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Teaching For Productive Learning In Maths

The Why, What, When and How

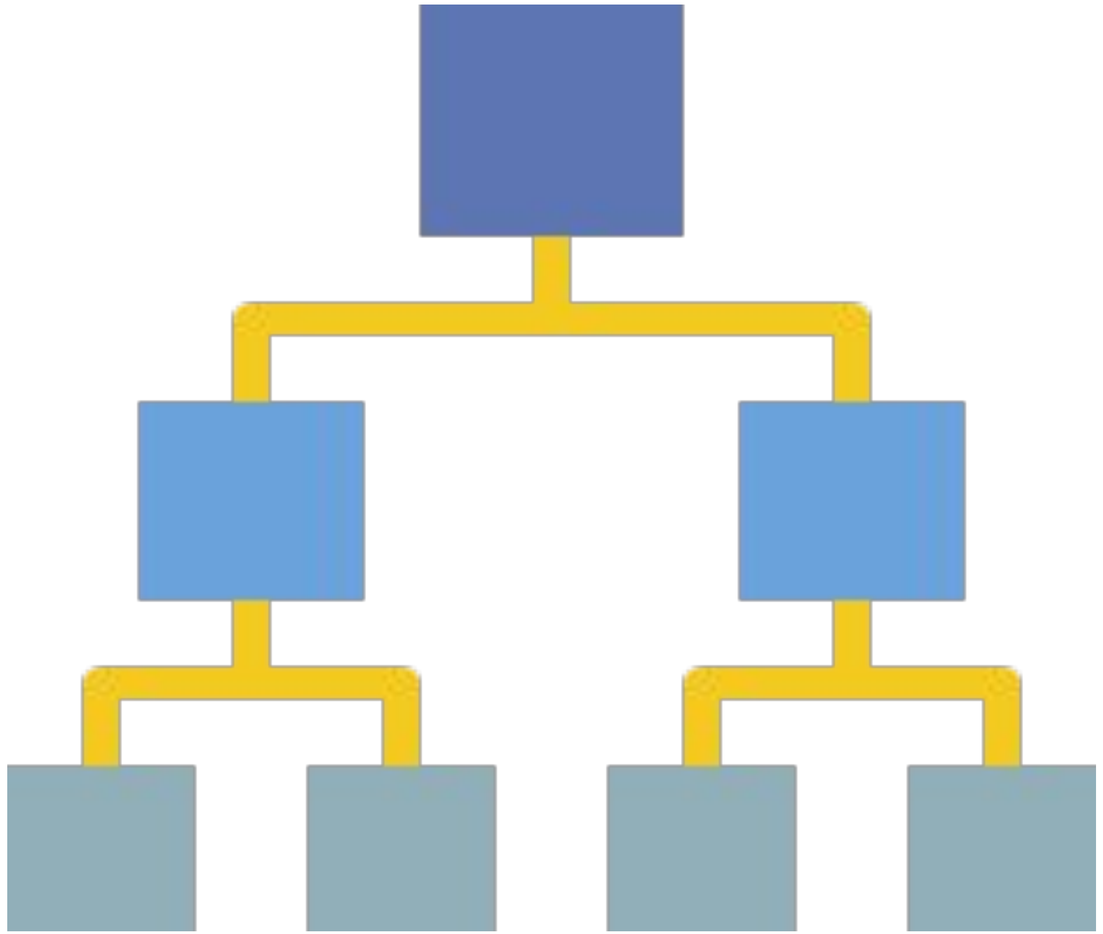
Brendan Lee

Teaching For Productive Learning In Maths

1. How Learning Happens In Maths
