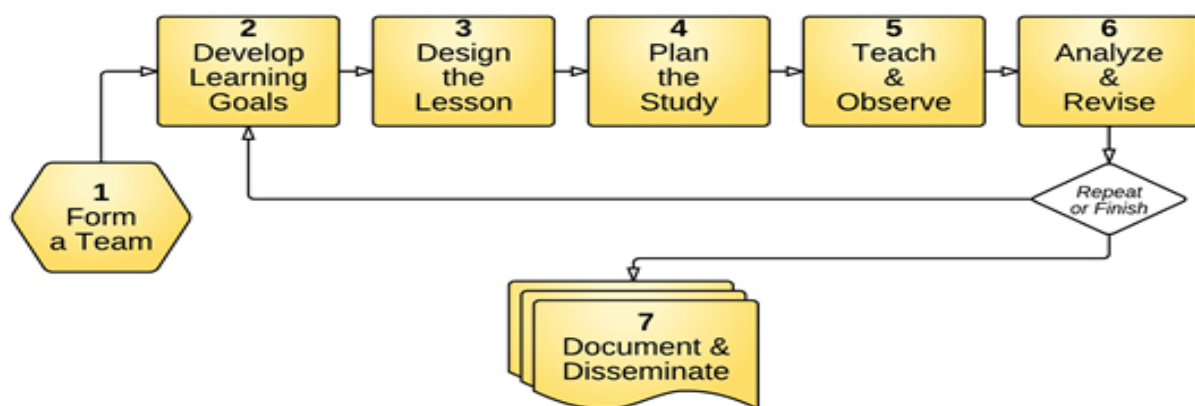# Reflections on Practice

The effective classroom use of exam questions

Lesson Plan for Fifth Year HL Maths: *What's the most effective way to use exam questions in the classroom?*

1. **Title of the Lesson:** *The effective classroom use of exam questions.*

2. **Brief description of the lesson:** *To help students reason and problem solve using a patterns exam question (JCHL Sample 2015 P1 Q8)*

3. **Aims of the Lesson:**

   I'd like my students to appreciate that mathematics can be used to communicate thinking effectively.
   I'd like my students to appreciate that algebra is a tool for making sense of certain situations.
   I'd like to foster my students to become independent learners
   I'd like to emphasise to students that a problem can have several equally valid solutions.
   I'd like my students to connect and review the concepts that we have studied already

4. **Learning Outcomes**:

   Students to understand how to solve pattern problems in a visual, rather than procedural, way

   Students to understand patterns more deeply through the use of hands on materials

   Students to see Algebra as a tool to generalise from patterns

5. **Background and Rationale**

In a typical lesson involving patterns the teacher may move to a table and formula too quickly. Students then see this type of activity as another procedure to be memorised. The approach in this lesson is an attempt to get students to reason visually towards a formula using a challenging exam question. They should also see how powerful Algebra can be as a generalising device.

6. **Research**

Handbooks developed by the Project Maths Development Team and Sample Examination Papers.

7. About the Unit and the Lesson

Typically this question would be covered with a JCHL 3rd year class close to the exam but in this case we felt the question was challenging enough to use as stand-alone problem solving material for a 5th year HL class. As such it can be placed anywhere in the scheme of work for the year but may be best suited somewhere in the section involving pattern work. The students we worked with hadn't covered any LC patterns material but had covered the JCHL syllabus.

7. Flow of the Lesson

Teaching Activity	Points of Consideration
1. Introduction **Teacher shows overhead of pattern to class.**	*Students have unifix cubes and whiteboards and work in groups of three.*
2 Posing the Task **Opening task: Students are asked to build the next two stages with the unifix cubes.**	*Teacher circulates and offers help/prompts if required.*
3. Anticipated Student Responses **Possible responses:** **Some students may build an incorrect pattern as this pattern in particular is open to interpretation e.g. add one to each end, add a "growing square" in the middle etc**	*Teacher points out incompatibilities in any incorrect work.* *Students are asked to justify their patterns.* *Teacher should capitalise on both mistakes and correct work. Students could be invited up to explain what they did.*
Posing the next task **Ask students to make a list of the lengths of the perimeters of all the shapes on their desks.** **Teacher points out that each side is 1 unit in length.**	*Teacher puts a table on the board like this:* **pattern no perimeter**

