**Title of the Lesson:** Representing simultaneous equations graphically

**Brief Description of the Lesson**: Students are posed a real life problem and asked to come up with as many ways to solve this problem as possible. Students should be able to use a graph to represent real-life problems.

**Long term goals:**

1. How algebra relates to real life situations.
2. For students to realise that there is more than 1 way to solve a problem.
3. Connections between solving problems graphically and algebraically.

**Learning outcomes:**

4. Selecting and using suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to equations. They identify the necessary information, represent problems mathematically, making correct use of symbols, words, diagrams, tables and graphs.
5. Use graphical methods to find approximate solutions where $f(x) = g(x)$ and interpret the results .
6. Solve first degree equations in one or two variables, with coefficients elements of Z and solutions also elements of Z.
7. Draw graphs of the following functions and interpret equations of the form $f(x) = g(x)$ as a comparison of functions
   - $f(x) = ax + b$, where $a, b \in Z$

**Background and Rationale:**

Syllabus as above.

Simultaneous equations are often quite a difficult topic for students to grasp as they are quite abstract.
Signs and changing signs- confusing.
It can be a boring topic for students and teachers and it can be difficult to be creative.
Ref: long range goals.

**Research:**
Junior Cycle HL 2014 P1 Q9
Maths in Action 2 OL
www.projectmaths.ie
Question with coins

**About the Unit and the Lesson:**

*Abstract*: Relating equations to real life problems and showing that solving them gives the intersection of two situations.

Showing students how to solve problems graphically overcomes the need for solving equations in the traditional manner and shows students that there is more than one way to solve a problem.

Adds some creativity and freedom for teachers and students to think outside the box and explore the problem. Students are encouraged to come up with more than one way to solve the problem.

**Flow of the unit:**

| Lesson | | number of lesson periods |
|---|---|---|
| CoOrdinate Geometry | Drawing a Graph to represent lines | 10 |
| Number Patterns | Representing a word problem in a variety of ways<br>- table<br>- graphs<br>- thinking it out<br>- finding a general formula | 3 |
| Algebra - simultaneous equations | 1. Solve first degree equations in one or two variables, with coefficients elements of Z and solutions also elements of Z.<br>2. Draw graphs of the following functions and interpret equations of the form f(x) = g(x) as a comparison of functions<br>• f(x) = ax + b, where a, b $\in$Z | 3 |
| | | |

**How the lesson is designed to help students meet the learning outcomes:**

Starting the lesson with prior knowledge gives students confidence and guidance. Using a real world problems allows students to connect an abstract concept such as simultaneous equations to a concrete real life scenario. This show students how they can apply Math's to their everyday life. As there are a range of different solutions of varying levels of difficulty all students get a sense of achievement from seeing some variation of their work on the board. Getting students up to the board to demonstrate their solutions helps increase their confidence with maths. Often students lack confidence and this allows them to see that they are capable and that there is not always only one method of solving a mathematical problem.

**Prior knowledge**

Coordinate geometry - intersecting lines
Patterns
Graphing linear functions/patterns
Writing patterns as an algebraic equation

| Teaching Activity | Points of Consideration | |
|---|---|---|
| This column shows the major events and flow of the lesson. | This column shows additional moves, questions, or statements that the teacher may need to make to help students.<br>This column identifies what the teacher should look for to determine whether to proceed, and what observers should look for to determine the effectiveness of the lesson. | |
| 1. Introduction<br>Prior knowledge:<br>What do we need to draw a line?<br><br>Lines of the form y=mx+c | | |
| 2. Posing the Task<br>Tony and Leah are saving money for a holiday to Nigeria. Tony has €50 in his money box and Leah has €120. Tony decides to save €15 a week and Leah decides to save €10 a week. After how many weeks will they have the same amount of money.<br><br>Students will be supplied with plain paper and graph paper, rulers and nothing.<br><br>Explain to the students how this works- working alone, coming up with as many ways to solve as possible/solutions. | How do we know if students understand the task?<br><br>It should be stressed that if students have any questions they should be asked at this point as they will not be able to ask in the thinking time.<br><br>Students who are known to have comprehension difficulties should be approached quietly at the start of the task to check that they have understood before they start to work.<br><br>Check all students have all supplies.<br><br>Encouraging students to use all supplies and to continue to work on different methods for the whole time period. | 5 mins<br><br>5 mins<br><br>20 mins |

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|---|---|---|
| 3. Anticipated Student Responses<br><br>R1: Trial and Error<br><br>R2 Adding week by week as linear sequence. (Numbers just written down)<br>(Incorrect solution: Weeks labled incorrectly)<br><br>R3 Table<br><br>R4 Bar Chart/Number Line/Visual Representation<br><br>R5 Graph of two lines<br>(Incorrect solution: Day 1 as day 0)<br><br>R6 Equations (With a trial and error response) | Encouraging students who give up early by circulating through the class and making small suggestions or offering small hints (why do you have that graph paper?)<br><br>Monitor for common misconceptions which can be tackled at the end of the board time.<br><br>Observing students work and taking note of students' names for responses for board time (note number of response with student name.)<br><br>Be aware of variations of same response and how they can be used to further students' learning.<br><br>Students should be given small prompts if very necessary but should be encouraged to work independently. | |
| 4. Comparing and Discussing<br>This section may identify which student solution methods should be shared and in what order, or generally how to handle the discussion.<br><br>Students solutions should be shared in an order from that perceived to be most basic to the most sophisticated/desirable.<br><br>The link between a R2 and R3 should be highlighted.<br><br>Similarly the link betweenR3 and R4 should be highlighted.<br><br>R5 is the most desirable solution and R6 is a bonus and students will be reflecting on this method for homework. | What are the ideas to focus on during the discussion?<br>What will indicate that students are benefiting from the discussion?<br><br>Linking graphing a problem to listing numbers and using tables.<br><br>Showing that it is quicker and easier to draw a line (as you only need 2 points). So graphing is the desired solution.<br><br>Highlight the number of solutions and that they are all equally valid.<br><br>All students are engaged with the learning.<br><br>Students are eager to come to the board.<br><br>Students discuss the solutions of others.<br><br>Students indicate by show of hands that they have the same or a similar solution.<br><br>Making links. | 20 mins |
| | | |

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| 5. Summing up<br><br>Students think pair share on which solution they thought was the best/most interesting/easiest to understand.<br><br>Rating their engagement with the lesson on the wall chart. | | |

**Evaluation:**

Observers are looking for variety and complexity of strategies from basic listing up to solving the problem graphically. Each observer will monitor 5 students taking pictures of relevant work using Lessonnote. The observers will be looking to see that students are engaged with the problem and will be recording common misconceptions in the students solutions.

**Reflection:**

The most common approaches seen to tackle the problem were listing, adding the constant amount for both situations, making a table and graphing it. One student found the difference and divided to solve the problem. We had anticipated this approach but we were still impressed nonetheless. Approaches that had not been anticipated were representing the problem in a pattern format, as a line plot, trial and improvement.
Some misconceptions seen were that students started at week 1 instead of week 0, with another student finding common multiples rather than finding a week were both values were the same.

Some students had difficulty with the scaling of graphs which was pointed out when the correct graph was put on the board. We were surprised by one student representing the problem in pattern format but it gave the teacher the opportunity to show that the pattern was linear and linking it to the linear graphs that other students had plotted.