Lesson Research Proposal for Junior Certificate Functions

For the lesson on 9/2/17
At St. Aloysius's School, Katie O'Donovan's class
Instructor: Katie O'Donovan
Lesson plan developed by: Katie O'Donovan and Larry Rigney

1. **Title of the Lesson:** Justifying Your Thinking

2. **Brief description of the lesson**
   Students are presented with an open-ended question that incorporates a real world graph. The students are tasked with being able to justify each of the answer'

3. **Research Theme**

1 - Real world uses of functions. Student's ability to use functions in a real world setting.
2 - Students should enjoy their learning, are motivated to learn and expect to achieve as learners.

4. **Background & Rationale**

Students find function terminology difficult. There are also many cases where functions are used in real life.

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

Junior Certificate Mathematics Syllabus Strand 5.1, 5.2 and 5.3

Related prior learning Outcomes	Learning outcomes for this unit	Related later learning outcomes
Students are familiar with all basic mathematical operations addition, subtraction, multiplication and division Students have prior experiences representing and interpreting data and using data sets to solve problems Students can engage with the concept of a function, domain, co-domain and range – Students can make use of function notation *f(x)* = , *f*:*x* →, and *y* = Students can interpret simple	Students can analyze information presented verbally and translate it into mathematical form Students apply their knowledge and skills to solve problems in familiar and unfamiliar contexts Students feel confident explaining finding and justifying conclusions	Students will learn calculus at Leaving Cert level. They will see how the slope of a line can be obtained by differentiating the function of the line. Calculus will also enable them to work out the changing slope of a tangent to a curve. Students at Leaving Cert level will learn and use composite functions, where one function is operated on by another. Students will study functions and graphing functions in greater depth, including cubic functions. Students will study more

graphs, plot points and lines Students can draw graphs of the following functions and interpret equations of the form $f(x) = g(x)$ as a comparison of $f(x) = ax$, where $a \in \mathbf{Z}$ $f(x) = ax + b$, where $a, b \in \mathbf{Z}$ $f(x) = ax^2 + bx + c$, where $a \in \mathbf{N}$; $b, c \in \mathbf{Z}$; $x \in \mathbf{R}$ $f(x) = ax^2 + bx + c$, where $a, b, c \in \mathbf{Z}$, $x \in \mathbf{R}$ $f(x) = a2^x$ and $f(x) = a3^x$, where $a \in \mathbf{N}$, $x \in \mathbf{R}$ Students can approximate solutions where $f(x) = g(x)$ and interpret the results using graphical methods Students can find the maximum and minimum values of quadratic functions from a graph Students can interpret inequalities of the form $f(x) \leq g(x)$ as a comparison of functions of the above form and use graphical methods to find approximate solution sets of there inequalities and interpret results Students can graph solution sets on the number line for linear inequalities in one variable		difficult inequalities, for example inequalities that involve expanding a set of brackets before solving. In the area of coordinate geometry, students will learn and use a formula to work out the area of a triangle. Students will study arithmetic in more depth, including working out a monthly compound rate of tax, given the annual equivalent rate. Through an emphasis on contexts and applications, students will gain a deeper appreciation of the use of maths and justifying their results and conclusions.

6. Goals of the Unit

- Students will be reminded of the prior knowledge associated with functions
- Students will gain confidence in applying prior knowledge of functions to justify conclusions
- Students will become familiar with recognizing functions in real life examples
- Students will understand why functions are used to describe real life examples

7. Unit Plan

Lesson	Learning goal(s) and tasks
1 The Research Lesson	Students will be presented with a problem that they will be able to solve and justify in a variety of ways
2	Justification 1: Students use the slope/steepness of the lines to justify picking one company instead of the other
3	Justification 2: Students identify the intersection of the lines and specify the exact number of units at which one company outprices the other.
4	Justification 3: As further work, students may form equations for each line and solve inequalities to demonstrate mathematically the value of units at which one company is more or less expensive than the other.

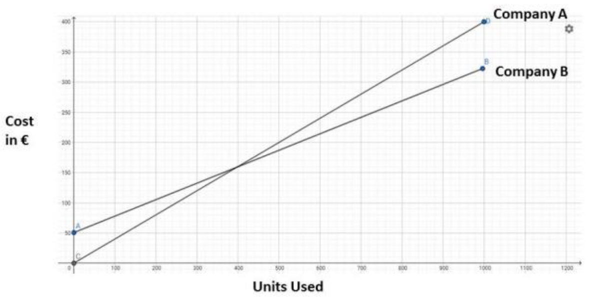
8. Goals of the Research Lesson:

- Expressing ideas mathematically
- Using number
- Discussing and debating
- Gathering, representing and interpreting data
- Exploring options and alternatives
- Thinking creatively and critically
- Estimating, predicting and calculating
- Seeing patterns, trends and relationships

1. Communicates effectively using a variety of means in a range of contexts
2. Recognizes the potential uses of mathematical knowledge, skills and understanding in all areas of learning
3.

