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THE MATHEMATICAL ASSOCIATION OF VICTORIA

Embedding the Proficiency Strands through Evidence Based Practices

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Let's start with a problem

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The petrol tank in my car holds 73 ½ litres. If the pump delivers 12 ¼ litres per minute, how long will it take to fill the tank?

Assuming the tank is completely empty.

How can we solve this problem?

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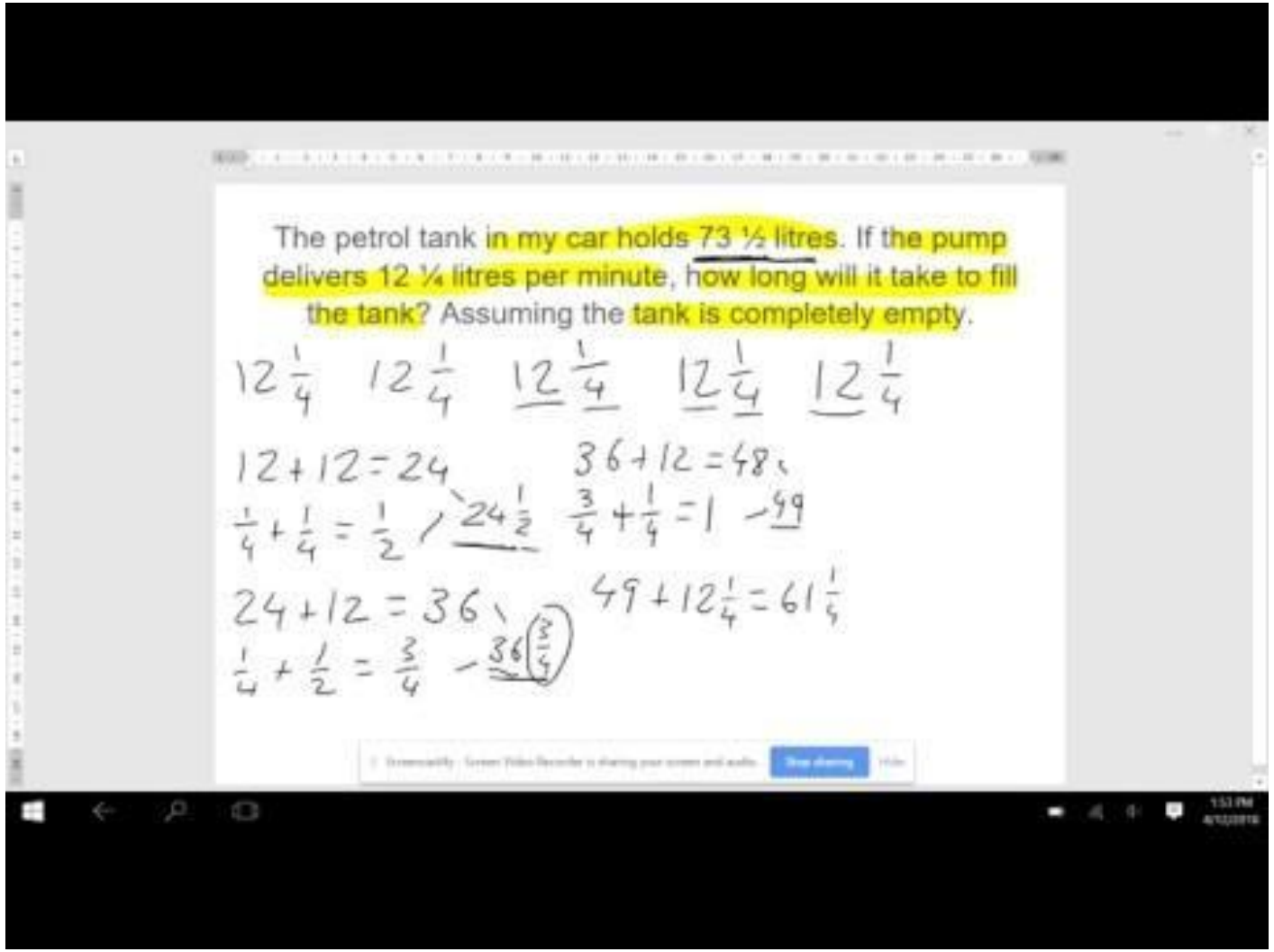

Transfer Learning

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How were we able to solve this problem?

What did we need to know to solve this problem?