2. Teaching For Productive Learning In Maths

How Learning Happens In Maths

Mathematics is highly hierarchical

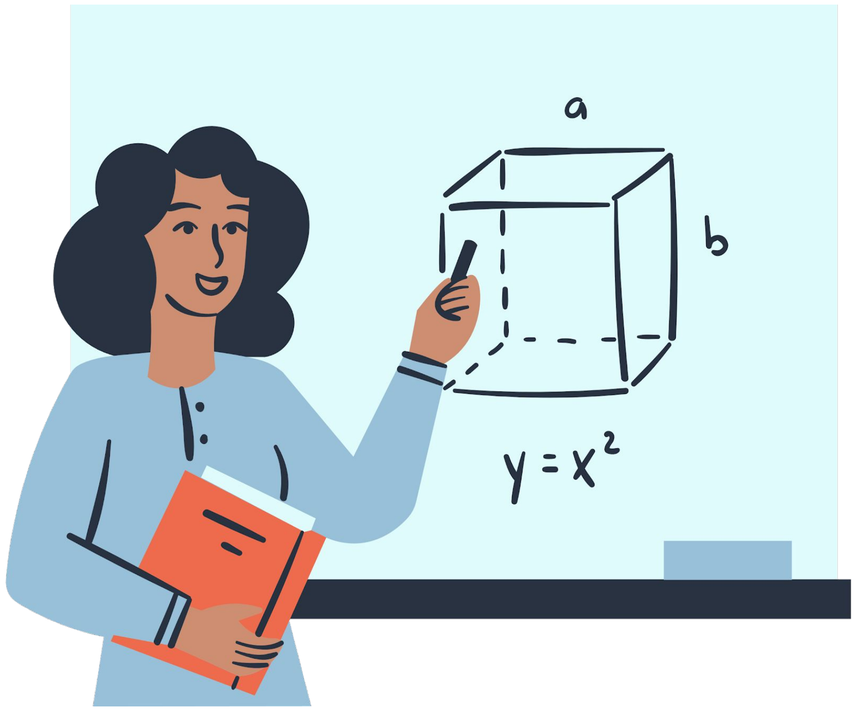


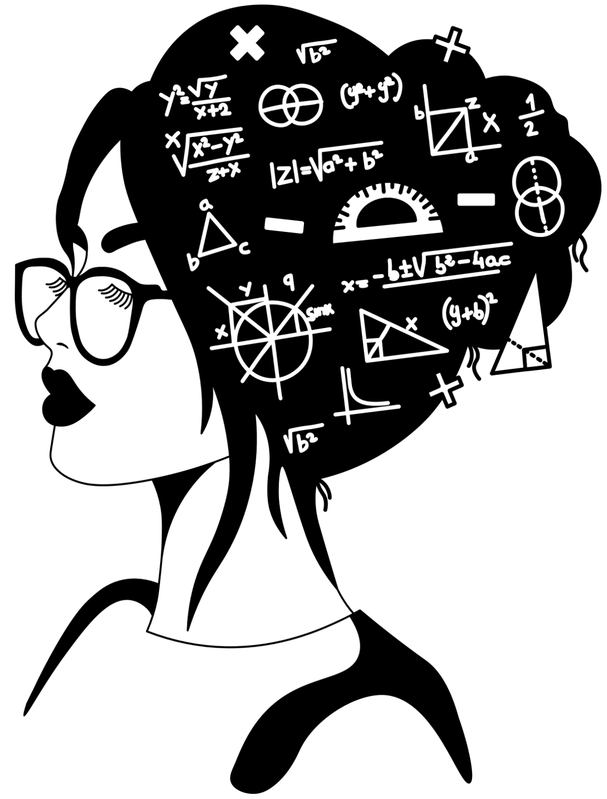
(Price, Mazzocco & Ansari, 2013; Schmidt & Houang, 2007)

