Lesson Research Proposal for 2nd Year Simultaneous Equations

Date of lesson: 25/02/19
School name: Hansfield ETSS
Teacher giving lesson: Caitriona Mullen
Associate: Andrew Hough

Lesson plan developed by: Caitriona Mullen, Andrew Hough, Dan O’Grady, Warren McIntyre, Kevin Murphy and Lauren McCann

1. Title of the Lesson:

2. Brief description of the lesson

This lesson aims to bring about the concept of ‘a linear relationship’ and arriving at the concept of simultaneous linear equations in a more natural way.

3. Research Theme

At this school we want students to:
- Learn through discovery.
- Reflect on their progress as learners and develop a sense of ownership of and responsibility for their learning.
- Experience opportunities to develop the skills and attitudes necessary for lifelong learning.

As Mathematics teachers we want students to:
- Become independent learners.
- Develop resilience in problem solving.
- Engage purposefully in meaningful learning activities.

As Mathematics teachers we want:
- To continually engage with new initiatives in the delivery of mathematics.
- Have a common approach across the department in using structured problem solving.
- Use Lesson Study as a form of collaboration in our department.

We will actively support the achievement of these goals by:
- Presenting the students with an engaging and meaningful task.
- Ensuring students experience regular formative feedback both written and verbal.

We have decided to choose Algebra as the general topic to design a structured problem-solving research lesson.
4. **Background & Rationale**

- **Topic:** Algebra – Word problems.
- We have chosen this topic as from teacher observation we have identified algebra word problems as a weak area with our current student cohort.
- Students have problems with linking/modelling words into Maths notation.
- Our goals hope to create less anxiety in approaching Maths problems.
- We hope to improve confidence.
- Our evidence is based on observation and experience across year groups.
- Common misconceptions about using two variables and not making connections between variables.
- Meaning of key terms.
- Linking skills between different topics.
- Recognising simultaneous equations.

5. **Relationship of the Unit to the Syllabus**

Describe how this unit relates to the syllabus/learning outcomes from prior years, for this year and for future learning.

<table>
<thead>
<tr>
<th>Related prior learning Outcomes</th>
<th>Learning outcomes for this unit</th>
<th>Related later learning outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Basic Patterns</td>
<td>• Analyse information presented verbally and translate into Mathematical form.</td>
<td>• Use graphical methods to find approximate solutions where f(x) = g(x) and interpret the results.</td>
</tr>
<tr>
<td>• BIMDAS</td>
<td>• Linking/modelling words into Maths Notation.</td>
<td>• Find the underlying formula algebraically from which the data are derived. (Linear)</td>
</tr>
<tr>
<td>• Algebra operations</td>
<td>• Making Connections between shape of a graph and story of the phenomenon.</td>
<td>• Write arithmetic expressions for particular terms in a sequence</td>
</tr>
<tr>
<td>• Integers</td>
<td>• Show that relations have features that can be represented in a variety of ways.</td>
<td>• Find the underlying formula algebraically from which the data are derived (linear, quadratic relations)</td>
</tr>
<tr>
<td>• Co-ordinates</td>
<td>• Find the underlying formula written in words from which the data are derived (linear).</td>
<td>• Discuss rate of change and the y-intercept; consider how these relate to the context from which the relationship is derived, and identify how they can appear in a table,</td>
</tr>
</tbody>
</table>
6. **Goals of the Unit**

The goals of this unit are to

- Develop students’ understanding of linear pattern as a relationship between two numbers.
- Assist students to make connections between mathematics and the real world.
- Develop students' skills at drawing the coordinated plane.
- Aid students in seeing the link between a rule involving two variables and a line on the cartesian plane.
- Recognize that there may be multiple representations, and therefore multiple solutions to the same problem.
- Increase student's confidence when approaching a question with models or problem solving.

- Investigate relations of the form $y=mx$ and $y=mx+c$.
- Recognise problems involving direct proportion and identify the necessary information to solve them.
- Explore patterns and formulate conjectures - explain findings - justify conclusions.
- Communicate mathematics verbally and in written form.
- Apply their knowledge and skills to solve problems in familiar and unfamiliar contexts.
- Analyse information presented verbally and translate it into mathematical form.
- Devise, select and use appropriate mathematical models, formulae or techniques to process information and to draw relevant conclusions.
• Understand the order of operations.
• Make connections within and between strands.
• Feel comfortable that they have the skills to tackle an unseen problem.

7. Unit Plan
How the research lesson fits into the larger unit plan, helping to show the bigger picture of the whole unit and the progression of learning. Clarify where the research lesson will be taught.

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Brief overview of lessons in unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Plotting x and y co-ordinates on the co-ordinate plane.</td>
</tr>
<tr>
<td>2</td>
<td>Slope of a line.</td>
</tr>
<tr>
<td>3</td>
<td>Length of a line/distance between two points.</td>
</tr>
<tr>
<td>4</td>
<td>Mid-Point of a line.</td>
</tr>
<tr>
<td>5</td>
<td><strong>Research Lesson:</strong> Simultaneous Equations/Intersection of two lines.</td>
</tr>
</tbody>
</table>

8. Goals of the Research Lesson:
Students will be able to:
• Comprehend that two pieces of information are required to solve for two variables.
• Formulate a linear equation to from a word problem.
• Use tables, graphs, trial and error or algebra to represent and solve an equation.
• Solve two linear equations simultaneously.
• Appreciate the meaning of the word “simultaneous” in the mathematical context and relate it to solving for two unknowns at the same time.
• Utilise all information given, including the use of one value to solve for the other variable.
• Feel confident when approaching an unfamiliar question.

