Heuristics Policy

"We need heuristic reasoning when we construct a strict proof as we need scaffolding when we erect a building."

George Pólya

The Beeches Primary School

By Emma McFarland

Last reviewed: March 2023

Next review date: March 2025

Objectives:

- To understand the rationale of using different heuristics in solving Maths problem sums in different year groups.
- To be able to identify the heuristics technique to solve primary problem.
- For staff to be able to guide pupils to solve problem sums using different heuristics.

Definition:

Heuristics refers to the different strategies that we can adopt to solve unfamiliar or non-routine Maths problems.

There are different types of heuristics and they can be grouped into four categories, based on how they are being used:

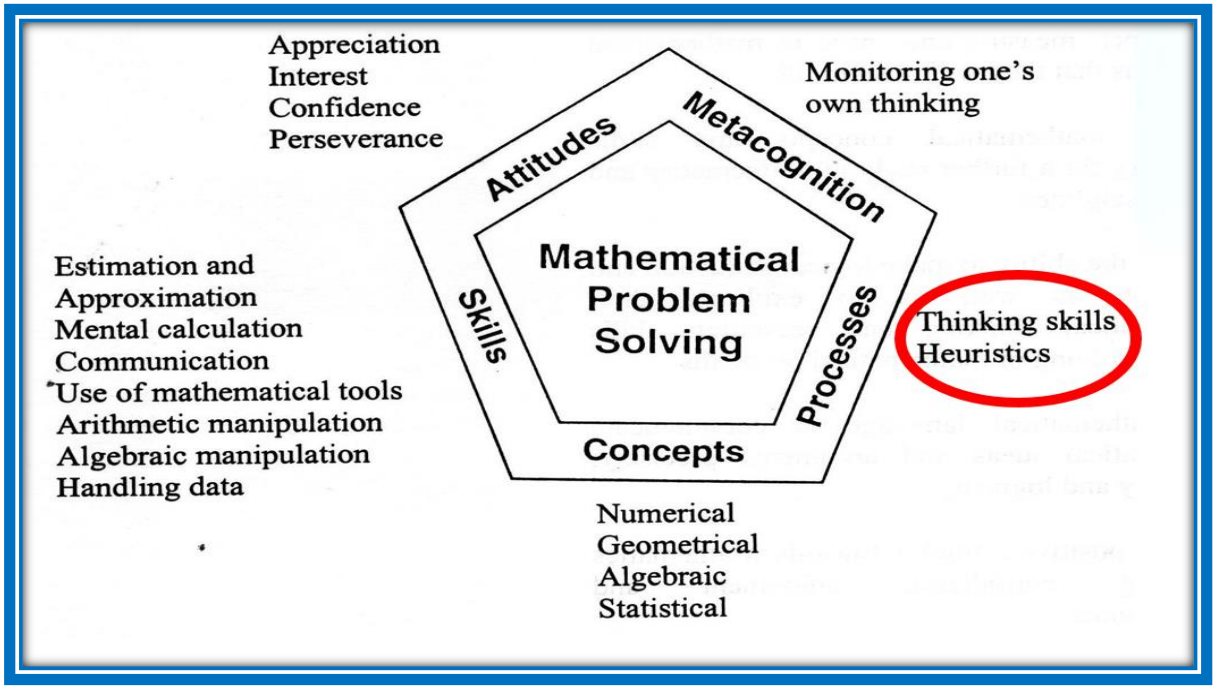
Thinking skills:

To give a representation	To make a calculated guess	To go through the process	To change the problem
• Draw a diagram/bar model • Make a list • Use equations	• Guess and check • Look for patterns • Make suppositions	• Act it out • Work backwards • Before-after	• Restate the problem • Simplify the problem • Solve part of the problem

Thinking skills are skills that can be used in a thinking process, such as:

- classifying
- comparing
- analysing parts and whole
- identifying patterns and relationships
- induction
- deduction
- generalising
- spatial visualisation

Curriculum Framework:

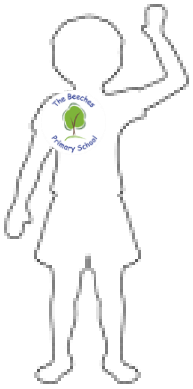


Why does the Beeches Primary School need to adopt these approaches?

To build resilience

To encourage parental support

To support EAL learners



To increase mathematical vocabulary and reasoning skills

To link to real life experiences

To increase pupils' self-esteem

Problem-solving Process:

Pupils need to be able to employ a problem-solving process and be able to choose an appropriate heuristic technique.

Step 1 – Study the Problem

-Read the problem a couple of times to fully understand it.

- Ask questions like:
  - What do I know?
  - Who is involved?
  - What do I not know?
  - What is the problem asking for?

- Highlight and connect the information.

Step 2 – Think of a Plan

- Think about the different strategies that could be used.
- Ask questions like:

-Which strategy should I use?
-Have I solved similar questions before?
- Keep track of strategies tried unsuccessfully so as not to repeat them on similar type of problem.

Step 3 – Act on the problem

- Apply the heuristics.

- Represent the content in the form of i.e. model, diagram, table, etc while solving the problem.
-Ensure approach is systematic.
-If "stuck", repeat Step 1.

Step 4 - Reflecting

-Ask questions like:

- Does my answer make sense?
- Is there a better alternative?
- Have I answered the question?

- Feed the answer derived back into the question to get back the original set of knowns.
- Extend the solution to other problems.

Year Groups' Heuristics Techniques

Year Group	Problem Solving Focus	Heuristic Techniques

Reception		• **STAR**
		  ▪ Study – what is the important information?
		  ▪ Think – choose your method.
		  ▪ Act – solve it.
		  ▪ Reflect – have we solved it correctly.
		• Acting out.
		• Pictures/ diagrams.
		• Manipulatives.
		• Lists.
		• Jottings.