You don't start at the top to get to the top

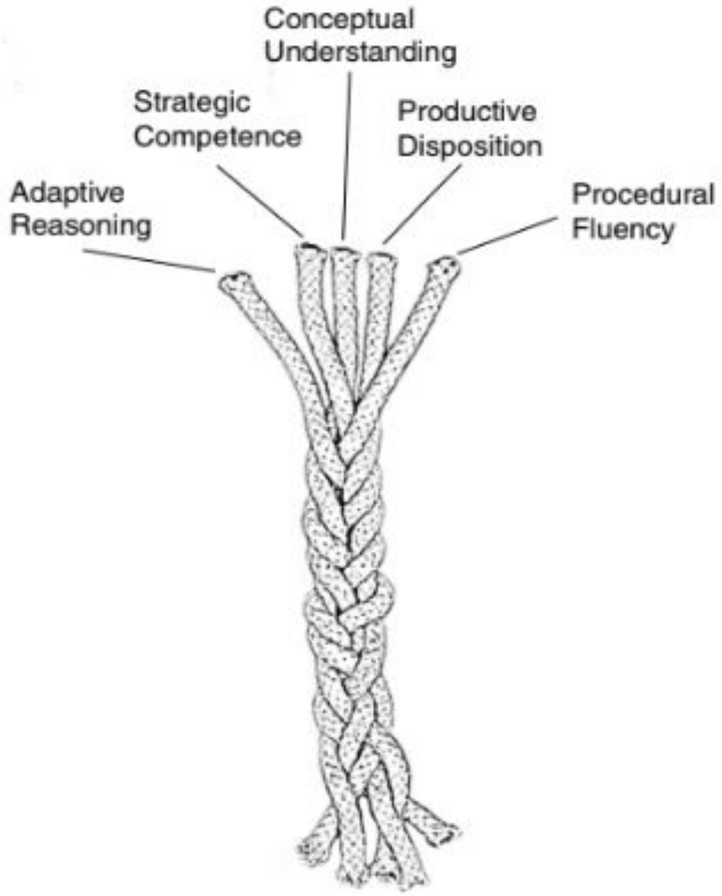
Image generated by AI

To think like a mathematician, we need to teach them maths





Intertwined strands of proficiency



(Kilpatrick et al, 2001)

Learning maths is like learning another language

(Hughes, Powell & Stevens, 2016)

"Having to understand mathematical concepts intuitively and the difficulty in conjuring up the spatial imagery is actually what causes the feelings of anxiety."