This lesson will demonstrate the key skills and statements as outlined below:

Key Skills
• Being Literate: Students will express ideas clearly and creatively when adapting different methods to solve this problem.
• Managing Myself: Through investigation, students may reflect on their learning and progress so far through reasoning. Students may need to reason and reflect on their chosen method(s) to take the most appropriate route of solving the problem.
• Staying Well: Being confident – The aim of the lesson is to grow students’ confidence when dealing with unfamiliar problems.
• Managing Information and Thinking: Critical thinking and reflection skills will aid students in solving word problems.
• Being Numerate: Students can apply the skills learned across the various strands to tackle word problems.
• Working with Others and Communicating: Groupwork will be utilised in the activity whereby students may work together to solve the problem.

Statements of Learning
1. Communicates effectively using a variety of means in a range of contexts.
15. Recognises the potential uses of mathematical knowledge, skills and understanding in all areas.
9. **Flow of the Research Lesson:**

<table>
<thead>
<tr>
<th>Steps, Learning Activities</th>
<th>Teacher’s Questions and Expected Student Reactions</th>
<th>Teacher Support</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction: Getting straight into it. Prior learning has been done in previous recent classes. Clarification of how the points system in basketball works.</td>
<td>Clarification if needed.</td>
<td>This column shows additional moves, questions, or statements that the teacher may need to make to help students.</td>
<td>This column identifies (a) what the teacher will look for (formative assessment) that indicates it makes sense to continue with the lesson, and (b) what observers should look for to determine whether each segment of the lesson is having the intended effect.</td>
</tr>
</tbody>
</table>

**Posing the Task:**

**Task 1 (5 mins):**

a) Andrew is playing Basketball, he scores a total of 17 points. In Basketball a lay-up is worth 2 points and a free throw is worth 1 point. List as many ways as possible he could have scored the 17 points.

b) Plot this on the labelled access.

**Task 2:**

a) In total Andrew scored 10 times. For example, one lay-up and nine free throws. List the
Different ways he could have scored these 10 baskets.

b) Plot this on the same axis used for task 1.

c) i) How many ways are there to score 17 points?  
ii) How many ways are there to score 10 baskets?

d) i) Do the two lines meet?  
ii) If so at how many free throws and how many layups?

### Student Individual Work:

**Task 1.** Students will work individually on each task. (5 minutes).

We expect students to list out all the possible ways of scoring 17 points using a combination of lay-ups and free throws.

After this we expect students to graph the lay-up vs free throw relationship on a provided labelled axis.

**Task 2.** Task 2 will be introduced after the board work for task 1 is complete. (7 minutes).

We expect students to be able to work through the different parts of the questions throughout the 7 minutes and do another graph on the provided labelled axis.

### Ceadrócht /Comparing and Discussing

After Task 1, board work will be addressed. Students will be called to the board to display a solution. Other students will be asked to explain how that solution was obtained. An explanation of the total of 17 points will be required for each set (for future learning of

Teacher will ask students to come to the board to show their solutions. Other students will be asked to verify and re-explain.

Observers will be noting whether students can clearly explain their solutions and stand by them confidently. They
<table>
<thead>
<tr>
<th>Creating the equation)</th>
<th>A student will plot the points on a graph (pre-drawn to save time).</th>
<th>Teacher will ask a student to plot points on the graph.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>If time, extra questions may be asked, about the shape of the graph etc. (15 minutes).</td>
<td>If time permits, teacher will develop some concepts further with more questioning.</td>
</tr>
<tr>
<td></td>
<td>Once Task 2 is complete board work will be addressed. Students will be called to the board to display a solution. Other students will be asked to explain how that solution was obtained. An explanation of the total of 10 baskets will be required for each set (for future learning of creating the equation).</td>
<td>Teacher will ask students to come to the board to show their solutions. Other students will be asked to verify and re-explain.</td>
</tr>
<tr>
<td></td>
<td>A student will answer how many ways there is to score 17 points. This will be consolidated from the previous board work.</td>
<td>Observers will be noting whether students can clearly explain their solutions and stand by them confidently. They will also be noting if other students can re-explain students' solutions.</td>
</tr>
<tr>
<td></td>
<td>A student will answer how many ways there are to score 10 baskets. This will be consolidated from previous board work.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A student will answer if the two lines meet. This will be shown on the graph.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A student will comment on how many lay ups and free throws correspond to the point at which these lines meet. This will be shown on the graph. (15 minutes).</td>
<td></td>
</tr>
<tr>
<td>Summing up &amp; Reflection</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Maths Development Team: Lesson Study 2017-2018**
10. **Board Plan**
Carefully plan the board work before the lesson takes place to decide on the order of the solutions and the links that will be made at the board. Put an image or a diagram of the pre-prepared board work here.

11. **Evaluation**
This section should include questions, to be discussed after the lesson, about the effectiveness of the lesson in terms of the team’s research goals. It should include at least one question specific to the research theme and at least one about the specific content goals. For example:
   a) Did the lesson successfully promote student-to-student discussion? (i.e. the theme)
   b) Do students understand that …? (i.e. a content goal)

Include any other questions that the planning team hopes to explore through this lesson and the post-lesson discussion.

In preparing for evaluating the lesson it may be useful to:

- Have a written record of responses, approaches and solutions
- Identify the approach used by each individual student
- Collect student work at end of lesson for assessment
- Identify students who do not understand the problem

12. **Reflection**
After the research lesson, the team should write a reflection, which will normally include:

   a) what the team had hoped to observe during the lesson
   b) what was actually observed during the lesson, by the team members and others;
   c) major points raised during the post-lesson discussion, and the team’s own opinions;
   d) points made by the knowledgeable other; and
   e) ideas for future study.

This may be a few paragraphs in length. A good reflection makes the final document much more valuable to an outside audience.