Anticipated Student Responses **Generally students should find this do-able particularly with the use of blocks.**	*Teacher may need to help some students with the concept of perimeter.*
"What is the perimeter of shape 9?" **"How about shape 78?"**	*Teacher needs to circulate and check how students are coping with this question.* *Students may need guidance with the second question.* *The question looking for shape 78 is to set up a "cognitive conflict".* *Students need to be given time to think about this question.*
Teacher uses a variety of representations to help students find the perimeter of shape 78. **e.g. Using the table and trying to find the "rule" which maps the inputs to the outputs** **Sketching a graph of the table to help visualise that the pattern is growing by 8 each time**	*Teacher needs to be careful here not to tell students too much.*
"Can you come up with a formula for the perimeter of _any_ shape in the pattern?" **Anticipated Student Responses** **If students have engaged with and thought about the "78" question then the general case should be achievable.**	*Listen to students.* *Teacher needs to use any student responses which could increase understanding for the group.*
4. Extension Activities **Q1. What's the pattern number of the shape with perimeter 236?** **Q2. All the perimeters are multiples of 4, can you explain visually why this is so?**	

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5. *Summing up*	*Listen to students.*
Teacher should remind students that we have just used Algebra to make predictions, problem solve and visualize a sequence of patterns.	*Help as required*
	Encourage to students to explain the work to others if required.
Students should appreciate that Algebra is a totally necessary tool that we need to move from the specific to the general. It is is also very succinct and can represent quickly more information than can be taken from a table etc	

8. Board Plan

The question was projected on to an ordinary whiteboard and the teacher wrote over or discussed the key points. Students were also invited to the board to explain their reasoning.
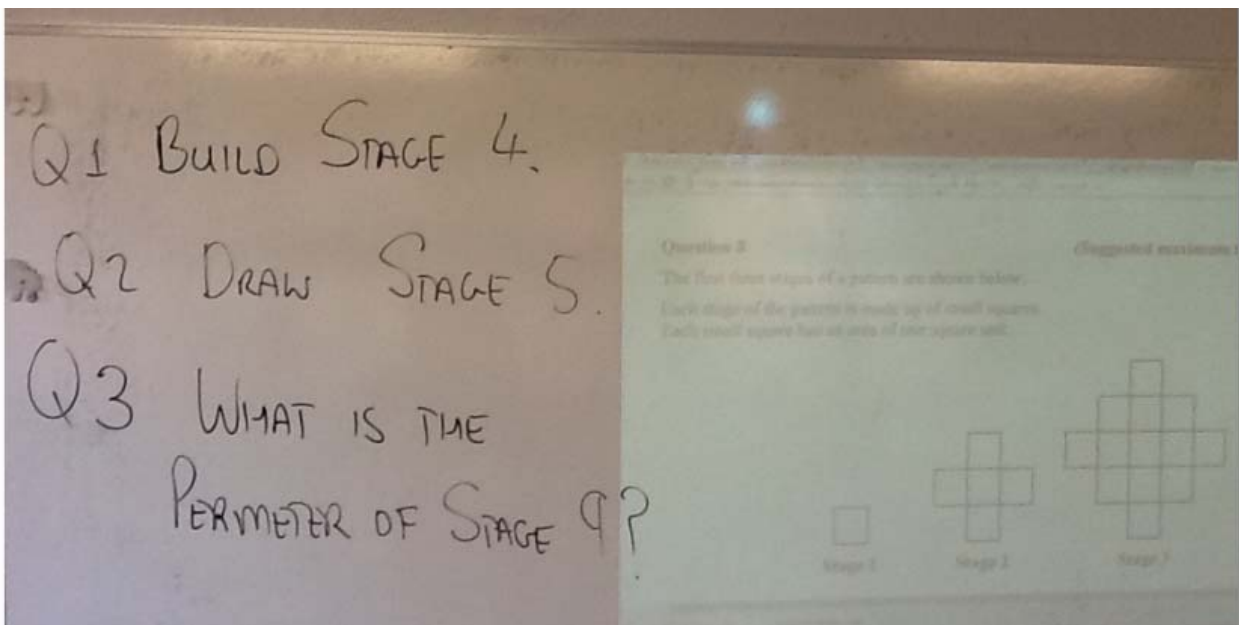
9. Post-lesson reflection