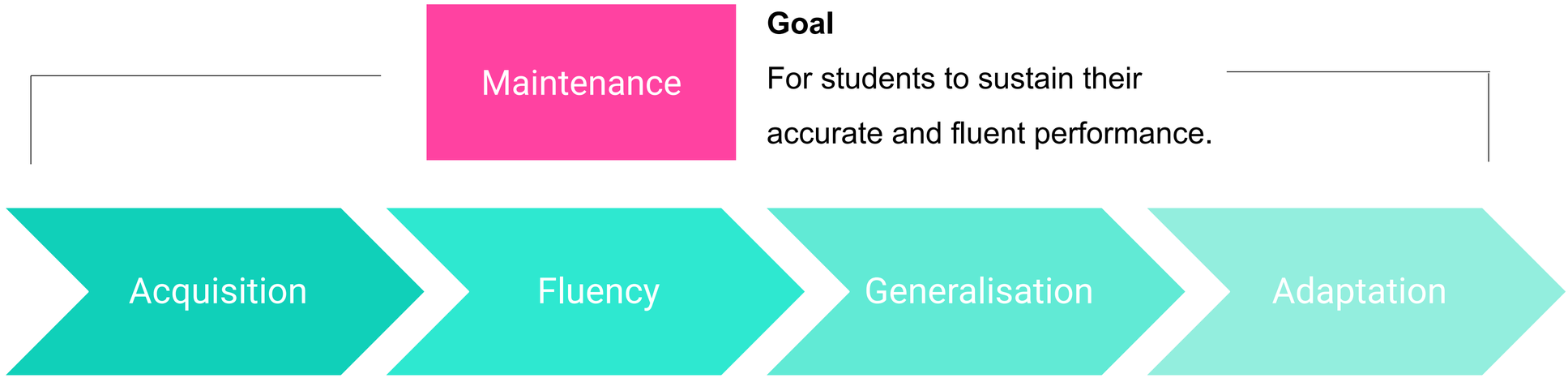
Krasa et al, 2022

Let the maths be the fun part

Success breeds success

Teaching For Productive Learning In Maths

The Instructional Hierarchy: Stages of Learning

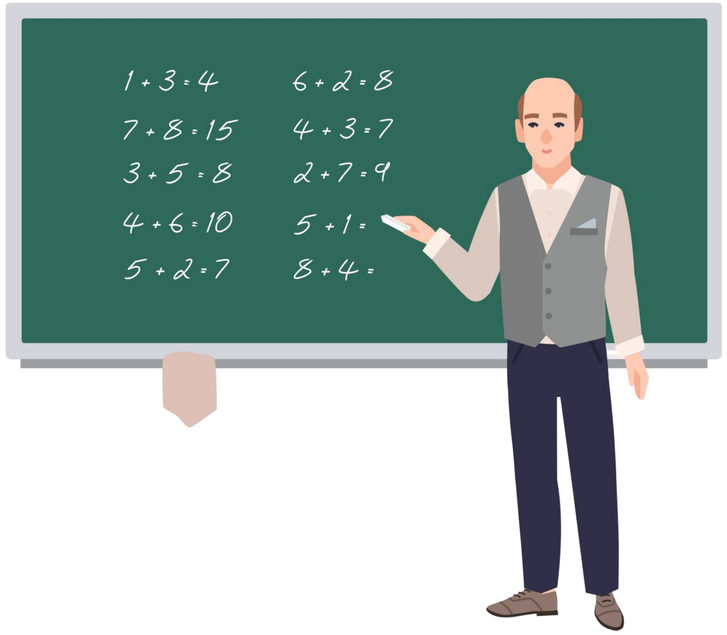


(Haring et al, 1978; VanDerHeyden & Peltier, 2024)

The connection between assessment and instruction

(Hughes, Powell & Stevens, 2016)

It's not a matter of either or, but rather when and how



Acquisition

Instructional Hierarchy: Stages of Learning

Students at the acquisition stage

- Struggle to start tasks
- May be unable to complete the task independently, consistently and accurately
- May be accurate, but slow
- Find it difficult to discriminate relevant elements
- Hesitant and may not know why something is correct or incorrect
- Feel frustrated!

(Haring et al, 1978; VanDerHeyden & Burns, 2023)

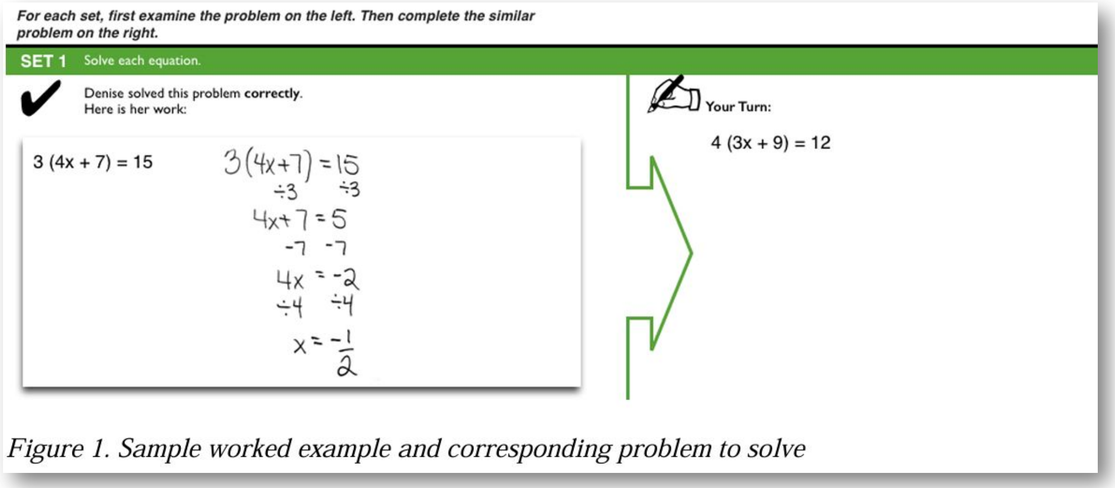
What students at the acquisition stage need to know

- What the skill/knowledge is
- The steps involved
- How the skill/knowledge is useful
- When to use the skill
- How to perform the skill accurately

(Haring et al, 1978)

Modelling (I do)

Types of Modelling



For each set, first examine the problem on the left. Then complete the similar problem on the right.

