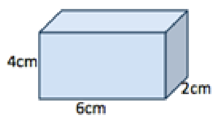
ELEMENT **2.4**

Domain 2 - Create Safe Conditions for Rigorous Mathematics Learning

Element 2.4 - Challenge students to achieve high standards with appropriate support

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

Strategy	From Closed to Open
Technique	**Many entry points:** Have students work backwards by providing the outcome first.

Level	Before	After
Primary	1. Use unifix cubes to measure the length of your book. 2. How many unifix cubes do you need to balance a packet of pencils? 3. How many unifix cubes can be stacked in this box?	The answer is: ‘I used 20 unifix cubes to measure it.’ 1. What might I be measuring? Think of more possibilities. What else? What else? .... 2. Are all your examples the same type (eg length)? Can unifix cubes be used to measure those same objects in a different way? How? …How else? What could an object be if it was measured using 20 cubes?
Secondary	**Calculate the volume of this rectangular prism.** 	The volume of the object is $24cm^3$. What shape could the object be and what are its dimensions? OR The volume of a rectangular prism is $24cm^3$. What could its dimensions be?

How do you think the technique Many entry points might support *Element 2.4 - Challenge students to achieve high standards with appropriate support?*

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

Element 2.4 - Challenge students to achieve high standards with appropriate support

How does the technique Many entry points support *Element 2.4 - Challenge students to achieve high standards with appropriate support?*

When there are multiple entry points to a problem, students will often enter at a level that most suits their current understanding. This provides teachers with the opportunity to notice and respond to students' thinking and design questions that challenge students to move to a higher level. For example, in the Secondary Years prism example, students could access this volume problem by:

- rearranging and recording the position of 24 centimetre cubes
- drawing images to support them to think about building layers of cubes to make a total of 24
- using an understanding of the formula for volume of a rectangular prism (_ x _ x _ = 24) and applying a 'trial and improvement' approach to generating three digits that multiply together to make 24
- as above, but applying a methodical process to identify all combinations
- applying an understanding of the formula, factors of 24 and a methodical process to establish combinations efficiently
- as above, but extending to include dimensions that are not integers etc.

The dot points reflect a progression of ways in which students could engage in this task. This range is sometimes referred to as providing 'a low floor for entry and a high ceiling for exit'. Learners are supported to achieve high standards when teachers identify different ways to enter and develop the task, and then challenge students to move beyond their initial response to the task.

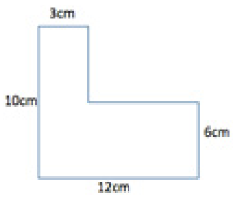
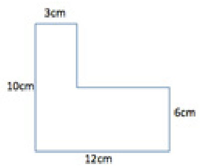
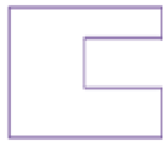
ELEMENT 2.4

Domain 2 - Create Safe Conditions for Rigorous Mathematics Learning

Element 2.4 - Challenge students to achieve high standards with appropriate support

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

Strategy	From Closed to Open
Technique	**Many pathways:** Ask for one problem to be solved in **multiple ways**, rather than multiple problems in **one way**.

Level	Before	After
Primary	Calculate: 39 + 43	Find at least two different ways to do the calculation: 39 + 43 Share your methods with another student. Together, try to identify at least three different methods. • Identify which method is the most efficient for this calculation. • Identify which methods are best for mental calculation • Identify if some methods would be better than others for addition sums with larger values.
Secondary	**Calculate the area of this shape:**  	Calculate the area of this ‘L’ shape in at least two different ways.  • Share your methods with another pair of students. Work together to try to identify at least three different methods. • Do you think that one method was easier, or more effective, than another method? Why? • Would one of your methods be more efficient than another if the shape was like this one? Why/why not? 

How do you think the technique Many pathways might support *Element 2.4 - Challenge students to achieve high standards with appropriate support?*

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

ELEMENT 2.4

Domain 2 - Create Safe Conditions for Rigorous Mathematics Learning

Element 2.4 - Challenge students to achieve high standards with appropriate support

How does the technique Many pathways support *Element 2.4 - Challenge students to achieve high standards with appropriate support*

When discussing conceptual understanding, the authors of, 'Adding It Up, 2001,' commented; 'To find one's way around the mathematical terrain, it is important to see how the various representations connect with each other, how they are similar, and how they are different'.

When teachers challenge students to generate many pathways to a solution, they challenge students to move beyond the method that comes most easily to them. The pathways necessarily have a connection to each other, as they are just different approaches to the one problem. This enables teachers to challenge students to evaluate different approaches, as shown in both the Primary and Secondary Years' examples.

Having multiple ways to approach a problem and understanding connections support students to 'navigate mathematical terrain successfully', hence achieving high standards.

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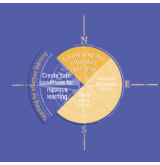
The following suggestions for practice are extracts from the ‘Transforming Tasks’ module on the Leading Learning resource:



Strategy	From Closed to Open
Technique	**Many solutions:** Ask questions which have many solutions. Stretch thinking by adding or removing constraints.

Level	Before	After
Primary	Work out: 4 + 6 =...... 5 + 7 = ... 2 ½ + 4 ½ =....... 7 ¼ + 2 ¾ =.........	The solution is 12. What could the question be? • Aim to find at least 20 different solutions. Add the following constraints: 1. You can only use addition. 2. You can only use two values in your calculation. 3. Flipped calculations don’t count as different solutions in this problem.
Secondary	Write the linear equation which has: a. gradient of 6 and a y-intercept of 3 b. gradient of 3 and a y-intercept of 2 c. gradient of 5 and a y-intercept of -2	Write down some equations that have a y-intercept of 3. 1. If you sketched the graph of your equations, which direction would they slope? Are there any solutions that slope the other way? (For example, downwards left to right, rather than upwards.) 2. What if each equation that you write down must have a steeper gradient than the previous one? 3. What if the coefficient of x cannot be a whole number? 4. What if the equation isn’t linear?

How do you think the technique Many solutions might support *Element 2.4 - Challenge students to achieve high standards with appropriate support?*

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

How does the technique Many solutions support

The part of this technique that drives the challenge of high standards is, 'adding or removing constraints'. Adding constraints, in the Primary Years example, challenges students to work with fractions and decimals, rather than producing a greater amount of examples that rely only on addition of whole numbers. Adding constraints facilitates easy differentiation, as all students can work on the same problem, but with different constraints. To extend this example further, the teacher could add the constraint of solutions being written as improper fractions, or as decimals, with at least two decimal places etc.

The Secondary Years example, uses a combination of removing constraints initially, to promote creativity, then adding constraints to drive challenge. Teachers can be intentional about using constraints that support students to 'see' a new possibility. For example, if students have only identified positive gradient solutions the teacher could add the constraint that the gradient cannot be positive.

When we extend or consolidate a students understanding through changing the constraints of a mathematics problem, we can support all learners to achieve high standards for them.