Lesson Research Proposal for 2nd Year Simultaneous Equations

Date of lesson: 25/02/19
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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.
- The Chief Examiner's Report (2015) reports that students had difficulty forming and solving simultaneous equations.
- 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.

Related prior learning Outcomes	Learning outcomes for this unit	Related later learning outcomes
- Basic Patterns - BIMDAS - Algebra operations - Integers - Co-ordinates - Simplifying and solving algebraic expressions. - Generalise and explain patterns and relationships in words and numbers.	- Analyse information presented verbally and translate into Mathematical form. - Linking/modelling words into Maths Notation. - Making Connections between shape of a graph and story of the phenomenon. - Show that relations have features that can be represented in a variety of ways. - Find the underlying formula written in words from which the data are derived (linear).	- Use graphical methods to find approximate solutions where f(x) = g(x) and interpret the results. - Find the underlying formula algebraically from which the data are derived. (Linear) - Write arithmetic expressions for particular terms in a sequence - Find the underlying formula algebraically from which the data are derived (linear, quadratic relations) - 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,

		in a graph and in a formula • 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.

6. Goals of the Unit

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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

- 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.

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

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

of learning.

16. Describes, illustrates, interprets, predicts and explains patterns and relationships.

17. Devises and evaluates strategies for investigating and solving problems using mathematical knowledge, reasoning and skills.

21. Applies practical skills as she/he develop models and products using a variety of materials and technologies.

9. Flow of the Research Lesson:

Steps, Learning Activities Teacher's Questions and Expected Student Reactions	Teacher Support	Assessment
This column shows the major events and flow of the lesson, including timings and what will go up on the board.	This column shows additional moves, questions, or statements that the teacher may need to make to help students.	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.
Introduction: Getting straight into it. Prior learning has been done in previous recent classes. Clarification of how the points system in basketball works.	Clarification if needed.	
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.**	Clarification of how the points system in basketball work may be made here and clarification of what is being asked so all students can actively participate.	Teacher will review and note down the student's responses and who/what order of students she will ask up to the board.
b) Plot this on the labelled access.	Individual assistance may be required for some students here.	Teacher will ask a student who completed their graph correctly to come to board to complete a pre-labelled axis.
Task 2: a) In total Andrew scored 10 times. For example, one lay-up and nine free throws. List the		Teacher will review and

different ways he could have scored these 10 baskets.	Clarification and one example if necessary.	note down the student's responses and who/what order of students she will ask up to the board.
b) Plot this on the same axis used for task 1.	Individual assistance may be required for some students here.	Teacher will ask a student who completed their graph correctly to come to board to complete a pre-labelled axis.
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.**	Teacher will circulate the room observing and noting down students work that will be brought to the board. Observers will be noting down student responses, misconceptions, errors, conversations etc.	Teacher will be able to see from observation if students are writing down correct combinations. Teacher will also be able to view of graphs are being completed correctly.
Task2. 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.**	Teacher will circulate the room observing and noting down students work that will be brought to the board. Observers will be noting down student responses, misconceptions, errors, conversations etc.	Teacher will be able to see from observation if students are writing down correct combinations. Teacher will also be able to view of graphs are being completed correctly.
Ceardaíocht /Comparing and Discussing After <u>Task 1</u>, 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

creating the equation).		will also be noting if other students can re-explain students' solutions.
A student will plot the points on a graph (pre-drawn to save time). **If time, extra questions may be asked, about the shape of the graph etc. (15 minutes).**	Teacher will ask a student to plot points on the graph. If time permits, teacher will develop some concepts further with more questioning.	
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).	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 will also be noting if other students can re-explain students' solutions.
A student will plot the points on a graph (pre-drawn to save time). **A student will answer how many ways there is to score 17 points. This will be consolidated from the previous board work.**	Teacher will ask a student to plot points on the graph. Teacher will ask a student to state how many ways there are to score 17 points. Teacher will verify this with previous board work.	
A student will answer how many ways there are to score 10 baskets. This will be consolidated from previous board work.	Teacher will ask a student to state how many ways there are to score 10 baskets. Teacher will verify this with previous board work.	
A student will answer if the two lines meet. This will be shown on the graph.	Teacher will ask if the two lines meet. Teacher can verify this with the graph.	
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).	Teacher will ask a student to state how many lay ups and free throws are where the lines meet. This will be verified with the graph.	
Summing up & Reflection		

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.

Board Plan

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.