Problem Solving in Mathematics

K–2

Sample Pages

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HODDER EDUCATION

1 Problem solving and why it is important

Today's students are growing up in an increasingly technological and information-rich world. This has led to some changes in education, notably a move away from rote learning to more enquiry- and skills-based approaches. Students, even at the early levels of schooling, are expected to develop a range of skills, including problem-solving skills.

Creative thinking and problem-solving skills are valued at school, but they are also very relevant in the real world. Students still need to learn basic mathematical skills, but they also have to be able to apply these in unfamiliar contexts and to communicate their thinking and explain how they got to their solutions.

This book aims to provide challenging but supportive contexts for teaching and learning how to approach problem solving in mathematics. The course is underpinned by the 'Five Es' approach to learning.

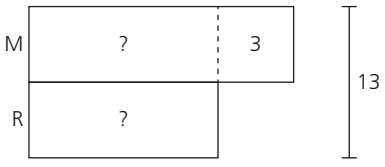
The course will help students to:

- **Engage** with problems meaningfully
- **Explore** different options for approaching and solving problems
- **Explain** how they are thinking
- **Elaborate** on their working and processes and see connections between different areas of mathematics
- **Evaluate** what worked and what didn't, learning from mistakes as well as successes.

Mathematical problems

In primary mathematics, problem solving is often associated with 'word problems' or 'story sums'. For example, Micah and Raydon have 13 marbles between them. Micah has 3 more than Raydon. How many does Raydon have?

For many students, the main 'problem' in these types of questions is that they don't know what is being asked of them. Once they work out what they are being asked to find, they can often do the calculations easily. One method of approaching these types of questions is to teach students to represent them visually. This is a key feature of successful mathematics teaching in Singapore and elsewhere. For example, the problem above could be shown like this:

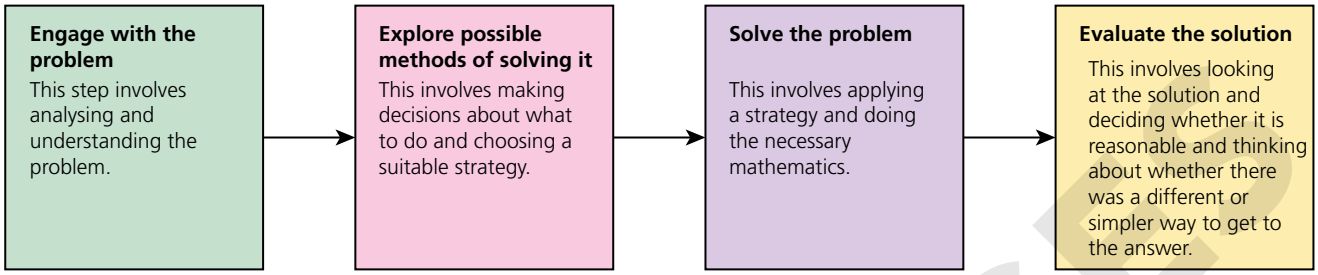


This is called a bar model and it is one of the strategies we will explore in the course.

In this book we include word problems but we also provide problems involving patterns, measurement, shape and space and data. In fact, any question where the solution and method of working are not immediately clear is considered to be a problem.

The process of problem solving

Problem solving refers to the process or steps that you take to find a solution (the answer). There are four main steps in the process:



Problem-solving strategies

The strategies that we introduce and teach in this book are designed to help students approach different types of problems. Some strategies are more suited to particular types of problems and it will be useful to give students experience of using these with carefully selected problems. Research suggests that this is an efficient method of developing problem-solving skills.

The key strategies for Grades K–2 are:

* Acting it out
* Modelling using real objects
* Drawing diagrams
* Making organised lists
* Using tables
* Looking for patterns and making connections
* Guess, check and improve.

Chapters 2–8 each deal with a single strategy. The strategy is introduced and a number of step-by-step worked examples are provided to show the strategy in use. Once the strategy has been taught, students can then work through a set of graded problems to try it out and gain experience in both using the strategy and recognising the types of problems that can be solved by applying the strategy.

In reality, students will not be told what strategy to use to solve problems. Chapter 9 provides a set of mixed problems to allow students to apply what they've learned and to choose their own strategies for solving the problems.

The answers to all problems are given on pages 59–61. A set of worked solutions can be found online at: www.hoddereducation.com/Problem-Solving-Answers

2 Act out problem situations

Explain

In the early years it is useful to let students 'act out' a problem situation using themselves and their bodies to model it.

Acting out problem situations is useful for logic problems and pattern- or position-related problems that involve small numbers.

Some data-handling problems can be demonstrated and solved by creating groups of children to represent the data in each category so that students can compare them, add or subtract numbers and count to find totals.

As students work in the higher numbers range and perform two-step operations, this strategy becomes less useful because it is impractical to model situations with people when the numbers are too large.

Note

Modelling problem situations using concrete objects and apparatus is covered in detail in Chapter 3.