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- Fractions
- Decimals
- Percentages
- Minutes
- Seconds
- Addition
- Subtraction
- Multiplication
- Division

- Draw a picture
- Think logically
- Act it out
- Work backwards
- Make a list or table
- Look for a pattern
- Guess, Check and Improve
- Experiment
- Simplify the problem

Problem Solving Strategies

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Make a list or Table

Guess, Check and Improve

Experiment (Idea and Test)

Simplify the Problem

Draw a Picture

Look for a Pattern

Make a Model

Work Backwards

Act it Out

Think Logically

So how do we embed?

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Make a List or Table	Look for a Pattern	Guess, Check and Improve	Experiment (Idea and Test)	Simplify the Problem	Make a Model	Draw a Picture	Think Logically	Work Backwards	Act it Out

Foundation	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Act It out	Act it out	Act it out	Act it out	Act it out	Experiment (Idea and Test)	Experiment (Idea and Test)
Guess and Check	Guess and Check	Guess and Check	Guess and Check	Guess, Check and Improve	Guess, Check and Improve	Guess, Check and Improve
Make a List	Make a List	Make a List	Make a List or Table	Make a List or Table	Make a List or Table	Make a List or Table
Use a Picture	Draw a Picture	Draw a Picture	Draw a Picture	Draw a Picture	Draw a Picture	Draw a Picture
Use a Pattern	Use a Pattern	Use a Pattern	Look for a Pattern	Look for a Pattern	Look for a Pattern	Look for a Pattern
	Work Backwards	Work Backwards	Work Backwards	Work Backwards	Work Backwards	Work Backwards
		Make a Table	Think Logically	Think Logically	Think Logically	Think Logically
				Simplify the Problem	Simplify the Problem	Simplify the Problem
					Make a Model	Make a Model

But we need to keep in mind….

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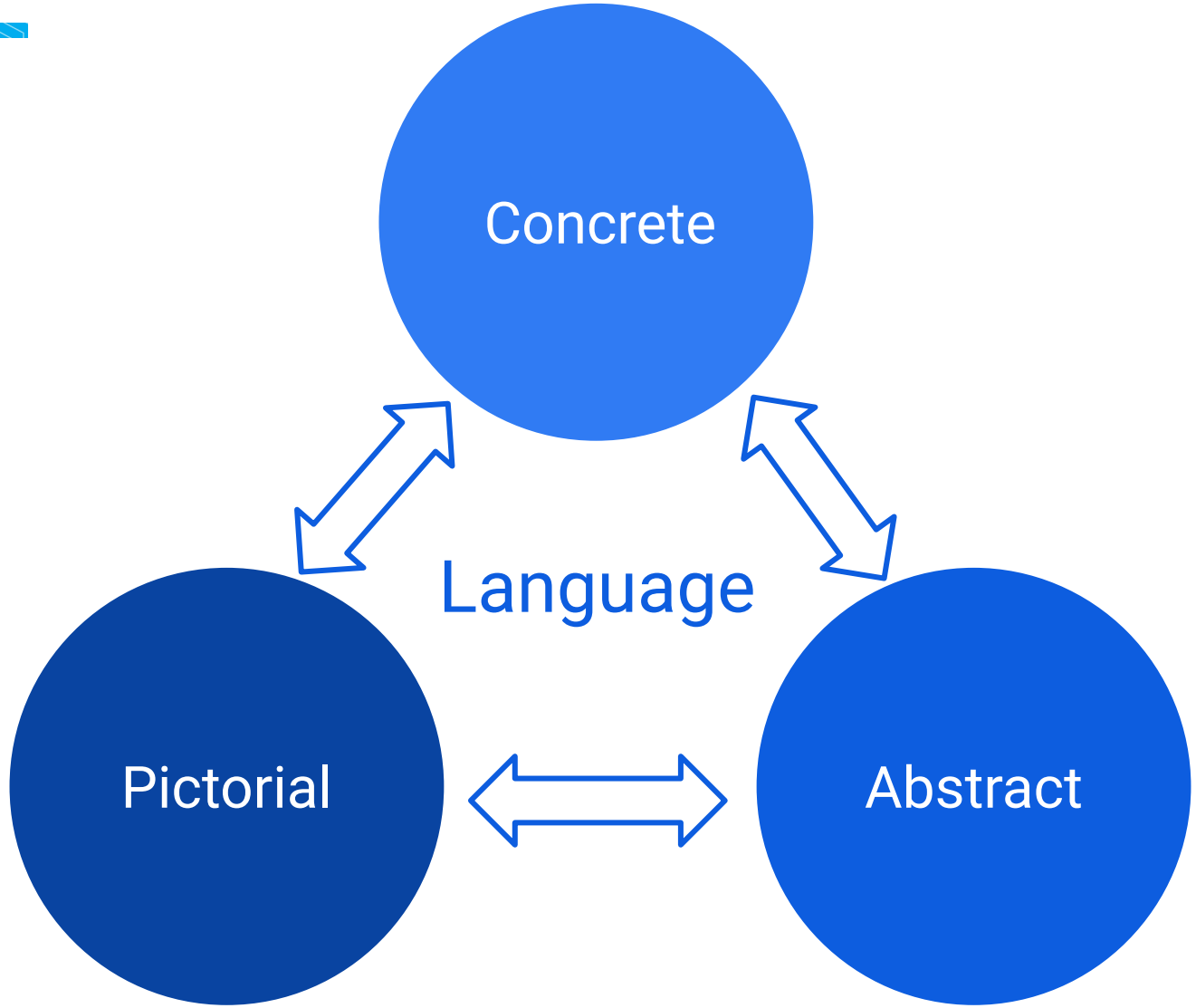

