ELEMENT 3.1

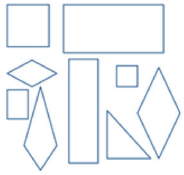
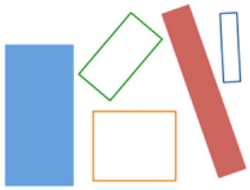
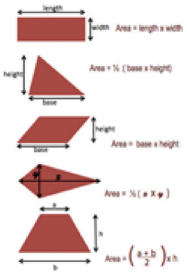
Domain 3 - Develop Expert Mathematics Learners

Element 3.1 - Teach learners how to learn

The following suggestions for practice are extracts from the 'Transforming Tasks' module on the Leading Learning resource:

Strategy From Information to Understanding

Technique **Compare and contrast:** Ask students to identify similarities and differences.

Level	Before	After
Primary	Rectangles can look different. Can you recognise different types of rectangles? Colour all 5 rectangles: 	These shapes are all rectangles. What's the same about all of the rectangles? What's different about them? Would it help if you cut the shapes out and moved them around? Do rectangles need to be long and thin? Do rectangles need to have sides that are horizontal/vertical? 
Secondary	A review of area calculations: Using these formulae, find the area of the shaded regions. 	**A review of area calculations:** 1. Label the dimensions that you might measure to calculate the area of each of these polygons and write the formula that you would use. 2. Check with a partner to see if you have the same/ different ideas about: a. the dimensions that you would measure. b. how they would be used in the formula. 3. What's the same about each of the formulae? What's different about them? (Did you notice that all formulae involve multiplication of two lengths? The triangle and kite also involve a multiplication by ½) Why?) 4. What's the same about the dimensions that you have labelled? What's different about them? (Did you notice that the dimensions are always perpendicular to each other) Why? 

How do you think the technique Compare and contrast might support *Element 3.1 - Teach learners how to learn*

There are many ways to articulate this relationship. One response to this question has been provided on the next page.

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The following suggestions for practice are extracts from the 'Transforming Tasks' module on the Leading Learning resource:

How does the technique Compare and contrast support *Element 3.1 - Teach learners how to learn*

Challenging students to 'compare and contrast' will not automatically lead towards an understanding of 'how to learn'. However, teachers can intentionally support students to reflect on the effect that comparing and contrasting has on their understanding.

In the Secondary Years example, where the students compare and contrast area formulae, teachers could ask, 'How did comparing the area formulae affect your understanding about each of the individual formulae?'

In the Primary Years example, students need to notice and bear in mind their observation about one feature of a rectangle while they look for the same feature in the other rectangles. Teachers can explicitly model choosing one feature to think about and really focus on (perhaps even saying it out loud to yourself), while checking that feature against other rectangles. Through modelling strategies for learning, teachers support the development of students' learning skills.

ELEMENT 3.1

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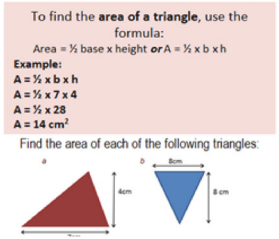
The following suggestions for practice are extracts from the 'Transforming Tasks' module on the Leading Learning resource:

Strategy From Tell to Ask

Technique **Socratic questioning:** Have students work backwards by providing the outcome first.

Level	Before	After
Primary	Multiplying by decimals is easy, just follow these two steps: 1. First, multiply the numbers normally, ignoring the decimal points. 2. Then, count the total number of decimal places in both numbers, and put that many decimal places in the answer.	Using a calculator, work out answers to questions a, b, c and d: a. 6 x 0.5 b. 3 x 0.5 c. 8 x 0.5 d. 5 x 0.5 Discuss 1. What do you notice about the solutions to these questions? Are the solutions larger or smaller than the value being multiplied by 0.5 Is that surprising? Will that always be the case? Could you test that out? 2. Why do you think that x 0.5 might be like finding half of the amount? 3. What do you think will happen if you multiply by 0.25? What makes you think that? How could you test that idea? 4. Do some more thinking about multiplying by decimals by asking your own 'what if?' questions 5. What ideas do you have now about multiplying by decimals? Do other people think the same or differently to you at the moment? 6. Look at the first questions that you tried (a, b, c, d). How do the questions (e, f, g, h) relate to them? What connections can you see between the answers to these two sets of questions? Use your observations to think of a way to make multiplying by decimals easier. Does your idea work if there are two decimal places in the question Eg 6 x 0.05? e. 6 x 5 f. 3 x 5 g. 8 x 5 h. 5 x 5
Secondary	Area of a Triangle: To find the area of a triangle, use the formula:  	**What do you notice about these three shapes?** Which triangle do you think coveres most/least of the area of the rectangle? Why do you think that? How sure do you feel at the moment? Look at the top picture - How much of the rectangle do you think the tirangle covers? What led you to that belief? How could you check that out/convince me?  How much of the rectable area do you think the triangles in the other two pictures cover? How could you check your thinking out/ convince yourself / convince me? Would it help if you could cut the pictures up and move pieces around? Try that if you think it will help you. How does the area of the triangle relate to the area of the rectangle in these three pictures? Would that always be the case with triangles? How could you check that thinking out? Examples of Socratic questions can be found online: http://courses.cs.vt.edu/cs2104/Summer2014/Notes/SocraticQ.pdf

How do you think the technique Socratic questioning might support *Element 3.1 - Teach learners how to learn*

There are many ways to articulate this relationship. One response to this question has been provided on the next page.

