Lesson Plan for ***Second Year Maths class***

For the lesson on 24th February 2015
At: St.Joseph's SS, Ballybunion, Co.Kerry
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Plan developed by: Siobhan Hayes, Marina Mulvihill

1. **Title of the Lesson:** Valuing the variable – The hidden code

2. **Brief description of the lesson:** This lesson involves interpreting the variable in several ways using a geometric representation. This is designed for students to examine the importance of developing multiple solution strategies to form equivalent expressions.

3. **Aims of the Lesson:**
   I would like to foster my students to become independent learner
   I would like my students to appreciate that mathematics can be used to solve real world problems.
   I would like my students to appreciate that mathematics can be used to communicate thinking effectively.
   I would like my students to appreciate that algebra is a tool for making sense of certain Situations.
   I would like my students to become more creative when devising approaches and methods to solve problems.
   I would like to emphasise to students that a problem can have several equally valid solutions.

4. **Learning Outcomes:**
   As a result of studying this topic students will be able to:

   - Develop strategies to interpret someone else's representation of the variable
   - Build on and consolidate a deeper understanding of the concept of the variable

5. **Background and Rationale**
   In a typical lesson on the growing pattern and its relationship to the variable, the lesson often starts as follows.
   "Today we are going to look at growing patterns and use them to generalise an expression for the way in which the pattern is growing. To do this we need to draw a table.
   We have a growing pattern of tiles so we all need to draw a table with columns; Column 1 represents Stage number and Column 2 represents the Number of tiles.
   Using the first difference/ second difference we will find the general form for the stage number and the number of tiles".

Stage Number	Number of Tiles

Using this approach, students will most likely learn the algorithm for generalising from a growing pattern. They do not get to investigate or examine the pattern; there is a lack of discussion and the opportunity for various solution strategies is stifled.

Difficulties in the past have arisen regarding students **over** reliance on the table and their inability to (i) devise their own strategies apart from the table method, (ii) see mathematics in different ways (iii) value other students thinking and bringing their own perspectives to the mathematics behind the problem.

This lesson while focused on interpreting the variable in several ways has wide ranging value in relation to several learning outcomes as stated in the syllabus.

According to the syllabus, students need to be able to;

Section 3.1

-consolidate the idea that equality is a relationship in which two mathematical expressions hold the same value
-analyse solution strategies to problems
-engage with the idea of mathematical proof

Section 4.1

-generalise and explain patterns and relationships in words and numbers

Section 4.2

-develop and use their own generalising strategies and ideas and consider those of others
-present and interpret solutions, explaining and justifying methods, inferences and reasoning.

Section 4.3

-find the underlying formula written in words from which the data are derived (linear relations)
-find the underlying formula algebraically rom which the data are derived (linear, quadratic relations)

Section 4.4

-show that relations have features that can be represented in a variety of ways
-distinguish those features that are especially useful to identify and point out how those features appear in different representations.
-use the representations to reason about the situation from which the relationship is derived and communicate their thinking to others.

Section 4.6

-use letters to represent quantities that are variable

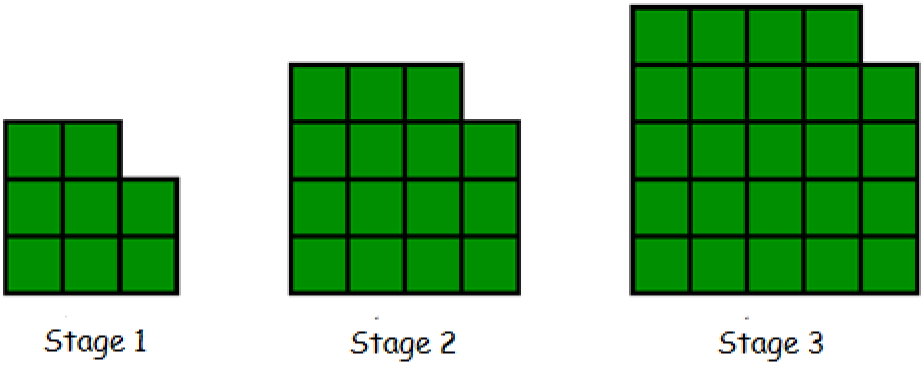
6. Research

Handbooks developed by the Project Maths Development Team, Sample Examination Papers and several geometric representations of growing patterns.

7. About the Unit and the Lesson

Prior knowledge of the linear growing pattern.

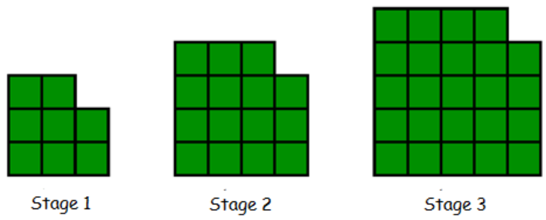
Students will be divided into groups of 3. Each group will be given the same geometric representation of a growing pattern. They will be given time to discuss the growing pattern in order to answer the question," How many tiles will be in the 100th stage of the pattern? They will then be asked to generalise the number of tiles in any stage number.