-Bruner, 1966

Challenging Tasks

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"whether a specific mathematics problem is a challenge depends on the mathematical experience of an individual learner"

-Powell, et.al, 2009

Enabling Prompts

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Reducing complexity not thinking:

- Change the range of numbers
- Reduce the number of steps
- Simplify the problem
- reduce the physical or mental demands through materials or visuals
- Collaboration
- Questioning

-Sullivan, 2015

Our Original Problem

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The petrol tank in my car holds 73 ½ litres. If the pump delivers 12 ¼ litres per minute, how long will it take to fill the tank? Assuming the tank is completely empty.

Enabling Prompt

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The petrol tank in my car holds 50 litres. If the pump delivers 12 ½ litres per minute, how long will it take to fill the tank? Assuming the tank is completely empty.

Extending Prompts

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Extending thinking, not more work:

- Form generalisations
- Change the range of numbers
- Explanation of thinking and strategies
- Materials
- Devise another problem

-Sullivan, 2015

Our Original Problem

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The petrol tank in my car holds 73 ½ litres. If the pump delivers 12 ¼ litres per minute, how long will it take to fill the tank? Assuming the tank is completely empty.

Extending Prompt

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The petrol tank in my friends car holds 91 ⅞ litres. If the pump still delivers 12 ¼ litres per minute, how much longer will it take my friend to fill their tank? Assuming the tank is completely empty.

Challenging Tasks

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"while challenge is one of the core ingredients of effective learning, the art is in making the challenge appropriate to the student"

-Hattie, 2012

Challenging Tasks

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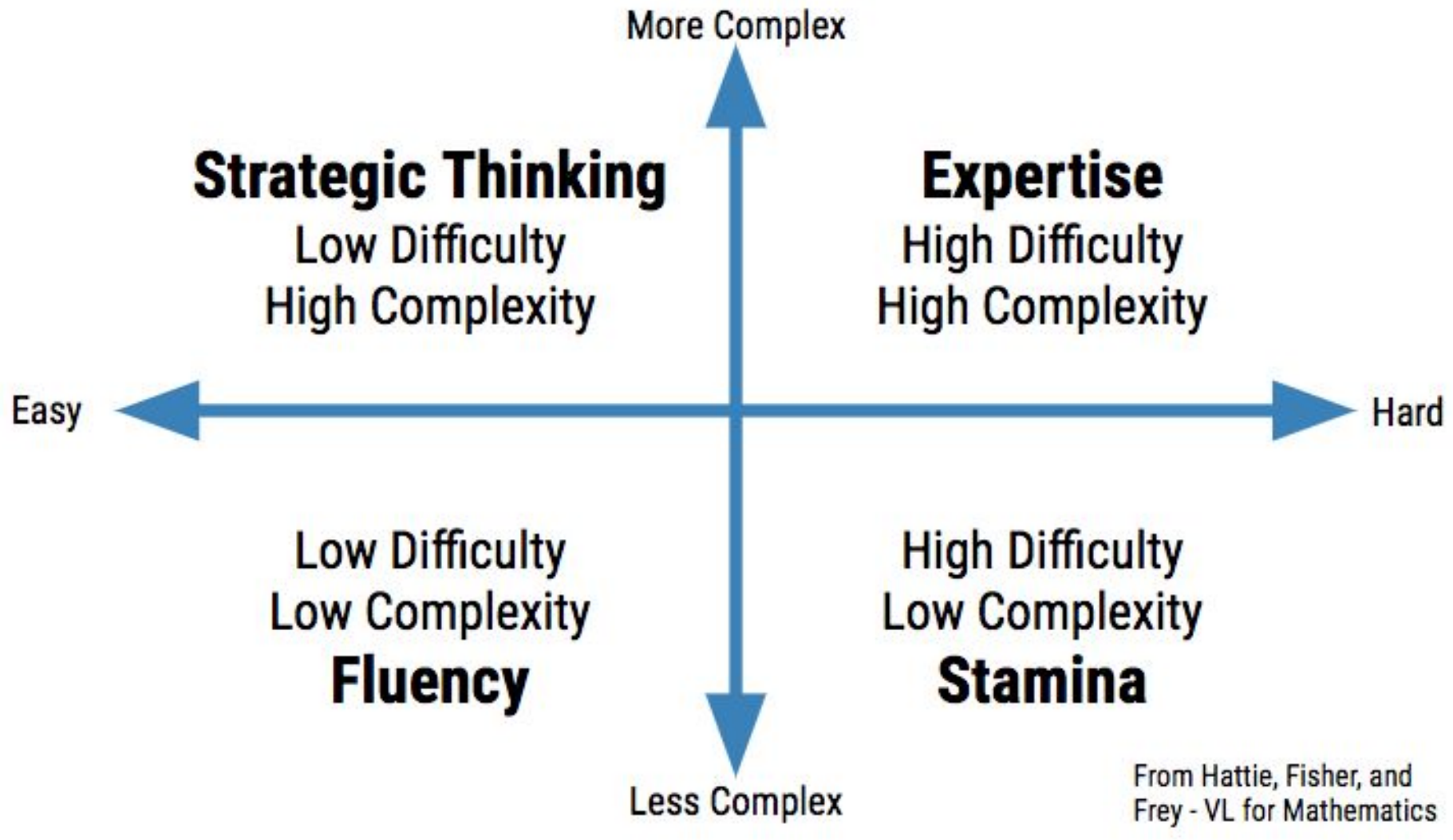

