ELEMENT **3.2**

Domain 3 - Develop Expert Mathematics Learners

Element 3.2 - Foster deep understanding and skilful action

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

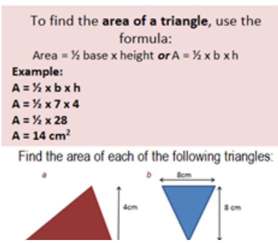
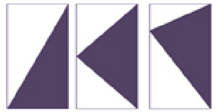
Strategy	**From Tell to Ask**
Technique	**Socratic questioning:** Have students work backwards by providing the outcome first.

<table>
<tr><th>Level</th><th>Before</th><th>After</th></tr>
<tr><td>Primary</td><td>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.</td><td>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 Eg 6 x 0.05?</td></tr>
<tr><td>Secondary</td><td>Area of a Triangle:
To find the area of a triangle, use the formula:


To find the area of a triangle, use the formula:
Area = ½ base x height or A = ½ x b x h
Example:
A = ½ x b x h
A = ½ x 7 x 4
A = ½ x 28
A = 14 cm²
Find the area of each of the following triangles:
a
4cm
b
8cm
8 cm</td><td>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 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</td></tr>
</table>

How do you think the technique Socratic questioning might support *Element 3.2 - Foster deep understanding and skilful action?*

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

Element 3.2 - Foster deep understanding and skilful action

How does the technique Socratic questioning support *Element 3.2 - Foster deep understanding and skilful action?*

Deep understanding and skilful action relates to the development of conceptual understanding. Carefully constructed Socratic questions that support students to look for and establish connections, in turn support the development of conceptual understanding.

In the Primary Years example, both the 'before' and the 'after 'task result in students gaining a method for multiplying decimals mentally and it may be the case that students experiencing the 'before' and the 'after' task would perform equally well if tested on application of thier method immediately. The cricial difference between these two tasks is HOW the student came to have a method to use. The 'learning' experience in the 'before' task compounds students view of mathematics as a set of disconnected rules that are to be learnt. In contrast the 'after' task builds on prior knowledge and supports students to delop a connected understanding of concepts in mathematics.. Students with conceptual understanding are more likely to be able to recall or reconstruct their understanding when the original learning experience has been forgotten.

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Domain 3 - Develop Expert Mathematics Learners

Element 3.2 - Foster deep understanding and skilful action

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 $3\overline{)4^{1}5}$ = 15 Example 2 Calculate 72 ÷ 4 $4\overline{)7^{3}2}$ = 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	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 3.2 - Foster deep understanding and skilful action?*

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 3.2 - Foster deep understanding and skilful action?*

When students are challenged, with appropriate support, to explore an unfamiliar problem before an approach is explained to them, they are provided with an opportunity to transfer understanding to a new situation. 'Transfer' requires deep understanding, but equally, deep understanding can result from repeated opportunities that challenge and support transfer.

When exploring unfamiliar problems prior to an explanation of an appropriate procedure, students may make conceptual errors. Research suggests that making a conceptual mathematics error, then learning to correct that error can result in greater understanding, which is retained for longer than learning in which no errors were made due to a clear process being modelled prior to the student exploring their own intuitive understanding. In this way, supporting students to explore, before we explain, could help to break the cycle of reteaching processes.