8. Flow of the Unit

Lesson	Section 4: Algebra	# of lesson periods
1	Revision and extension of algebraic expressions and simple linear equations from first year.	4 classes
2	Linear and quadratic relationships: Multi-representational approach	8 classes #2 research lesson
3	Algebraic Factors	8 classes
4	Algebraic Fractions	2 classes
5	Linear inequalities and solving simultaneous linear equations	8 classes
6	Solving quadratic equations	5 classes

9. Flow of the Lesson

Teaching Activity	Points of Consideration
1. Introduction Recap on terms associated with patterns Students were given a linear pattern and asked to create a formula for the nth pattern. This was used as scaffolding for the final task. Reinforce the stage number for each sequence of the pattern	
2. Posing the Task  Opening question: In your groups, discuss how you see this pattern growing. How nay tiles do you think are needed for the 100th stage of the pattern?	Do students understand the question posed?
3. Anticipated Student Responses Possible responses: Pattern 1: (i): In each stage the width is increasing by 1 tile and the height is increasing by 1 tile. (ii): Each stage is a square with 1 tile removed. (iii): The first one is (2x3)+2, the second one is ((3x4)+3 and the third one is (4x5)+4	Are students able to verbalise what they see in the growing pattern?
Posing the Task Students were asked to draw the next three patterns in the sequence. If the pattern continues growing in this way, using what you have discovered and the way	

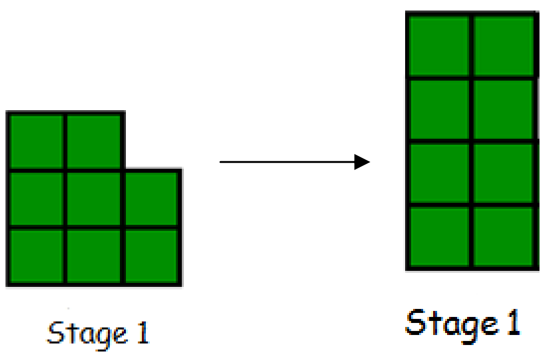
in which you discovered it; can you tell me how many tiles will be in the next stage of the pattern?	
Anticipated Student Responses Pattern 1: (i): 35 green tiles (ii): (6x6)-1 (iii):Following the pattern; Stage 1= (2x3)+2 Stage 2=(3x4)+3, Stage 3=(4x5)+4, so, Stage 4=(5x6)+5 Pattern 2: (i): 3+ 4^2+16	Write student responses on the board. Allow time for students to examine these responses and to check if they all give the same result. Do students see a connection between the stage number and the number of tiles?
Posing the Task Now in your groups can you create a formula for the number of tiles in the nth pattern? (for the quadratic sequence)	Do students understand what is meant by the nth pattern? Help students/groups as necessary if this needs further explanation Students are given time in their groups to establish a formula.
Anticipated Student Responses Pattern 1: (i): (n+2)(n+2)-1 The width is the stage number +2. The height is the stage number +2. Multiply these and then subtract 1. (ii): (n+1)(n+2)+(n+1) Taking the first stage and the rectangle of width 2 and height 3; this gives us a width = the stage number +1. The height = stage number +2 and then the two tiles on eth side = the stage number +1 (iii): $(n+2)^2$-1 Filling in the square. Each stage has a width =n+2 and a height = n+2. If we multiply these and take away 1 tile we will have the total number of tiles. The area is then (n+2)(n+2)-1	Ask each group to explain their work or come to board and explain it? Display both patterns on power point.

<table>
<tr><td></td><td></td></tr>
<tr><td>Comparing and Discussing

Ask students to compare the answers they found.
Are all of these answers equivalent to each other?</td><td>Listen to feedback
Do students understand what equivalence means?
Help individuals and groups as necessary.</td></tr>
<tr><td>Posing the Task – <u>Extension</u>

Is there another way we could establish the formula for the number of tiles in the nth pattern?

Would the number of tiles in each stage change if we were to move some of them?</td><td>Encourage students to take another look at the pattern.</td></tr>
<tr><td>Anticipated Student Responses

(i): We could move the ones at the side and put them on top to make a rectangle.
(ii): I was thinking we could move the ones from the top and put them on the side and we would still have a rectangle.</td><td>Do students understand how this may be done?
Would doing this alter the number of tiles in each pattern?</td></tr>
<tr><td>

For any stage, the number of tiles equals the stage number plus 1 multiplied by the stage number plus 3. This gives us (n+1)(n+3)</td><td></td></tr>
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10. Evaluation

We plan to observe students during the lesson in order to ascertain the level with which students of varying ability deal with the task. Each teacher will observe a group of 3 students. A student observation template has been drafted and will be filled in by teachers during the class. Photographs of student work will be taken on the day and the main focus will be how students engaged in interpreting the variable in as many ways as possible.

11. Board Plan

As students gave feedback, their responses were put in the board including the use of spider-diagrams and visual representations.

12. Post-lesson reflection

- The most surprising outcome from the lesson was the way in which all students, irrespective of their ability, were able to interpret the variable in several different ways. The visual stimulus provide d them with the opportunity to open discussion within each group and to see the point of view of their peers.
- The group discussion and problem solving worked very well in most cases and students demonstrated confidence in expressing their reasoning.
- However, time was an important factor for this lesson and so we would recommend that the lesson take place over a double period.
- We found that students were more comfortable discussing the problem with their peers and expressed their views more confidently within the group.
- The mixed ability groups worked well when carefully designed.
- On reflection, we feel that the use of unifix cubes would have enhanced the ability and speed with which students would re-arrange the growing pattern.
- By affording students the opportunity to explore the geometric representation of the pattern in as many ways as possible they were surprised at arriving at the same solution by using different approaches yet this approach allowed them to 'think for themselves' with very little input from the teacher.
- Finally, we found this experience very worthwhile for our Maths Department and reinforced our opinion that when given the opportunity students are capable of thinking creatively and concisely about mathematics.
- The process for us as maths teachers, which involved collaborating with other maths teachers was extremely valuable for all involved but particularly for the students we teach. In saying that, time for this important, in-depth collaboration needs to be afforded to teachers when school planning details are being decided upon.