From Hattie, Fisher, and Frey - VL for Mathematics

How do we Problem Solve?

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"through Opportunity to Develop Strategic Competence (ODSC) students are given opportunities to solve problems and practice, practice, practice"

-Ally & Christiansen (2013)

Problem Solving Steps

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1. Understand the problem
2. Devise a plan
3. Carry out the plan
4. Look back

-George Polya

- Understand the problem
- Relevant / Irrelevant
- Select a strategy
- Take action
- Look back
- Explain/ Justify / Share

Problem Solving Plan

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Understand the problem:

Read the problem out loud to understand what it is asking you and try to visualise what it's asking you. Clarify any words you don't understand.

Relevant / Irrelevant:

What relevant information or key words help us solve the problem? What irrelevant information does not help us? Highlight the relevant information and leave out the irrelevant information.

Choose a strategy:

What problem solving strategy will you use? Will you need any mathematical strategies to assist you?

Problem Solving Plan

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Take action:

Use your strategy or strategies to help you work it out. If it's not working try another strategy.

Look back:

Reread the question. Have you answered the question properly? Check over your working out.

Explain / Justify / Share:

Explain in detail the strategy you used and how, the steps you took and what mathematics was involved. Explain why the strategy was used and what could be done differently, if anything.

What does this look like?