9. Flow of the Research Lesson:

Steps, Learning Activities Teacher's Questions and Expected Student Reactions	Teacher Support	Assessment
We introduce a problem where there is a graph with two linear functions representing the cost of electricity per unit for two different companies. We ask students to look at the graph and decide which company would be best to go with.		
Introduction We introduce the task by showing the graph and then discussing what it represents.	The teacher may ask the students about the graph and what the labels on the	The teacher will ask questions to see if students understand

	axes mean. The teacher may ask what the lines represent.	the idea of x and y axes and what each interval represents on each axis. We want to see if students have the required knowledge of graphs for us to be able to continue
Posing the Task We introduce a problem where there is a graph with two linear functions representing the cost of electricity per unit for two different companies. We ask students to look at the graph and decide which company would be best to go with. We expect that students will say that it depends on the number of units used. For weaker students they may base their opinion on the highest y value. We can then use the graph to write down two functions. Simultaneous equations may be used to identify the point at which the functions are the same.  Which company would you recommend and why? There may be more than one answer; you must be able to justify each answer.	Students will be provided with worksheets but the problem will also be shown on the board. Reemphasize that students will have to justify their answers as they are acting as consultants for a firm.	
Students Individual Work	We anticipate that a lot of	

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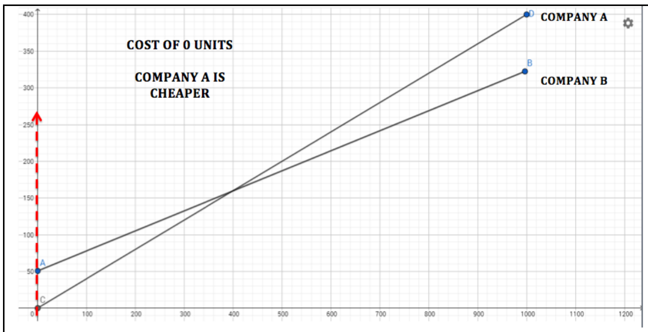

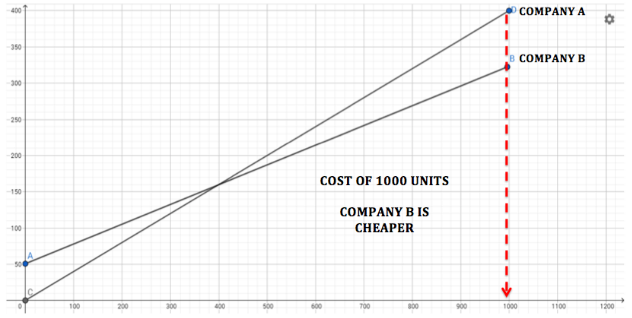

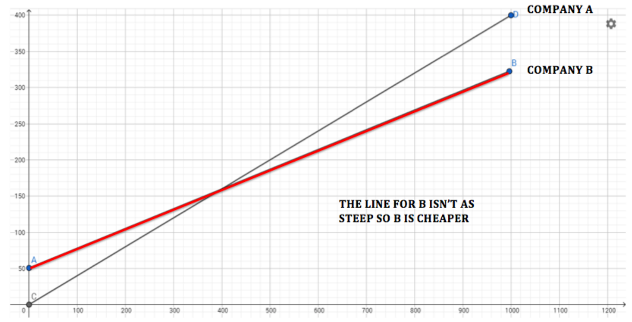

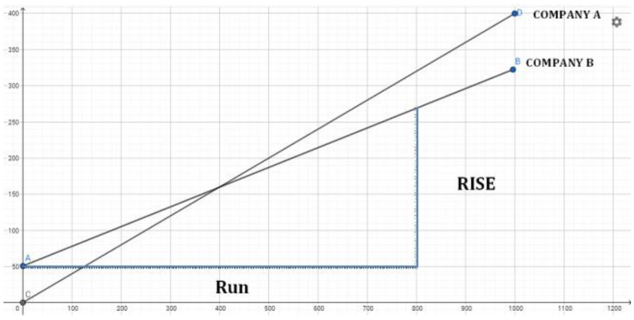

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students will say company B as the line appears lower at the end. These students will be pushed to compare the slopes of the line if they do not suggest this information themselves.

