






Problem Solving Strategy

What Are Problem Solving Strategies?

Strategies are things that Pólya would have us choose in his second stage of problem solving and use in his third stage (What is Problem Solving?). Polya called them **heuristics**. To Pólya they were things to try that he couldn't guarantee would solve the problem but, of course, he sincerely hoped they would. So they are some sort of general ideas that might work for a number of problems. And then again they might not.

Problem Solving Strategies										
Make a table <table border="1"> <tr> <td>4 legs</td> <td>2 legs</td> <td>no legs</td> </tr> <tr> <td>cat</td> <td>boy</td> <td>snake</td> </tr> <tr> <td>dog</td> <td>emu</td> <td></td> </tr> </table>	4 legs	2 legs	no legs	cat	boy	snake	dog	emu		Make a list <ul style="list-style-type: none"> ○ 4 dogs ○ 3 cats ○ 7 rabbits
4 legs	2 legs	no legs								
cat	boy	snake								
dog	emu									
Draw a picture/diagram 	Act it out 									
Make a model 	Identify a pattern <p>5, 10, 15, 20</p>									
Write a number sentence <p>$3 \times 4 = 12$</p>	Solve a simpler, related problem <p>102, 104 ??? 2, 4, 6, 8, 10...</p>									
Guess and Check 	Work backwards 									

An In-Depth Look At Strategies

We now look at each of the following strategies and discuss them in some depth. You will see that each strategy we have in our list is really only a summary of two or more others.

1. Guess and Check

This stands for two strategies, guess and check and guess and improve.

Guess and check is one of the simplest strategies. Anyone can guess an answer. If they can also check that the guess fits the conditions of the problem, then they have mastered guess and check. Because it is such a simple strategy to use, you may have difficulty weaning some children away from guess and check. If you are not careful, they may try to use it all the time. As problems get more difficult, other strategies become more important and more effective. However, sometimes when children are completely stuck, guessing and checking will provide a useful way to start and explore a problem.

Guess and improve is slightly more sophisticated than guess and check. The idea is that you use your first incorrect guess to make an improved next guess.

2 Act It Out

We put two strategies together here because they are closely related. These are Act it Out and Use Equipment.

There are pros and cons for this strategy. It is an effective strategy for demonstration purposes in front of the whole class. On the other hand, it can also be cumbersome when used by groups, especially if a largish number of students is involved. We have, however, found it a useful strategy when students have had trouble coming to grips with a problem.

Use Equipment is a strategy related to Act it Out. Any object that can be used in some way to represent the situation the children are trying to solve, is equipment. This includes children themselves, hence the link between *Act it Out* and *Use Equipment*.

One of the difficulties with using equipment is keeping track of the solution. Actually the same thing is *true* for acting it out. The children need to be encouraged to keep track of their working as they manipulate the equipment.

3. Draw

Draw a Picture. But the picture need not be too elaborate. It should only contain enough detail to solve the problem.

It's hard to know where Drawing a Picture ends and Drawing a Diagram begins.

Venn diagrams and tree diagrams are particular types of diagrams that we use so often.

4. Make a list

Making **Organised Lists and Tables** are two aspects of working systematically. It helps you to bring a logical and systematic development to their mathematics if they begin to organise things systematically as they go. This even applies to their explorations.

There are a number of ways of using **Make a Table**. Tables can also be an efficient way of finding number patterns.

When an **Organised List** is being used, it should be arranged in such a way that there is some natural order implicit in its construction.

5. Think

In many ways we are using this strategy category as a catch-all. This is partly because these strategies are not usually used on their own but in combination with other strategies.

The strategies that we want to mention here are:

- Being Systematic,
- Keeping Track,
- Looking For Patterns,
- Use Symmetry and
- Working Backwards and
- Use Known Skills.

Being systematic may mean making a table or an organised list but it can also mean keeping your working in some order so that it is easy to follow when you have to go back over it. It means that you should work logically as you go along and make sure you don't miss any steps in an argument.

It is very important to **keep track** of your work. Keeping track is particularly important with Act it Out and Using Equipment. But it is important in many other situations too.

In many ways **looking for patterns** is what mathematics is all about. We want to know how things are connected and how things work and this is made easier if we can find patterns. Patterns make things easier because they tell us how a group of objects acts in the same way. Once we see a pattern we have much more control over what we are doing.

Using symmetry helps us to reduce the difficulty level of a problem.

Finally **working backwards** is a standard strategy that only seems to have restricted use. However, it's a powerful tool when it can be used.

Then we come to **use known skills**. This isn't usually listed in most lists of problem solving strategies but as we have gone through the problems in this web site, we have found it to be quite common. The trick here is to see which skills that you know can be applied to the problem in hand.

Uses of Strategies

Different strategies have different uses. We'll illustrate this by means of a problem. For example:

The Farmyard Problem: In the farmyard there are some pigs and some chickens. In fact there are 87 animals and 266 legs. How many pigs are there in the farmyard?