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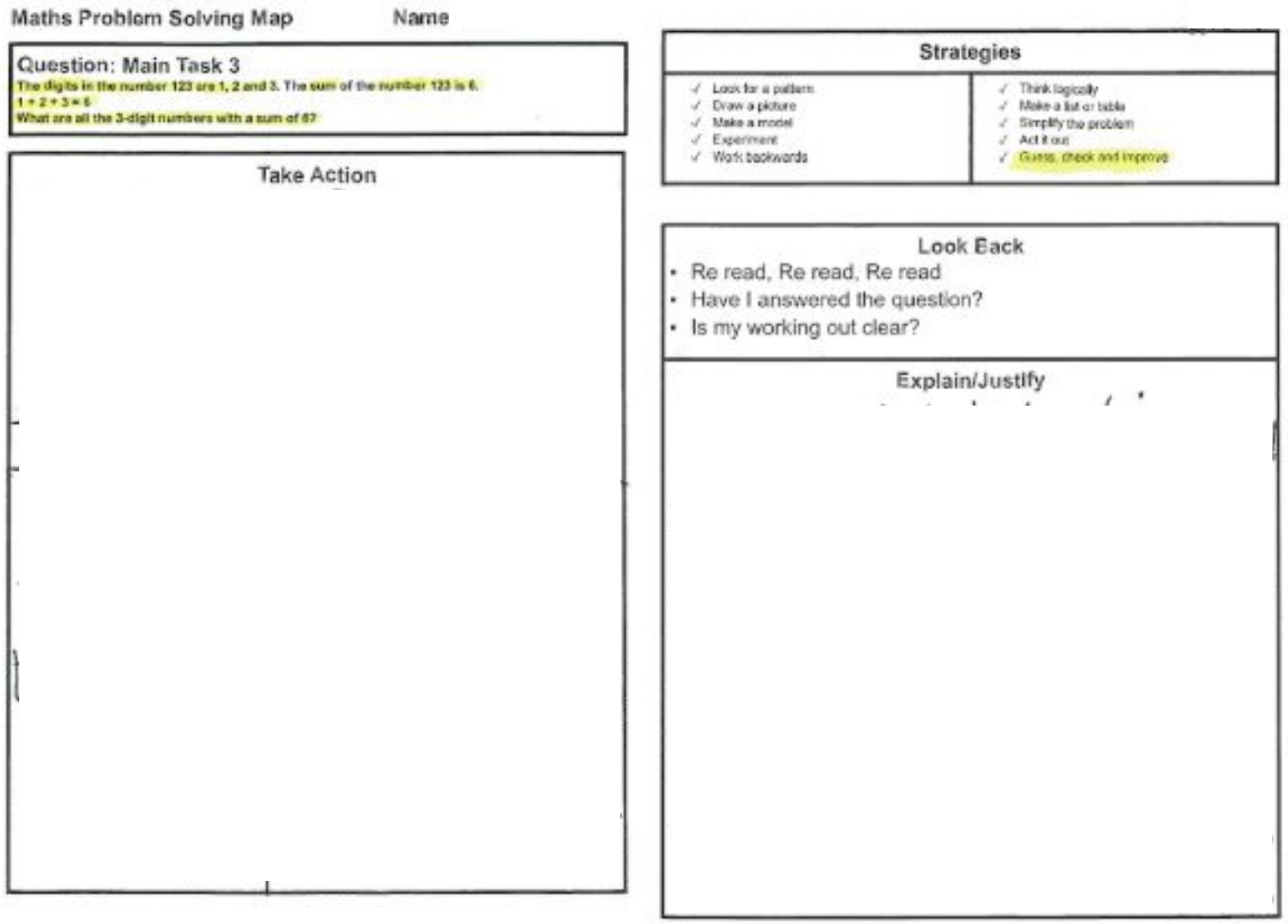

Maths Problem Solving Map Name

Question: Main Task 3

The digits in the number 123 are 1, 2 and 3. The sum of the number 123 is 6.
1 + 2 + 3 = 6
What are all the 3-digit numbers with a sum of 6?

Take Action

Strategies

- ✓ Look for a pattern
- ✓ Draw a picture
- ✓ Make a model
- ✓ Experiment
- ✓ Work backwards
- ✓ Think logically
- ✓ Make a list or table
- ✓ Simplify the problem
- ✓ Act it out
- ✓ Guess, check and improve

Look Back

- Re read, Re read, Re read
- Have I answered the question?
- Is my working out clear?

Explain/Justify

Where does Mathematical Proficiency fit in?

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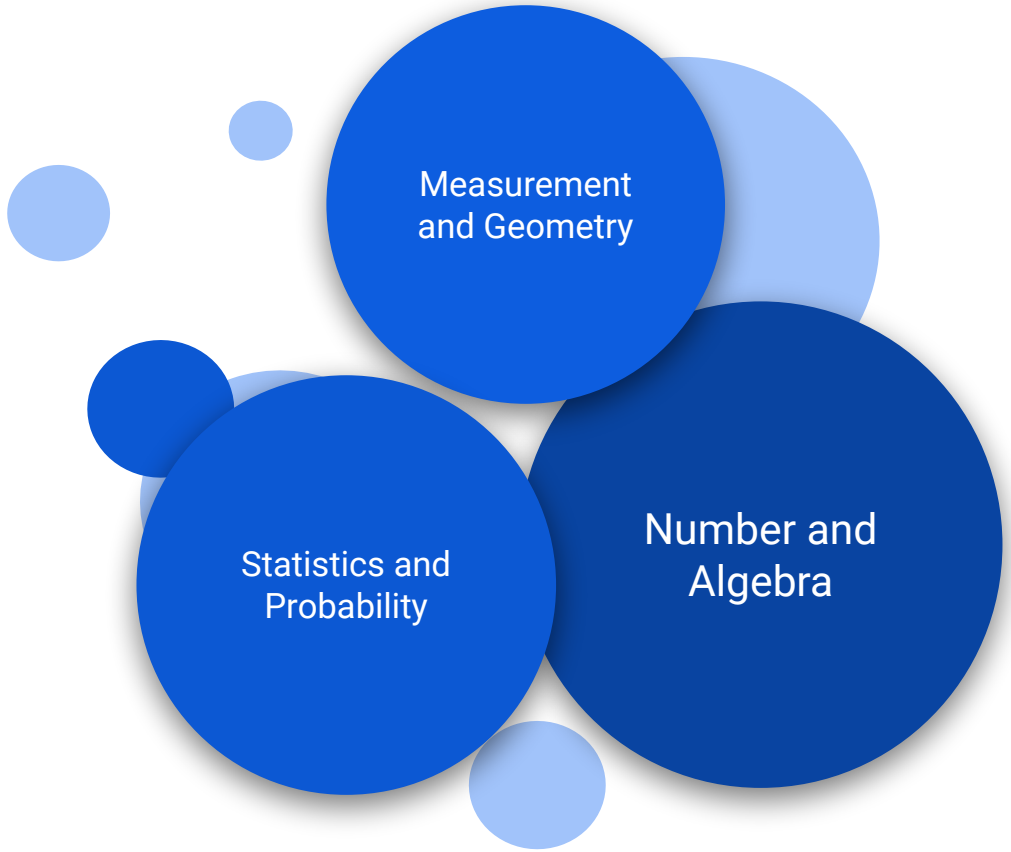

