ELEMENT 3.1

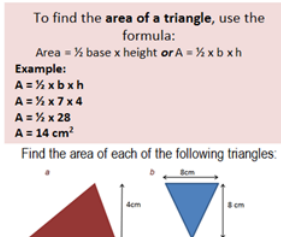
Domain 3 - Develop Expert Mathematics Learners

Element 3.1 - Teach students 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 **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 e. 6 x 5 f. 3 x 5 g. 8 x 5 h. 5 x 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. For example 6 x 0.05?
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 covers most/least of the area of the rectangle? Why do you think that? How sure do you feel at the moment? Look at the first 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 students 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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How does the technique Socratic questioning support *Element 3.1 - Teach students 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 develop rigorous questioning habits, through frequently modelling the use of socratic questions such as:

- What do you notice?
- How do you know?
- How could you find out?
- Will that always be the case?
- Is this good evidence for that idea?
- What evidence supports your idea?
- Is that enough evidence?
- How sure can you be?
- What effect would changing.....have? (What if.....).

We teach students how to learn when we support them to notice and use (Socratic) questions that lead them to:

- think deeply
- question what they notice
- question what they think
- question the certainty of their idea etc.

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

Level	Before	After
Primary	Example 1: Calculate 45 ÷ 3 → 15 with 3 ⟌ 45 Example 2: Calculate 72 ÷ 4 → 18 with 4 ⟌ 72	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	Example Simplify: $\frac{a}{2} + \frac{2a}{3}$ $= \frac{a \times 3}{2 \times 3} + \frac{2a \times 2}{3 \times 2}$ $= \frac{3a}{6} + \frac{4a}{6}$ $= \frac{3a + 4a}{6}$ $= \frac{7a}{6}$ 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 students 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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How does the technique Explore before explain support *Element 3.1 - Teach students 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.