- *The class became more comfortable with the observers as the lesson went on- if it were to happen again it wouldn't be a big deal at all.*
- *The students definitely saw this as very different to a "normal" maths lesson.*
- *Teacher has to work hard during this type of lesson because the student groups all move at a different pace and need to be "moved on" to the next task at different times. As a result you need to know the problem well and be able to think on your feet!*
- *The pupils engage more with the pattern through building and discussion than if the teacher just presents approaches at the board.*
- *We felt that this type of lesson was crucial in preparation for the Contexts and Applications section of the exam.*
- *It's probably not possible to teach this way all the time but at least some of our maths lessons should take this approach.*
- *This lesson would be perfect for a subject inspection visit!*
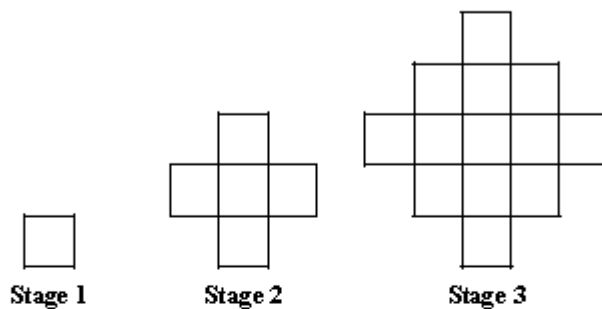
10. Handout

Question 8   (Suggested maximum time: 20 minutes)

The first three stages of a pattern are shown below.

Each stage of the pattern is made up of small squares.
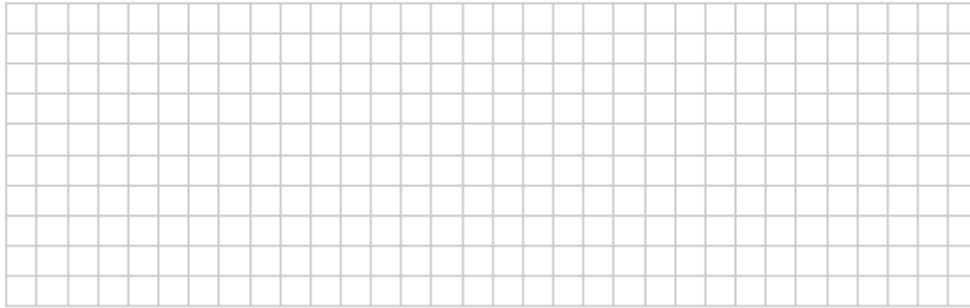Each small square has an area of one square unit.

Stage 1   Stage 2   Stage 3

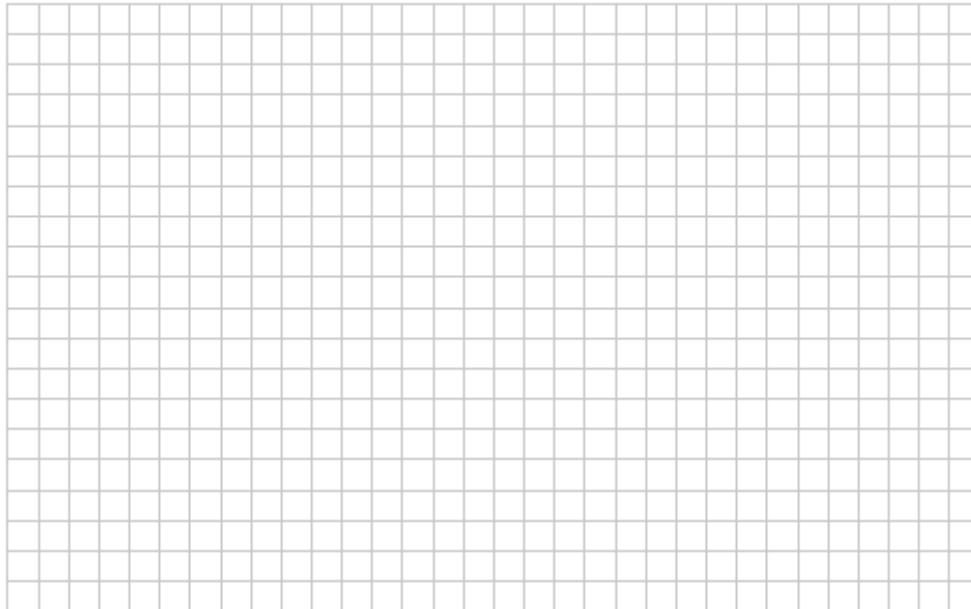**(a)**   Draw the next two stages of the pattern

(b)   The perimeter of Stage 1 of the pattern is 4 units.
The perimeter of Stage 2 of the pattern is 12 units.

Find a general formula for the **perimeter** of Stage n of the pattern, where $n \in \mathbb{N}$.

(c)   Find a general formula for the **area** of Stage n of the pattern, where $n \in \mathbb{N}$.

(d)   What kind of sequence (linear, quadratic, exponential, or none of these) do the **areas** follow? Justify your answer.