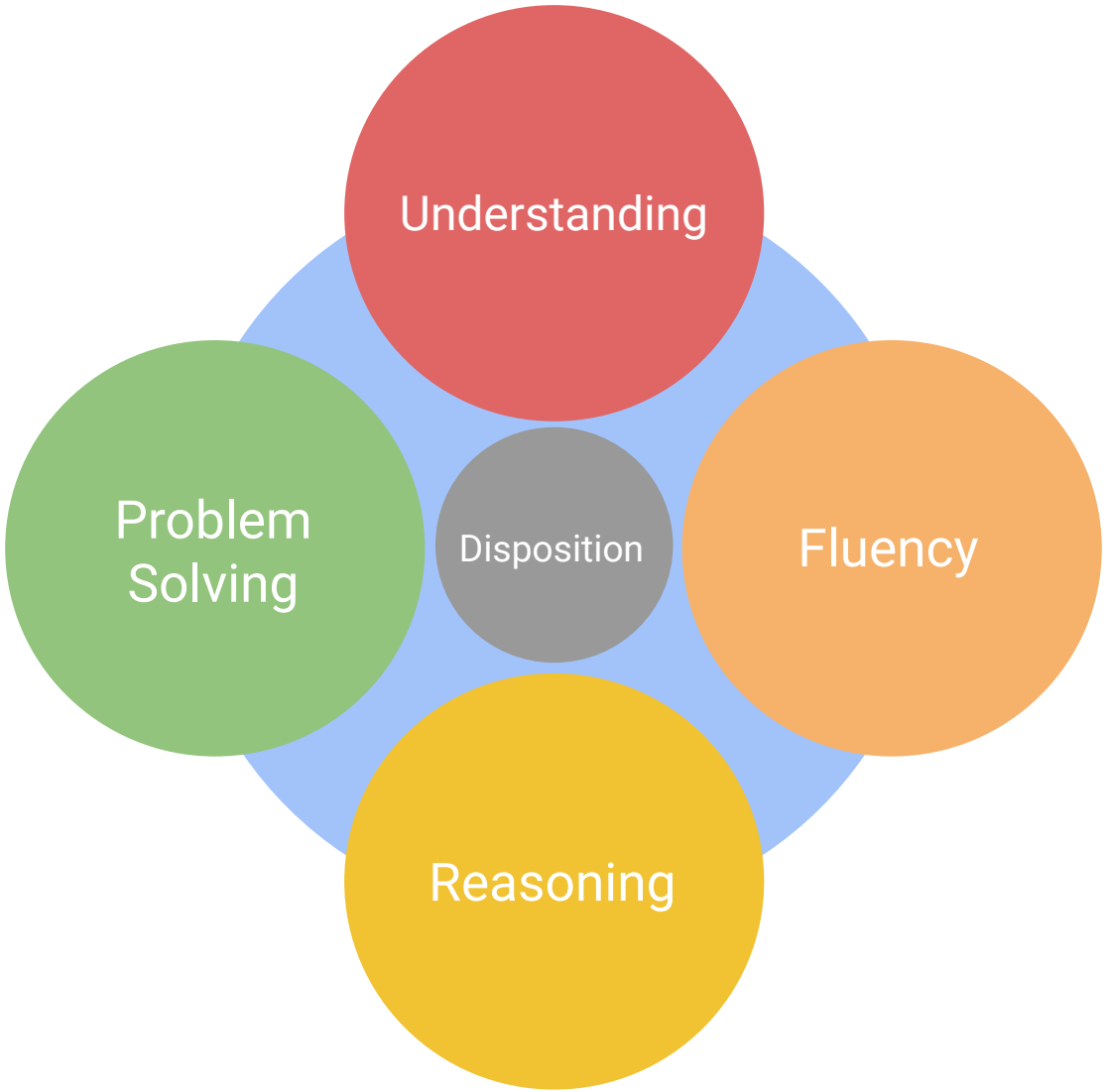

The Mathematical Web