SET 1 Solve each equation.

✔ Denise solved this problem **correctly**. Here is her work:

$3(4x+7) = 15$

$\div 3 \quad \div 3$

$4x + 7 = 5$

$-7 \quad -7$

$4x = -2$

$\div 4 \quad \div 4$

$x = -\frac{1}{2}$

Your Turn:

$4(3x + 9) = 12$

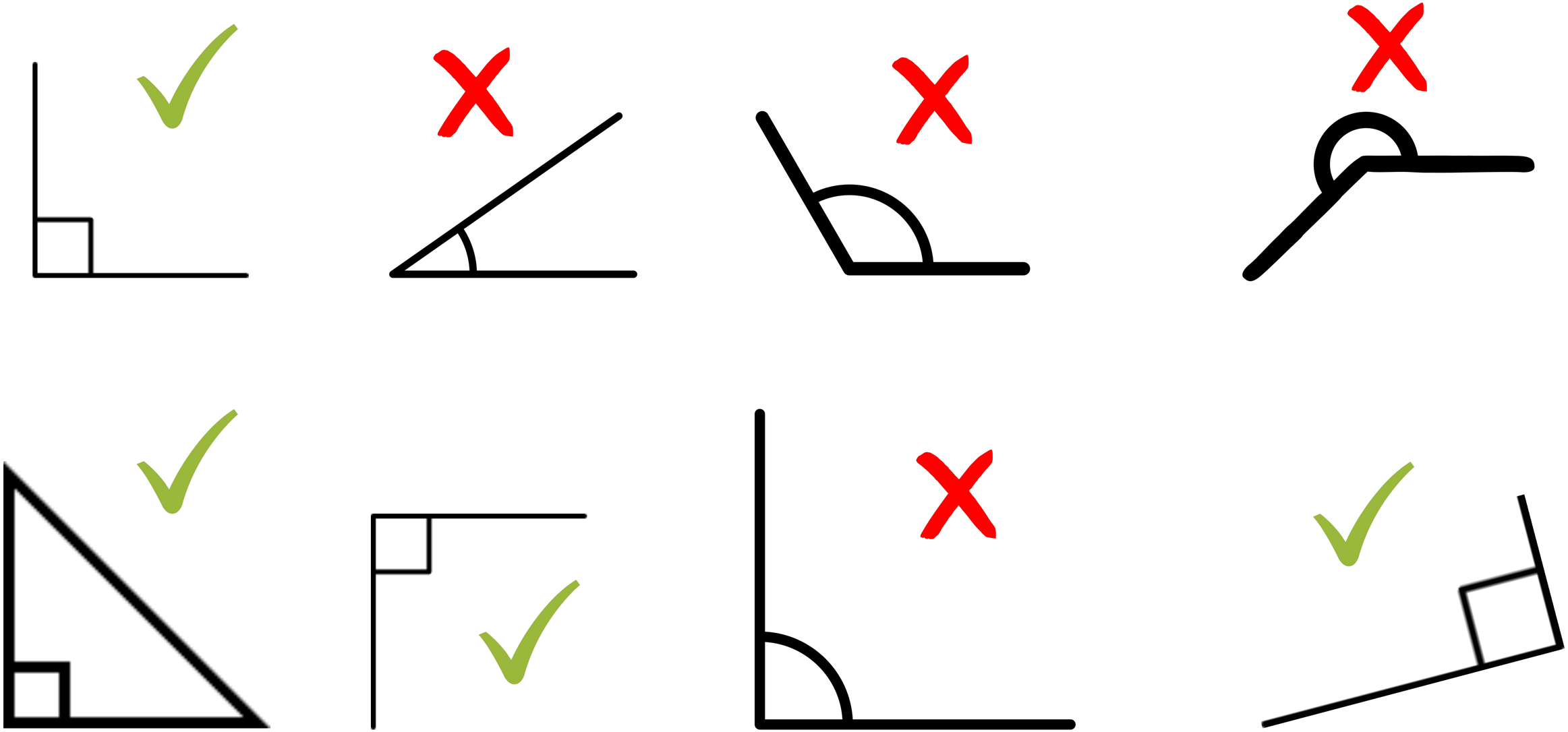
Figure 1. Sample worked example and corresponding problem to solve