Some students would say that it depends on which part of the graph you take. These more capable students might reference the intersection as an important point.

Some students will justify their answer using the
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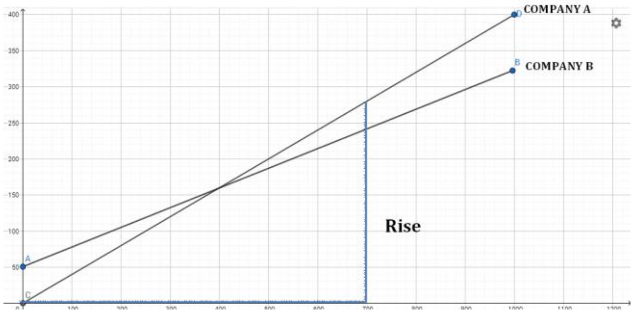
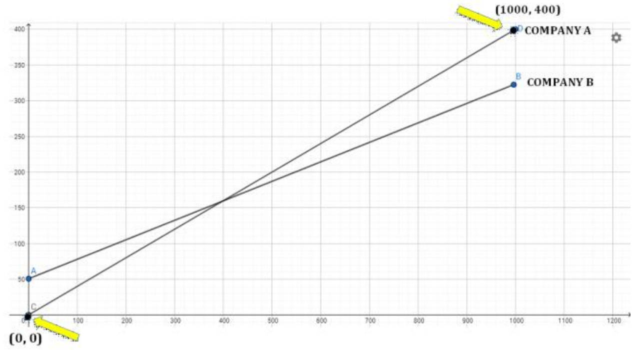
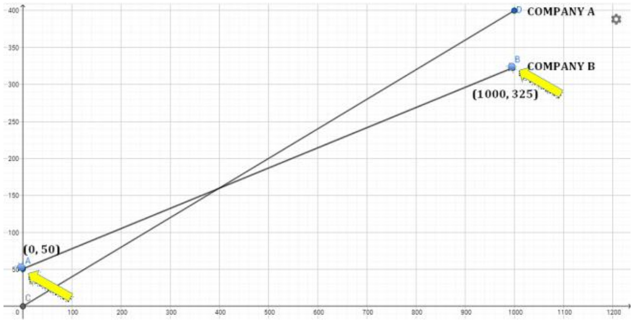
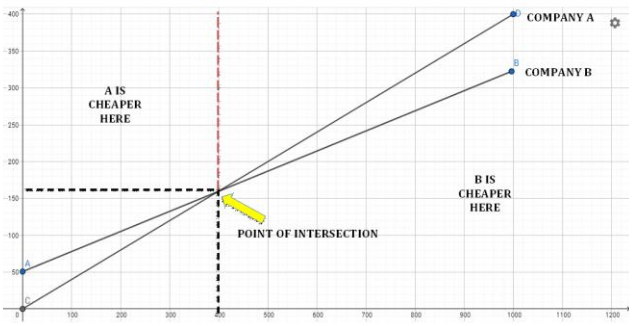
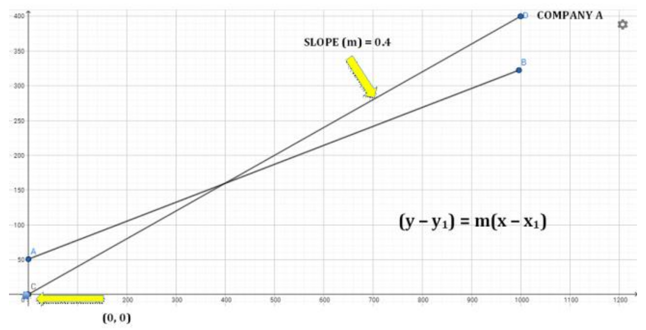
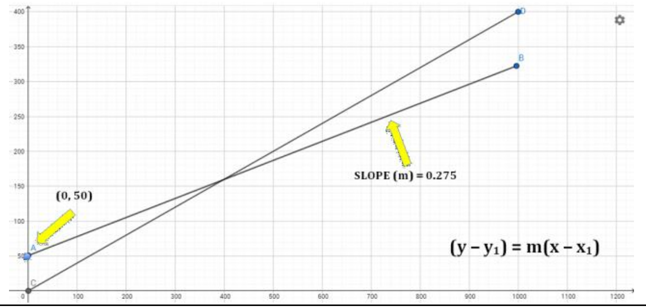
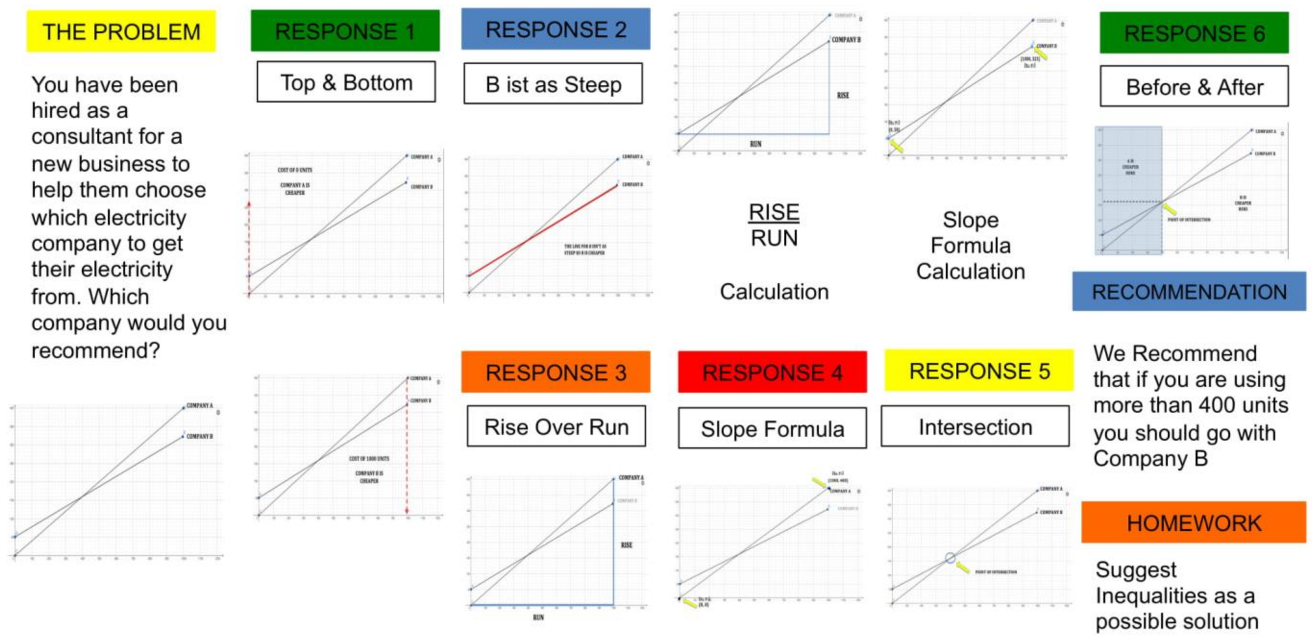
	terminology greater than or less than.	
	Some students might create expressions and try to solve them. Some of these might approach the expression from a patterns direction and others from a coordinate geometry direction.	
	Some students will try to solve using simultaneous equations. Some will try to solve an inequality. Some might try to solve the simultaneous equation using trial and error.	
		