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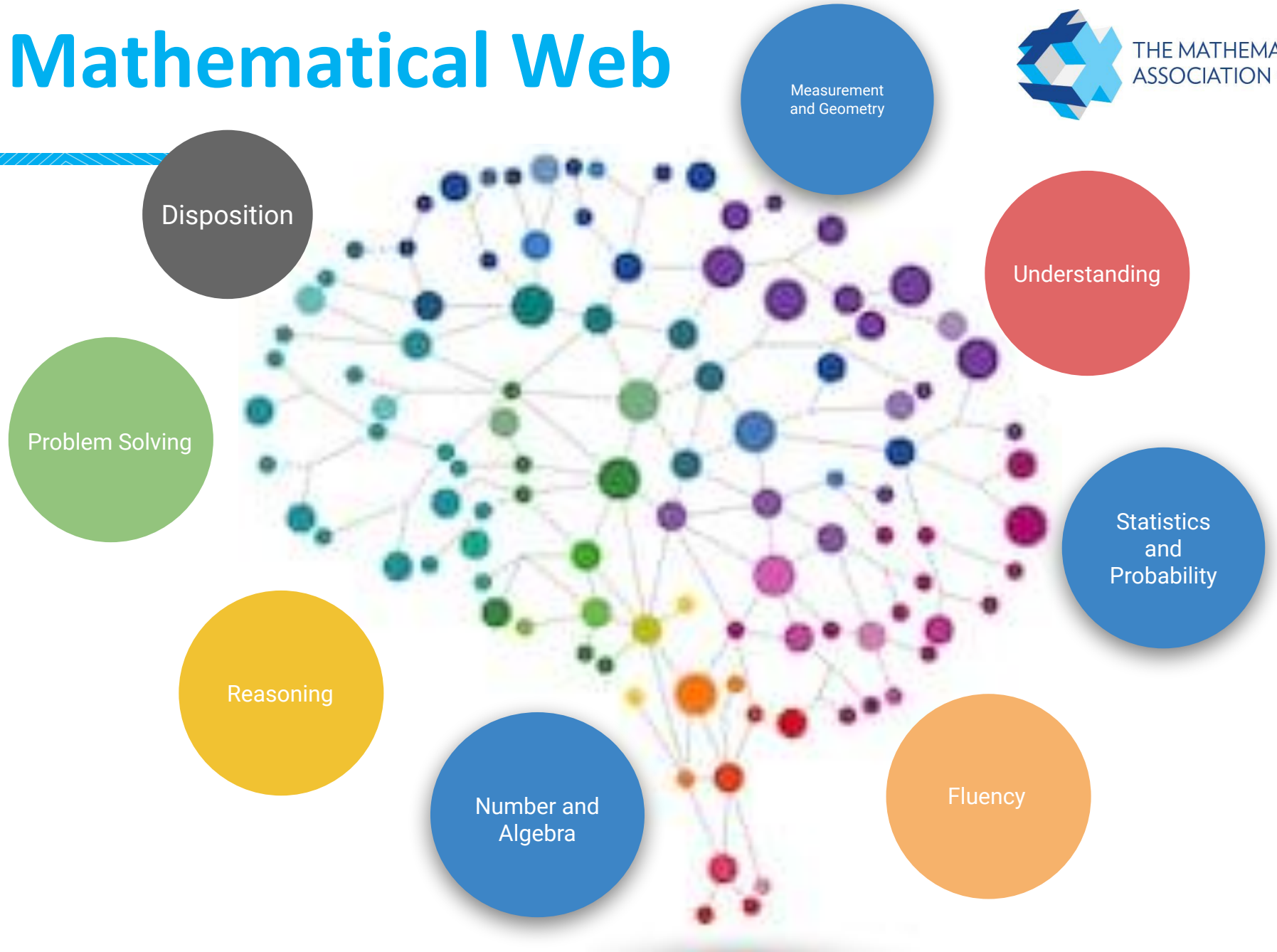

