Lesson Research Proposal for 2nd Year Co-ordinate Geometry

For the lesson on January 12th 2018
At St. Marys College, Dundalk, 2nd year
Instructor: Mr. Cathal Halpenny
Lesson plan developed by: Natasha Kellett, Stephen Mc Shane, Denyse Hughes, Christine O'Hare

1. Title of the Lesson: Are We There Yet?

2. Brief description of the lesson

Students are encouraged to solve a problem by finding the midpoint between two points. This can be achieved in many ways. Through ceardaíocht students will be directed to the development of a general formula.

3. Research Theme

At St. Mary's College and Colaiste Ris, we want our students to:

a) Enjoy their learning, are motivated to learn and expect to achieve as learners.
b) Reflect on their progress as learners and develop a sense of ownership of and responsibility for their learning.

4. Background & Rationale

It is well known that many Irish schools are now currently trying to incorporate within their Whole School Evaluation, improvements in Numeracy amongst young students. In order to try and improve numeracy levels, it's important for Maths teachers to develop methodologies that promote an enjoyment of learning mathematics and also an appreciation of its applications in society. We felt as a team that topics such as Coordinate Geometry can often be difficult for some students to comprehend and develop a liking for. We've often observed that many students have a tendency to rely on Rote-Learning by copying formulas from their Formulae Tables and applying them without any real understanding as to where the formulas are derived from. Students do not develop a sense of ownership over their learning, why they are learning the topic to begin with, or what its possible applications could be to real life situations. Without feeling a sense of achievement, or being able to see the value of where they can apply this new knowledge to, students typically become unmotivated by the topic and unwilling to challenge themselves further in their learning.

5. Relationship of the Unit to the Syllabus

Related prior learning Outcomes	Learning outcomes for this unit	Related later learning outcomes
In primary school, students have not received much exposure to coordinate geometry however they would have had to learn to draw a circle and calculate the radius of a circle	Students will have developed an understanding of the properties of lines and line segments, including midpoint and slope.	Students will be able to apply this understanding to later topics such as finding the slope of a line, parallel and perpendicular lines and also to finding the center of a circle.

5th Class The child should be enabled to • estimate sums, differences, products and quotients of whole numbers • construct a circle of given radius or diameter • estimate and measure length using appropriate metric units 6th Class The child should be enabled to • explore and calculate averages of simple data sets • plot simple co-ordinates and apply where appropriate • use and interpret scales on maps and plans In First Year students have only previously experienced plotting points and drawing lines and line segments on a coordinate plane. Reading real life graphs e.g. Distance versus Time		

6. Goals of the Unit

- Students need to be able to use problem-solving skills and apply mathematical calculations to solve a real-life problem or challenge and also to develop a sense of responsibility and ownership in their learning.
- Students need to understand the rationale behind applying formulas in real-life situations in order to feel motivated in their learning of mathematics.
- Students need to feel a sense of achievement and hence enjoyment in their learning through development of their own methods and formula.

7. Unit Plan

Lesson	Learning goal(s) and tasks
1	Students will have prior knowledge of plotting points from 1st year. Students will be given tasks to expand and reinforce their knowledge of plotting points.
2 The Research lesson	The mid-point of a line or line segment • The concept of midpoint of a line segment making connections with different areas of the course. • To develop a midpoint formula from the methods the students used to solve the problem.
3	Distance formula and relate it to trigonometry (Pythagoras's Theorem) • Instruments & units used to measure distance • How Pythagoras theorem can be used to measure distance • The distance formula in coordinate geometry & its connection to Pythagoras theorem • The relationship between the midpoint and the length of a line segment
4	Slope of a line • Investigation of slopes of lines and how they can be quantified as a ratio of rise to run • Understanding of the relationship of the slope formula and rise over run • Links between slope and rate of growth
5	Slope formula y=mx+c • Links to real life context (e.g. growth of plant with a constant growth rate) • How to generalise to the slope of a line formula
6 .	Equation of a line • Using tables, graphs and diagrams in relation to the equation of a line • The connection between the y-intercept, slope and the equation of a line • The equation of line in the forms: $y = mx + c$ and $y – y1 = m(x - x1)$ • The connection between the x and y intercepts and the equation of a line from a graphical and algebraic perspective • Points on a line (and not on a line) from a graphical and algebraic perspective • Properties of the equation of a line
7	Intersection of two lines • How to use tables, graphs and algebra in relation to the intersection of lines • Links to real life context (e.g. comparing plants with varying constant growth rates and starting heights)