Worked example 1

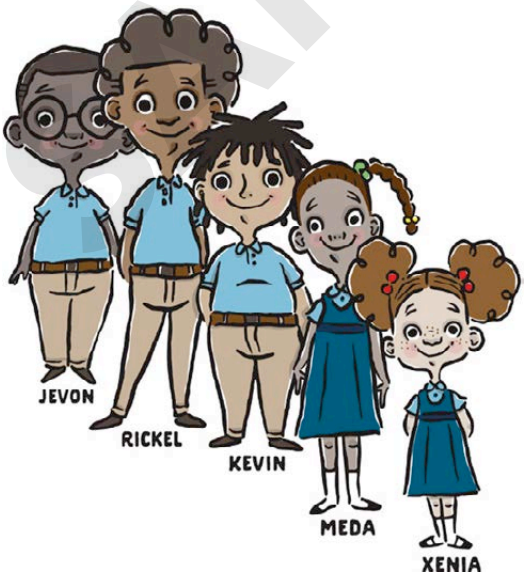
Five students are standing in line to buy snacks.

- Jevon is behind Rickel. There is no one in between them.
- Kevin is between Meda and Rickel.
- Meda is behind Xenia.

Which student is last in line?

Acting it out	Thinking
	Let five students play the role of the students in the problem. Let them each have a name card.

Worked example 1 Continued...

Acting it out	Thinking
	Arrange Jevon and Rickel so that Jevon is behind Rickel.
	Kevin is next to Rickel but he can't be behind him because Jevon is there. Let Kevin stand in front of Rickel. Meda has to be in front of Kevin because Kevin is between her and Rickel.
	Meda is behind Xenia, so Xenia has to be in front of Meda. Now all five children are in position and you can see that Jevon is last in line. Answer: Jevon

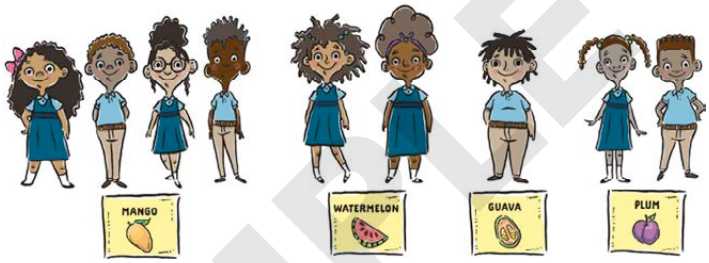
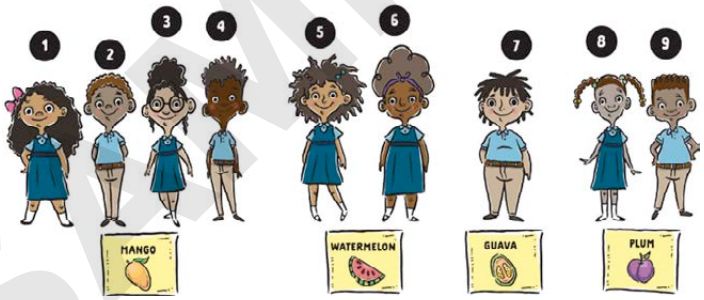
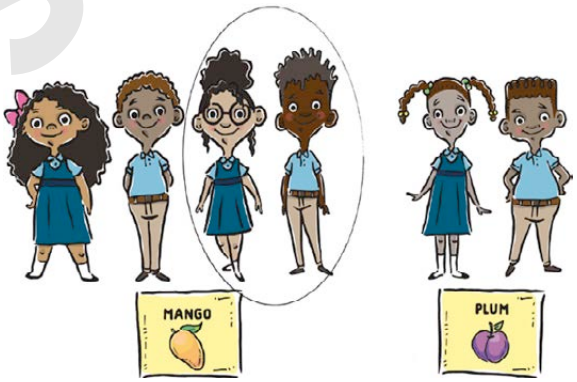
Worked example 2

This pictogram shows the favourite fruits of a group of Grade 1 students. Each fruit represents one child.

Fruit	Children who chose it
Mango	
Water melon	
Guava	
Plum	

a How many children are in the group?

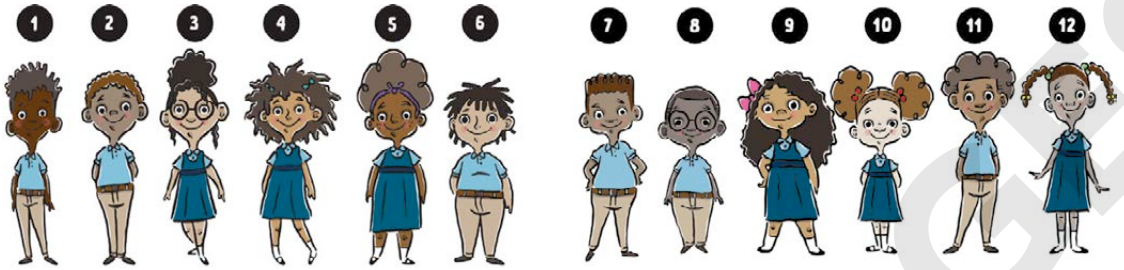
b How many more children like mangoes than plums?

