quotient, average



References

Burris, Anita (2005). *Understanding the Math You Teach*.
Merrill Prentice Hall, ISBN 0-13-110737-2.

Math Strategies:

<http://www.fcps.k12.va.us/DeerParkES/kids/diane/Math/tenstrat.htm>

Problem Solving Strategies:

<http://math.about.com/cs/testprep/a/ps.htm>