8. Goals of the Research Lesson:

The Goals of the lesson should refer to:

a) Mathematical Goals

By the end of the lesson students should:

- Understand the concept of midpoint

- Know that a bisector of a line cuts a line in to two equal parts
- Through investigation develop a general midpoint formula
- Understanding how to apply the formula to various situations

b) Key Skills and Statements of Learning

Key Skills:

1. Being Literate: Students will have developed the opportunity to express ideas clearly and accurately.
2. Being Numerate: Estimating, predicting and calculating.
3. Staying Well: Being positive about learning
4. Managing Information and Thinking: Reflecting on and evaluating students learning
5. Managing Myself: Students being able to reflect on their own learning
6. Working with Others: Learning with others
7. Communicating: Using numbers
8. Being Creative: Imagining

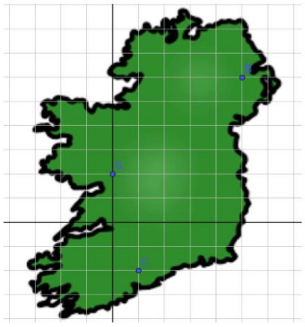
Statements of Learning:

This lesson is designed to meet the following Junior Cycle Statements of Learning:

- 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
- 18 - Observes and evaluates empirical events and processes and draws valid deductions and conclusions.

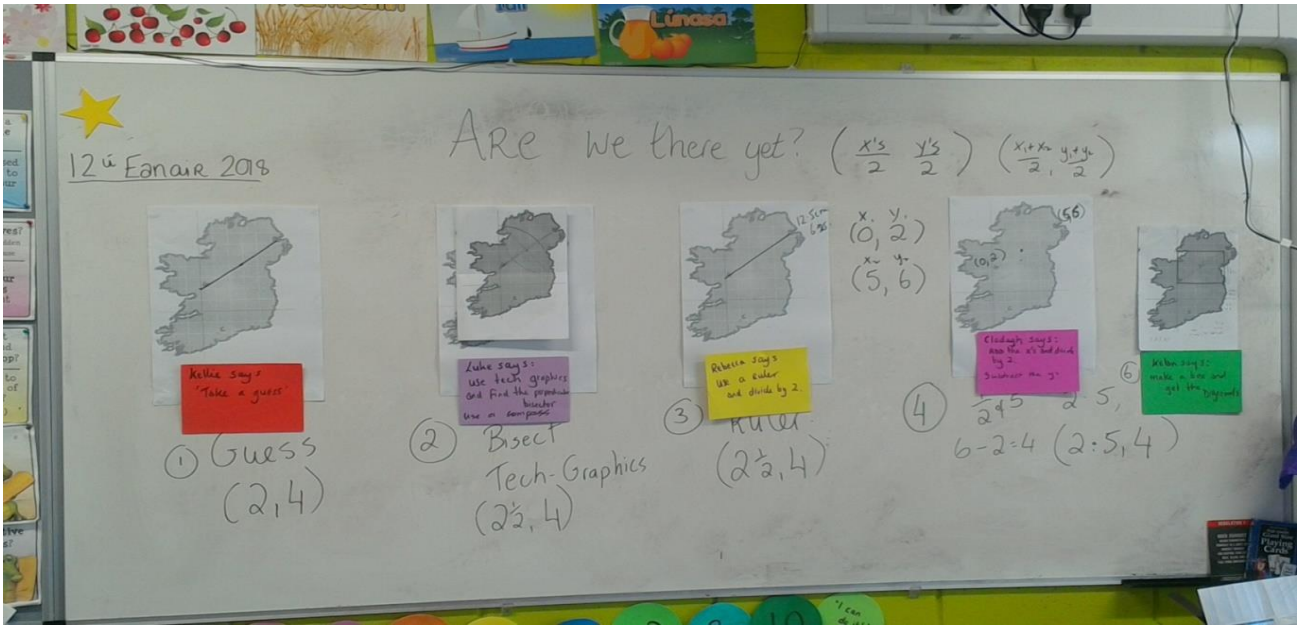
9. Flow of the Research Lesson:

Steps, Learning Activities **Teacher's Questions and Expected Student Reactions**	**Teacher Support**	**Assessment**
Step1: Prior knowledge activity (3 min)	Teacher will give a problem to students where they will have to revise on plotting points.	Have students plotted four points correctly and connected the four points to create a 2-d shape.
Introduction Handout with page titled 'Are we there yet?' given to each student.	Teacher will read through the problem given to students and clarify that students are clear on how to proceed. Teacher will clarify that each box is one unit.	Are students clear on what they are being asked to do? Are students clear on where Galway, Belfast & Cork are located?

Posing the Task Students are presented with the following problem; Are We There Yet? On a trip from Belfast to Galway there is a deal made. You agree to sit in the back of the car until you get to the half way point. Using the map provided can you find the best coordinates to switch seats. Can you develop different methods as to how this point can be achieved? Check your methods to find the same point between Belfast and Cork.  Students will be told that there is more than one solution therefore it is important to find as many ways as possible.	Handout given to student Geometry set will be given A4 solution sheet	
Student Individual Work 1. Students will take a guess. 2. Use a ruler to measure the distance and divide by 2. 3. Perpendicular Bisector 4. Stair method 5. Trigonometry (Pythagoras theorem)	- Teacher will ask student to explain how they guessed the answer. - Teacher will ask the student to show on the board how they used the ruler correctly. - Teacher will ask student to demonstrate this with a compass and straight edge at the board. - Teacher will ask student to demonstrate at the board how they concluded this. - Teacher will ask student to describe to the class at the board	

6. Count boxes across and find half way and then count up and get half way. (average) 7. Rectangle method 8. Finding the difference between x and y coordinates and calculating the middle of value of each. 9. Finding the average of the sum of the x and y value coordinates to find the midpoint	how they used trigonometry to find the midpoint - Teacher will ask student to show their method . - Teacher will ask student to show the class at the board how they used a rectangle to find the midpoint - Teacher will ask student to explain what they did using the x and why coordinates. - Teacher will ask student to explain the method of averaging.	
Ceardaíocht /Comparing and Discussing The order is set as above. 1-9 "What do you think"? (ask another student(s) other than the presenter) "Why is that"? (Looking for evidence). "Did anyone else solve it the same way? Can you explain this method"	The focus of the ceardaiocht is to direct students towards finding the average of the co-ordinates.	
Summing up & Reflection		
The teacher will guide the students through the methods they used to direct them to why they are dividing by two? What are they doing with the values on the x and y axis and can they develop how this may be written in a formula?		Potential questions would include; What is the idea behind dividing by 2?

10. Board plan



11. Evaluation

Questions that will be discussed after the lesson include;

- Did all the students understand the problem?
- Did the students enjoy the lesson?
- Were the goals of the lesson achieved?
- What methods were observed during the live lesson?
- Which methods were the most popular?

12. Reflection

It was hoped that students would use different methods and the majority of the class used at least three. The students stayed focused and naturally moved on to find a new method upon the completion of one.

Strong cross curricular links Tech graphics and Geography. One student was teaching another the method he used. Students were engaged and discussing different methods, asking questions amongst each other.

At the end of the lesson students were asked to write a reflection on the lesson. The overall feedback was very positive.

Comments included; *"I enjoyed figuring out the problem for ourselves and then reviewing the different methods used"*

"I thought the class was very informative and it was interactive and we were able to figure out stuff on our own"

From this feedback it is evident that students were very enthusiastic about the problem and enjoyed the class.

The teacher was very strong at questioning and guiding students towards how the formula could be developed from the student's methods. The teacher found the process of structured problem solving a must for the future. The problem being posed first and using the knowledge that students have already is a preferred method to just show and tell.

Are We There Yet?

On a trip from Belfast to Galway there is a deal made. You agree to sit in the back of the car until you get to the half way point. Using the map provided can you find the best coordinates to switch seats. Can you develop different methods as to how this point can be achieved? Check your methods to find the same point between Belfast and Cork.