(Booth et al, 2024)

A completed model

Live modelling

Examples & Non-Examples



Concrete-Pictorial-Abstract Framework

- Strengthens conceptual and procedural understanding and enables students to think more flexibly
- Use multiple representations

2 x 2 = 4

2 groups of 2 is 4

(Fuchs et al., 2021; Peltier et al., 2020)

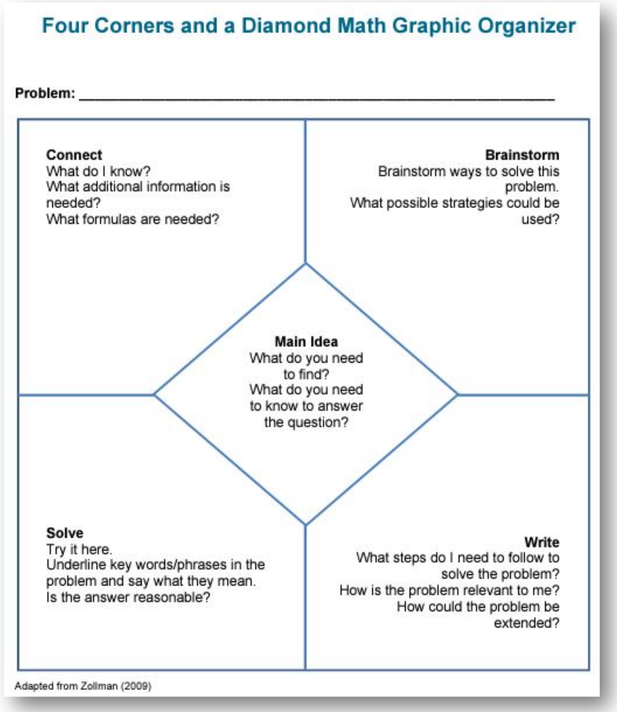
Concrete-Pictorial-Abstract Framework

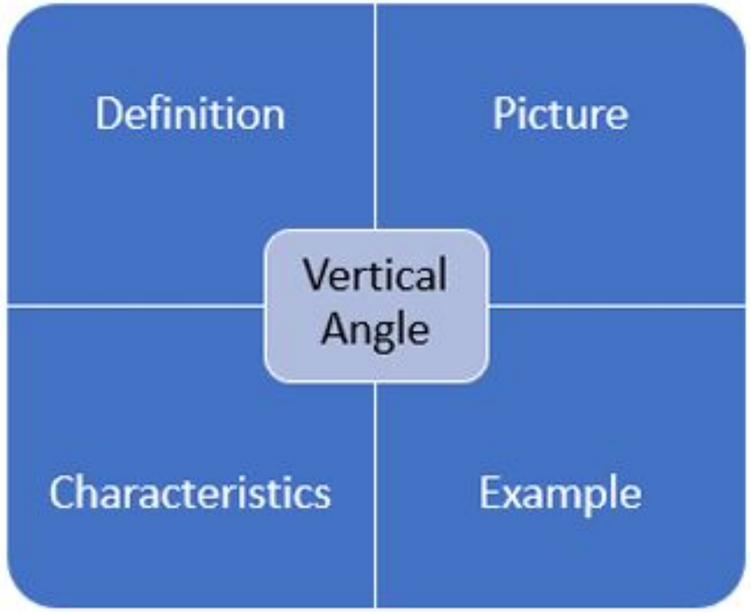
- Strengthens conceptual and procedural understanding and enables students to think more flexibly
- Use multiple representations
- Aim to fade
- Be intentional with the choice of manipulatives
- Being able to use manipulatives correctly doesn’t mean they understand the concepts