Year 1	Solve one step number problems, including missing numbers. Solve time problems.	• **STAR**
		  ▪ Study – what is the important information?
		  ▪ Think – choose your method.
		  ▪ Act – solve it.
		  ▪ Reflect – have we solved it correctly.
		• Acting out.
		• Pictures/ diagrams.
		• Manipulatives.
		• Lists.
		• Jottings.

Year 2	Solve problems involving all four operations, including missing numbers.	• **STAR**
		  ▪ Study – what is the important information?
		  ▪ Think – choose your method.
		  ▪ Act – solve it.
		  ▪ Reflect – have we solved it correctly.
		• Acting out.
		• Pictures/ diagrams.
		• Manipulatives.
		• Lists.
		• Jottings.
		• Guess and check.
		• Look for patterns.
		• Writing steps to success to help them systematically understand the steps to solve the problem.

Year 3	Solve one and two step problems, including missing numbers.	• **STAR**
		  ▪ Study – what is the important information?
		  ▪ Think – choose your method.
		  ▪ Act – solve it.
		  ▪ Reflect – have we solved it correctly.
		• Acting out.
		• Pictures/ diagrams.
		• Manipulatives.
		• Lists.
		• Jottings.
		• Guess and check.
		• Look for patterns.

Year 4	Solve one and two step word problems, deciding which operations and methods to use and why, including missing numbers. Solve problems converting measures, including time (12/24 hour; hours to minutes; minutes to seconds; years to months; weeks to days).	• **STAR**
		  ▪ Study – what is the important information?
		  ▪ Think – choose your method.
		  ▪ Act – solve it.
		  ▪ Reflect – have we solved it correctly.
		• Acting out.
		• Pictures/ diagrams.
		• Manipulatives.
		• Lists.
		• Jottings.
		• Guess and check.
		• Look for patterns.

Year 5	Solve multi-step problems, deciding which operation and explain why, including missing numbers	• Identify the questions being asked.
		• Choose the correct choice of heuristic quickly.
		• **STAR**
		  ▪ Study – what is the important information?
		  ▪ Think – choose your method.
		  ▪ Act – solve it.
		  ▪ Reflect – have we solved it correctly.
		• Acting out.
		• Pictures/ diagrams.
		• Manipulatives.
		• Lists.
		• Jottings.
		• Guess and check.
		• Look for patterns.

Year 6	Solve problems involving the calculation of percentages. Solve number and practical problems with multi-steps, including missing numbers	• Identify the questions being asked. • Choose the correct choice of heuristic quickly. • **STAR** ▪ Study – what is the important information? ▪ Think – choose your method. ▪ Act – solve it. ▪ Reflect – have we solved it correctly. • Acting out. • Pictures/ diagrams. • Manipulatives. • Lists. • Jottings. • Guess and check. • Look for patterns.

Monitoring & Evaluation

The Headteacher and other senior staff will monitor the effectiveness of the training and classroom use of heuristic approaches as part of the monitoring and evaluation cycle termly. They will take account of the following:

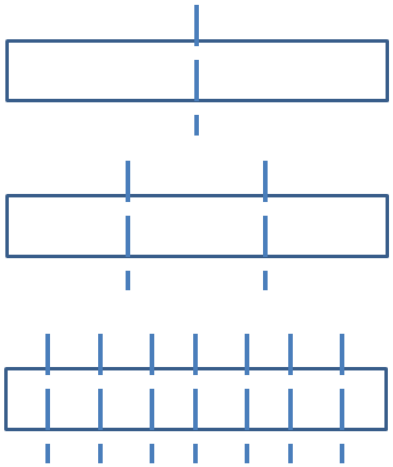
- Lesson Observations
- Learning walks
- Pupil feedback
- Staff feedback
- Working wall displays
- Book scrutinise
- Pupil Progress reports
- Pupil Attainment reports

Appendices

This section contains examples of heuristics techniques.

Draw a Diagram

A piece of thick log has to be cut into smaller pieces. It takes 30 seconds for one cut.



To cut the log into 8 pieces, I need 7 cuts.

7 x 30 = <u>210</u>

Draw a Table

Mrs Tan is 32 years old. Her daughter, Lisa, is 8 years old.
How old will Mrs Tan be when Lisa is half her age?

Mrs Tan	Lisa
32	8
33	9
34	10
35	11
36	12
...	...

Act it Out

There were 4 children in the classroom, i.e. Alex, Ben, Carl and Daniel. Each child shook hands with the other 3. How many handshakes were there altogether?

Alex Ben Carl Daniel

Ben Carl Daniel
Carl Daniel
Daniel

3 + 2 + 1 = 6

Guess and Check

There are 10 animals in a farm. Some of them are chickens and the rest are cows. There are 36 legs altogether.

How many chickens and cows are there?

Chickens		Cows		
No.	Legs	No.	Legs	Total Legs
9	18	1	4	22
8	16	2	8	24
…	…	…	…	…
2	4	8	32	36

Create an Organised List

A pair of dice is rolled.

The 2 rolled numbers are then added together.

How many different ways can you roll a total of 6?

There are 5 ways altogether.

Die 1	Die 2
1	5
2	4
3	3
4	2
5	1

Look for a Pattern

How many dots are there in Pattern 10?

Pattern 1 Pattern 2 Pattern 3 Pattern 4

Pattern	Total no. of dots
1	1
2	4
3	9
4	16
…	…

1×1 1

2×2 $1 + 3$

3×3 $1 + 3 + 5$

4×4 $1 + 3 + 5 + 7$

…