Acting it out	Thinking
	Model the graph using students. Let them line up next to each other in oder of fruits.
	Ask the students to number themselves one by one to find the total number in the group. Answer a: There are 9 in the group.
	Ask the mango group to stand in line. Tell the plum group to stand next to them. Match up students and count how many more are in the mango group. Answer b: Two more children like mangoes than plums.

Worked example 3

A teacher has 12 students. She wants to put them into 3 groups of the same size. How many students will be in each group?

Acting it out



Ask 12 students to come to the front.
Count them to show the class that there are 12.

Allocate a spot for each group.
Let 3 students walk to the groups, 1 per allocated spot.

Repeat this until all 12 students are placed in groups.
Count the number in each group.
Check that the class agrees the groups are the same size.
Answer: There are 4 students in each group.

Now you try …

Solve these problems by acting them out in groups.

Write your answers in this book.

1 Micah has 7 seven dogs. Three of the dogs are brown, the rest are black. How many dogs are black?

_____ dogs are black.

2 Three children were in a group. Another 2 children joined them. How many are in the group now?

There are _____ children in the group.

3 A group of 15 students stands in 3 rows with the same number of students in each row. How many students are in each row?

There are _____ students in each row.

4 It is 5 steps from Tina's desk to the chalkboard. She walks to the board and back 3 times in a lesson.

How many steps does she take?

Tina takes _____ steps.

5 Shara, Michelle, Jayson and Keira are sitting in a row next to each other.

Shara is not next to Michelle.

Michelle and Kiera are next to each other.

Jayson is two seats away from Michelle.

Shara is sitting on the first seat from the left.

In which order are the children sitting?

6 Jayden, Mickel and Rayvon are taking photos. They stand in a line to do this. How many ways are there of arranging themselves?

Hint: Just write the initials. It will take too long to write out the names each time.

Act this out and record all the ways they could stand in a row in the table below.

First person	Second person	Third person

There are ☐ ways of arranging themselves in a row.

7 In a group of children there are 40 fingers and toes. How many children are in the group?

There are ☐ children in the group.

8 A class of 22 students is going on a trip on 2 different buses. Half of the students will go on each bus. How many students will there be on a bus?

There will be ☐ students on each bus.

9 Four children measured their mass. James was heavier than Kyle but not as heavy as Rickel. Peter was heavier than Rickel.

Write the names of the children in order from lightest to heaviest.

☐

10 A boy is playing a game on the steps. He jumps up 2 steps then he jumps back down 1 step. There are 6 steps and he starts on the ground. How many jumps does he take to reach the top step?

He takes ☐ jumps.

11 A taxi picks up passengers on the way to town. Two people get on at the first stop. At the second stop, 1 gets off and 3 more people get on. At the third stop no one gets off and 2 people get on. How many people are in the taxi now?

There are ☐ people in the taxi.

12 Two boys and 2 girls want to sail to an island. The boat can only hold 2 girls or 1 boy at a time. How can all 4 of them get to the island?

Work with three friends to act out how they could do this.

We live in an increasingly technological and information-rich world. Education is focusing more on enquiry and skills-based approaches. Students, even at the early levels of schooling, are expected to develop a range of skills, including problem-solving skills.

Creative thinking, using information appropriately and problem solving are important for students in the school curriculum and in daily life. This book will help students learn how to apply mathematical skills in different contexts and explain how they got to their solutions.

This book is easy for parents and teachers to use, and teaches multiple strategies for solving problems, using stimulating and supportive contexts. The approach is underpinned by the Five Es approach to learning.

The course will help students to:

- Engage with problems meaningfully
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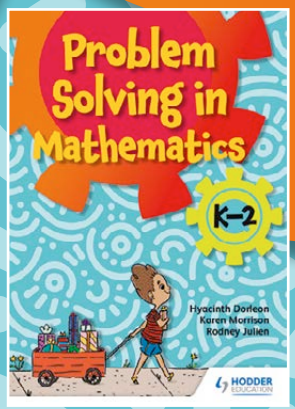

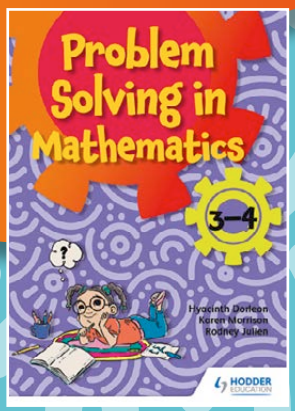

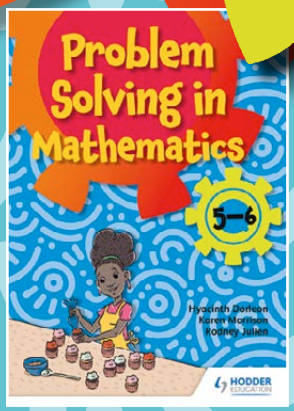

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