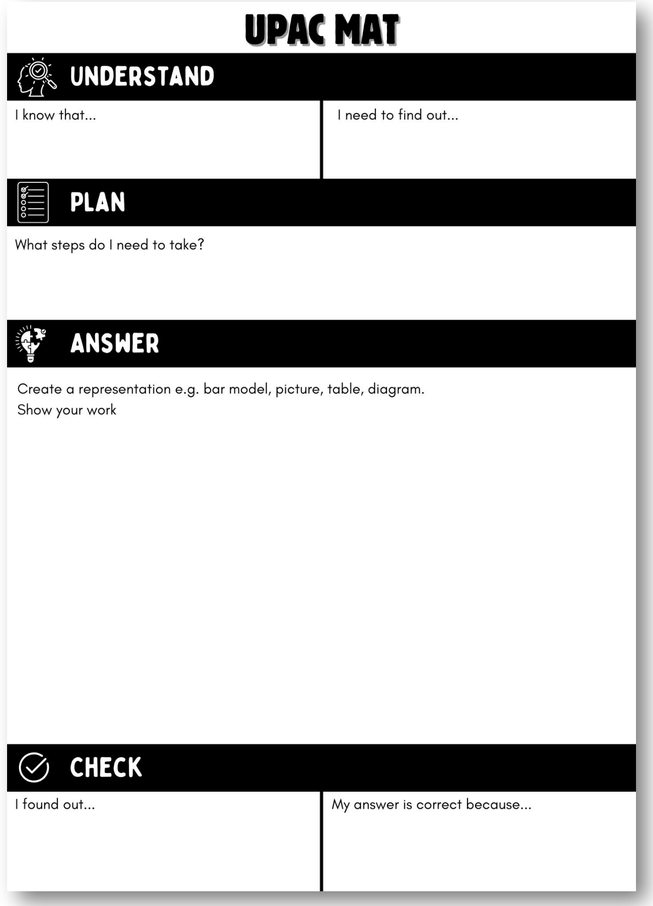
(Fuchs et al., 2021; Peltier et al., 2020)

Guided Practice (We do)

Graphic Organisers







Example-Problem Pair

Guided Practice Techniques

- Pair worked examples with minimally different problems for students to complete
- Only reveal the paired problem after the worked problem has been live-modelled

I

4 friends have 24 lollies to share.
How many do they get each?

24			
6	6	6	6

24 ÷ 4 = 6

They get 6 lollies each.

6 friends have 24 lollies to share.
How many do they get each?

W

24					

Example-Problem Pair Example

Guidance Fading

Guided Practice Techniques

- Worked-out steps provided by the instructor are progressively replaced with problem-solving steps for learners to complete
- Allows learners to retain sufficient working memory capacity to deal with the increasing demands

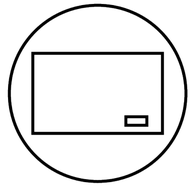
Multiplication and division are the inverse operations of each other

I

If I know 5 x 8 = 40

Then, I know 40 ÷ 8 = 5

and 40 ÷ 5 = 8



We

If I know 7 x 5 = 35

Then, I know 35 ÷ _5_ = 7

and 35 ÷ 7 = 5

Guidance Fading Example

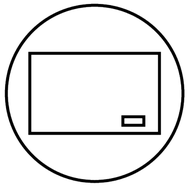
Multiplication and division are the inverse operations of each other

I

If I know 5 x 8 = 40

Then, I know 40 ÷ 8 = 5

and 40 ÷ 5 = 8



We

If I know 4 x 8 = 32

Then, I know 32 ÷ 8 = 4

and 32 ÷ 4 = 8

Guidance Fading Example

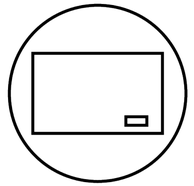
Multiplication and division are the inverse operations of each other