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The following suggestions for practice are extracts from the 'Transforming Tasks' module on the Leading Learning resource:

How does the technique Socratic questioning support *Element 3.1 - Teach learners how to learn*

Challenging students to think deeply, through the use of Socratic questioning will not automatically lead them towards an understanding of 'how to learn'. Teachers can intentionally support students to reflect on the ways in which looking for patterns, connections, similarities and differences, affects their learning.

ELEMENT 3.1

Domain 3 - Develop Expert Mathematics Learners

Element 3.1 - Teach learners how to learn

The following suggestions for practice are extracts from the 'Transforming Tasks' module on the Leading Learning resource:

Strategy From Tell to Ask

Technique **Explore before explain:** Ask students to try their ideas first.

Level	Before	After
Primary	Example 1: Calculate 45 ÷ 3 → $3\overline{)45}$ = 15 Example 2: Calculate 72 ÷ 4 → $4\overline{)72}$ = 18	How can you divide larger numbers? Think about what you understand about division. Work with a partner, to have a go at one (or both) of these questions: Calculate 45 ÷ 3 Calculate 72 ÷ 4 Check your answers with a calculator.
Secondary	Simplify: $\frac{a}{2} + \frac{2a}{3} = \frac{a \times 3 + 2a \times 2}{2 \times 3 \quad 3 \times 2} = \frac{3a + 4a}{6 \quad 6} = \frac{3a + 4a}{6} = \frac{7a}{6}$ Questions: 1. $\frac{b}{5} + \frac{5b}{10}$ 2. $\frac{c}{2} + \frac{2c}{7}$	Use your skills with adding fractions, to challenge yourself to work with fractions that include variables. Work with a partner, to have a go at these two questions. 1. $\frac{b}{5} + \frac{5b}{10}$ 2. $\frac{c}{2} + \frac{2c}{7}$ Prompts: • How would you usually add fifths and tenths? • Would it help if you tried some fraction addition without variables? • Would it help if you drew a diagram?

How do you think the technique Explore before explain might support *Element 3.1 - Teach learners how to learn*

There are many ways to articulate this relationship. One response to this question has been provided on the next page.

ELEMENT 3.1

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The following suggestions for practice are extracts from the 'Transforming Tasks' module on the Leading Learning resource:

How does the technique Explore before explain support *Element 3.1 - Teach learners how to learn*

Challenging students to explore a new type of problem, before you explain it, will not automatically lead them towards an understanding of 'how to learn'. Teachers can be intentional about reminding students to use strategies they have developed to assist them to 'know what to try when they don't know what to do'. Strategies could be displayed in the classroom or kept in the students' maths books. Teaching students to develop the habit of using strategies when they are working on an unfamiliar problem supports students to know how to learn.

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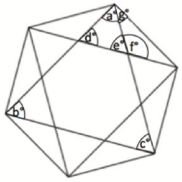
The following suggestions for practice are extracts from the 'Transforming Tasks' module on the Leading Learning resource:

Strategy From Procedural to Problem Based

Technique **Let students identify the steps:** Provide multi-step problems and do not state all the steps.

Level	Before	After
Primary	A movie ticket for one adult costs $12. A movie ticket for one child is three quarters of the cost for an adult. a. What's the cost for one child? b. What's the cost for four children? c. What's the cost for a family of two adults and four children?	A movie ticket for 1 adult costs $12. A movie ticket for a child is three quarters of the cost for an adult. What's the cost for a family of two adults and four children? This question is based on a NAPLAN question. Many NAPLAN questions are multi-step problems and do not state all the steps.
Secondary	This design is drawn inside a regular hexagon. Calculate the marked angles. 	This design is drawn inside a regular hexagon. What is the size of the angle marked a?  This question is from a NAPLAN paper. Many NAPLAN questions are multi-step problems and do not state all the steps.

How do you think the technique Let students identify the steps might support *Element 3.1 - Teach learners how to learn*

There are many ways to articulate this relationship. One response to this question has been provided on the next page.

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The following suggestions for practice are extracts from the 'Transforming Tasks' module on the Leading Learning resource:

How does the technique Let students identify the steps support *Element 3.1 - Teach learners how to learn*

Not providing all the steps establishes opportunities for teachers to support students to 'learn what to try when they don't know what to do'.

When students are challenged to pave their own way through a problem teachers can support students to be meta cognitive about their progress with their learning. Teachers can drive the development of students asking questions (or making statements) such as:

- Am I heading in the right direction with this?
- How are other people/other groups doing this?
- I wonder if there is another way?
- I wonder if there is a more efficient way?
- I think I might need to stop and learn something new before I continue with this.