Making Connections

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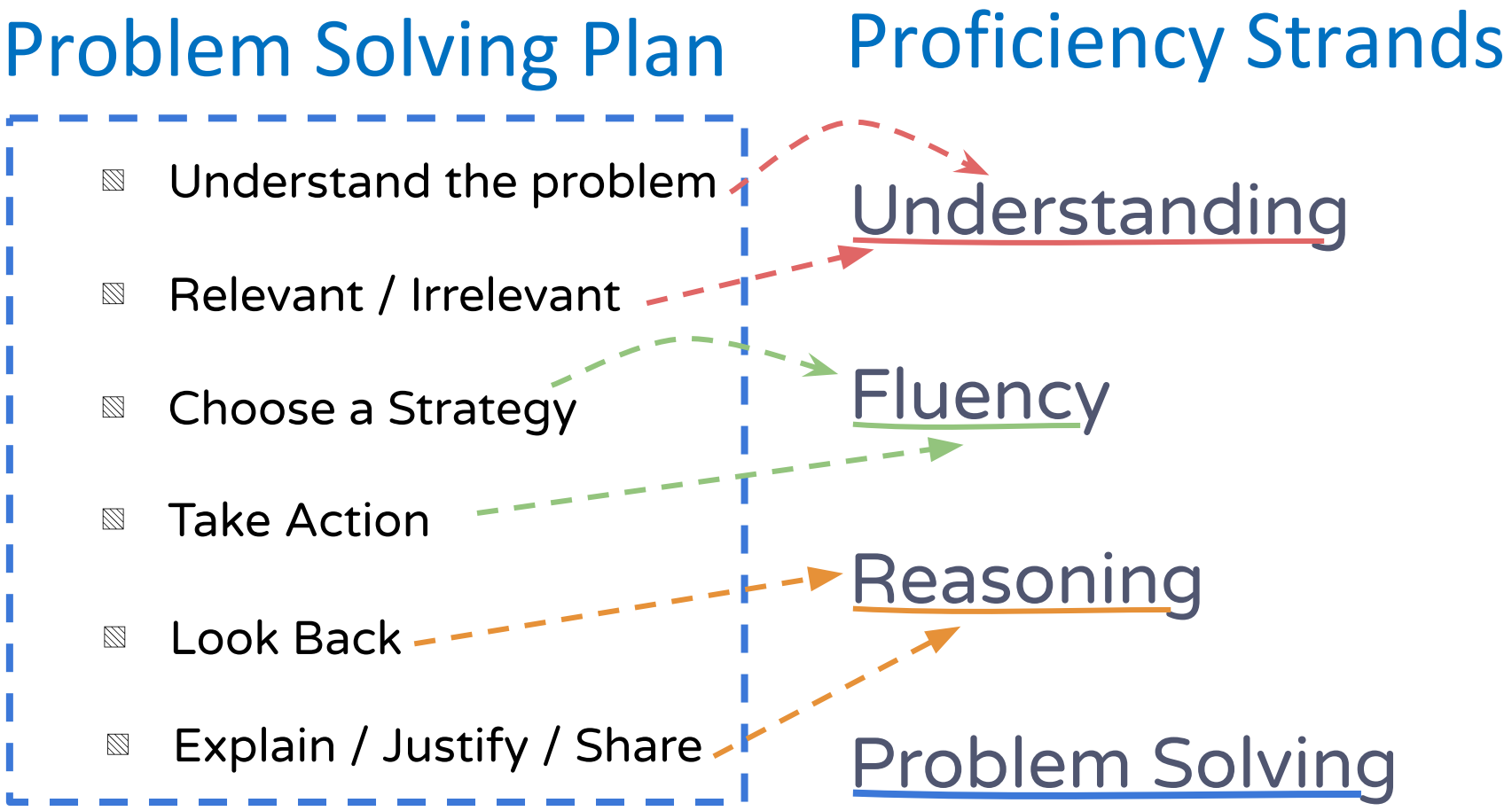

Embedding the Proficiency Strands through Evidence Based Practices

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- Problem Solving Strategies
- Concrete, Pictorial, Abstract
- Challenging Tasks
- Enabling and Extending Prompts
- Difficulty vs Complexity
- Problem Solving Steps
- Problem Solving Plan
- Proficiency Strands

Where to next?

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Teacher Clarity, Collective Efficacy and Assessment Capable Students

Thank you

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