I

If I know 5 x 8 = 40

Then, I know 40 ÷ 8 = 5

and 40 ÷ 5 = 8



We

If I know 3 x 9 = 27

Then, I know 27 ÷ 9 = 3

and 27 ÷ 3 = 9

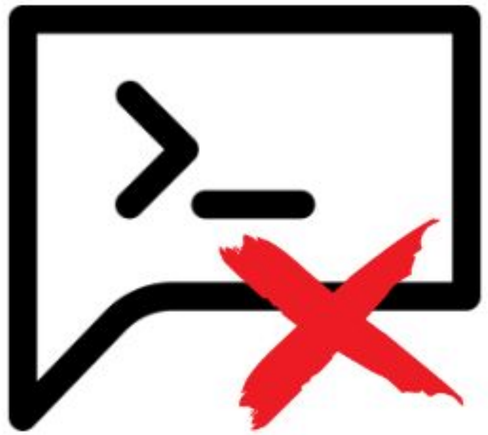
Guidance Fading Example

Guided practice should prepare them for what they are about to do independently

Independent Practice (You do)


I’ve just shown you how to do something, now have a go at doing something that I haven’t taught you!

Independent practice



Time to practice what they've been taught

Fluency

Instructional Hierarchy: Stages of Learning

Students with fluency in basic maths facts

- Better at making estimations, mental calculations, complex computation, solving word problems and algebra
- Have an increase in engagement
- Exhibit less anxiety
- More likely engage with higher level maths

(Axtell, et al., 2009; Fuchs, et al., 2006; Jordan, Hanich & Kaplan, 2003; NMAP, 2008; Singer-Dudek & Greer, 2005)

Fluency in basic maths facts opens doors

Getting the reps in

Generalisation

Instructional Hierarchy: Stages of Learning

Students at the generalisation stage

- Novel problem types
- If student confuses target skill with similar skill(s), the student is given practice items that force him/her to correctly discriminate between similar skills
- Teach how to apply the skill in different contexts
- Help connect mastered and new skills
- Provide checklists to increase self-regulation skills
- Spaced and Interleaved practice

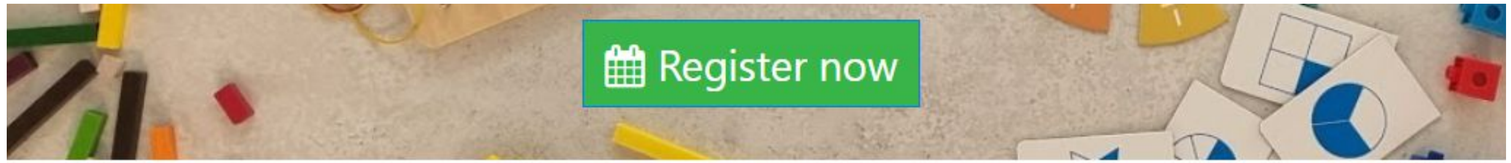
(Haring et al, 1978; VanDerHeyden & Burns, 2023)

Think of how we teach someone to ride a bike

What Good Maths Teaching Looks Like

Friday 5 September (Term 3 Staff PD Pupil Free Day)

Canterbury College 9am – 3pm



The 'What Good Maths Teaching Looks Like' is a science of maths professional development day hosted by ISQ at Canterbury College on the Term 3 Staff Professional Development/Pupil free day (Friday 5 September) and is open to teachers from all 3 school sectors (State, Catholic and Independent). This is an opportunity for maths teachers to receive professional development on the best evidence-based teaching practices which are based on cognitive science and endorsed by the Australian Education Research Organisation (AERO). Please note that this is an in-person event only and there will be no video recordings of the sessions.

Australian Professional Standards for Teachers
1.2, 2.5, 3.6

Please sign in to view member prices.

Event Details:
Date: Friday 5 September 2025
Time: 9:00am – 3:00pm
Location: Canterbury College
Program Participants (ticket): Free
Early Bird Member Pass (available until COB 30 May): $100
Member Pass (ticket): $130
Early Bird Non-Member Pass (available until COB 30 May): $150
Non-Member Pass (ticket): $180

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Knowledge for Teachers

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