The following strategies help you to understand a problem:

- 1) Guess and check
- 2) Guess and Improve
- 3) Making a Table
- 4)

What Strategies Can Be Used At What Levels

Based on many research findings students are able to tackle and use more strategies as they continue with problem solving. They are also able to use them to a deeper level. The following strategies being used in the stated Levels.

Levels 1 and 2

- Draw a Picture
- Act it Out
- Use Equipment
- Guess and Check

Levels 3 and 4

- Draw a Diagram
- Act it Out
- Use Equipment
- Guess and Improve
- Make a Table
- Make an Organised List

It is important to say here that the research has not been exhaustive. Strategies can develop in at least two ways.

- First children's ability to use strategies develops with experience and practice.
- Second, strategies themselves can become more *abstract* and *complex*.
- Not all children may follow this development precisely. Some children may skip various stages.

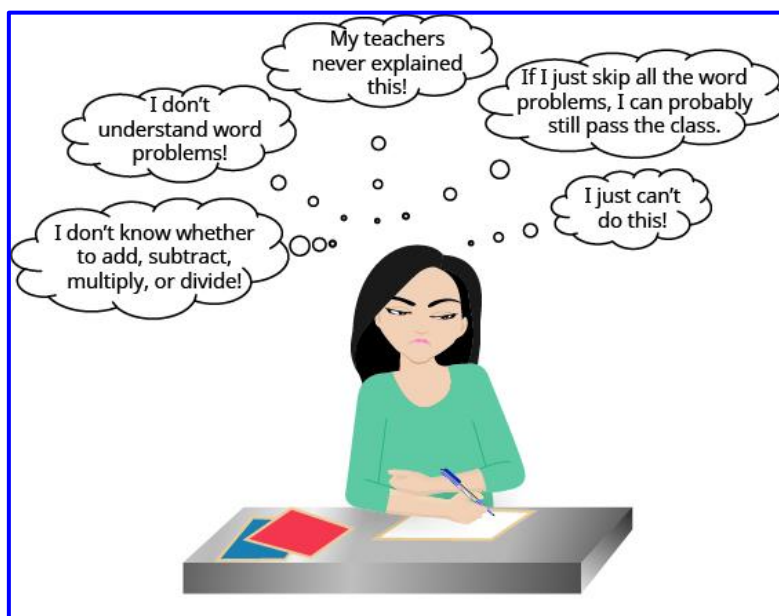
The 9 Problem Solving Strategies

- 1 Look for the important words in the question**
Write them down.
Underline them.
Make sure I know what to do.
- 2 Look for a pattern**
Can I see something happening over and over again?
Will this help me solve the problem?
- 3 Have a go**
Try an answer.
Does the answer make sense?
- 4 Use a table or a chart**
Will something like this help?

- 5 Use a drawing**
Can I draw something about the problem?
Will this help me to find the answer?
- 6 Work backwards**
Can I start at the end of the question to help work it out?
Will my answer work?
- 7 Try an easier problem**
Can I change the numbers in the question to make it simpler?
Will this make finding the answer easier?
- 8 Make a model**
Can I use paper or blocks to help me find the answer?
Can I use people to help me find the answer?
- 9 Think logically**
Can I tell something about the answer straight away?
Can I get rid of answers that are not correct?

Approach Word Problems with a Positive Attitude

Do you know anyone who has had *negative experiences* in the past with word problems? Have you ever had thoughts like the student in the cartoon below?



Negative thoughts about word problems can be barriers to success.

When we feel we have no control, and continue repeating negative thoughts, we set up barriers to success. We need to calm our fears and change our negative feelings.

Start with a fresh slate and begin to think positive thoughts like the student in the cartoon below. Read the positive thoughts and say them out loud.



When it comes to words problems, a positive attitude is a big step toward success.

If we take control and believe we can be successful, we will be able to master word problems.

Think of something that you can do now but couldn't do three years ago. Whether it's driving a car, or speaking a new language, you have been able to learn and master a new skill.

Word problems are no different. Even if you have struggled with word problems in the past, you have acquired many new math skills that will help you succeed now!

Problem-Solving Strategy

1. **Read** the word problem. Make sure you understand all the words and ideas. You may need to read the problem two or more times. If there are words you don't understand, look them up in a dictionary or on the internet.
2. **Identify** what you are looking for.
3. **Name** what you are looking for. Choose a variable to represent that quantity.
4. **Translate** into an equation. It may be helpful to first restate the problem in one sentence before translating.
5. **Solve** the equation using good algebra techniques.
6. **Check** the answer in the problem. Make sure it makes sense.
7. **Answer** the question with a complete sentence.

Word Problems

1. Mr. Peter bought a shirt on sale for \$18, which is one-half the original price. What was the original price of the shirt?
2. Wanchai brought apples and bananas to a picnic. The number of apples was three more than twice the number of bananas. Wanchai brought 11 apples to the picnic. How many bananas did he bring?