 		
Ceardaíocht /Comparing and Discussing		
Response One	Check for understanding with the rest of class	
Response Two	Ensure students are using corrected language. Teacher could say, “I don’t believe you that it’s “steeper””.	Justify using a protractor
Response Three	What values did you get for the rise over the run?	Did anyone else in the class use different triangles to calculate this?
Response Four	Slope formula	Did anyone else in the class use different points?
Response Five	At the point of intersection the cost is the same.	What do you mean by “that’s the same”
Response Six	Shaded graph	Ensure students are using the phrases “less than” or “greater than”. Why is A cheaper here?
Summing up & Reflection		

When you are working as a consultant you will need to be able to justify your conclusions to your client. Frequently in Math you are going to be asked to justify your answer, it's a regular thing, and these are just some of the methods we have come up with so far.		

10. Board Plan



11. Evaluation

The lesson was too rushed, there wasn't enough time to do the boardwork as we would have liked. It would probably work a lot more smoothly in a double class, or perhaps an hour long class. The students really did understand the concept of having to justify their findings, which is fantastic. We noticed that the students did start working in pairs on the problem, but we found this was helping them explain their justifications and as such helped the class achieve its goals.

12. Reflection

It was great that the students really needed minimal prompting to approach from different perspectives, we found that the boardwork really helped the students see that a problem can have multiple solutions.