5thrdinary Level & Algebra

the lesson on 24th January 2017 At St. Aidan's CBS, Whitehall, Dublin 9., 5th YearTeacher: Cathy PeoplesLesson plan developed by: Cathy Peoples, Samantha Morton, Emma O'Dell, *Niamh O'Brien and Kate Urell*

1. Title of the Lesson: Heading For Trouble? Solving Simultaneous Equations-one linear and one non-linear

2. Brief description of the lesson Students will explore how to find x and y values which will satisfy both equations with different methodologies

3. Aims of the Lesson

I would like the students to be confident in using mathematical language and

therefore to appreciate that maths can be useful for communicating logical thinking.

I would like them to understand and use words such as solve, linear, non-linear, roots, function, graph, function, substitute, points of intersection and simultaneous equations.
I would like them to be able to graph linear and non-linear functions.
I would like them to be able to solve simultaneous equations by the method of substitution.
I would like them to be able to justify the use of a particular method with confidence

4. Learning Outcomes

As a result of studying this topic students will be able to:Solve a linear and a non-linear equation by substitution

Solve the same problem by graphing a line and a curve
Discuss the merits of each possible solution with confidence

5. Background and Rationale

Students need to know how to solve linear and non-linear equations using algebra methods.
Students need to know how to graph linear and quadratic and circle functions.
Difficulties: Some will forget how to graph points. Some will try the elimination method as used for two linear functions. Some will run out of energy while attempting trial and error. Some will try substitution but will not square properly.

6. Research

The team spent time discussing possible questions which had real-life applications. It was particularly important that we chose a topic which this ordinary-level group would feel confident with and would fit into the scheme for the year. We researched a lot of the Leaving Certificate textbooks and online to find something suitably challenging.

7. About the Unit and the Lesson

This is taken from page 31 of the Leaving Cert Ordinary Level Maths syllabus: Students will be able to select and use suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to • simultaneous linear equations with two unknowns and interpret the results • one linear equation and one equation of order with two unknowns (restricted to the case where either the coefficient of x or the coefficient of y is ± 1 in the linear equation) and interpret the results

8. Flow of the Unit:

Lesson		# of lesson periods
1	• How to graph a line using slope and y-intercept • How to graph a function by manually entering values into function within a domain of values • How to solve a linear and non-linear function by substitution	3 x 30 min.
2	• How to graph a quadratic using Desmos or Geogebra.	1 x 30 min.
3	• How to use graphs and algebra methods to solve simultaneous equations	2 x 30 min. **(research lesson)**
4	• How to match a graph to its corresponding equation	3 x 30 min.
5	• How to graph exponential functions	1 x 30 min.

9. Flow of the Lesson

Teaching Activity	Points of Consideration
1. Introduction Students will be reminded of prior knowledge: substitution, graphs.and roots of quadratics.	The teacher will ask prompt questions such as “What does a quadratic look like?” or “How do we know that an equation is a line?” to stimulate thinking.
2. Posing the Task A problem will be written on a slide of a Powerpoint Presentation and projected onto the screen. Each individual will also be given a paper copy.	Students may be asked to recognise a line and a quadratic in the question.

Students will be encouraged to work in pairs.	
3. Anticipated Student Responses *R1: May try elimination method.* *R2: May not square properly* *R3: May pick the incorrect factors* *R4: May try trial and error and get tired* *R5: May graph the line and the curve but fail to draw a conclusion.*	*The teacher will* *Indicate that you cannot subtract unlike terms* *Point out that the squaring needs to be re-done* *Ask the student to look at the factorising again* *Ask him to try another method* *Ask the student to explain the graph in his own words.*
4. Comparing and Discussing The teacher will look for the most common method and ask one student to come to the board to explain what he did. Then the teacher will ask the class for another way to solve it. If an individual does not volunteer the teacher will have looked out already for alternatives which she will then invite that student up to the board.	We will focus on whether the students can explain the reason for each step in their solution The teacher will encourage each student to discuss the merits of his solution.
5. Summing up The teacher will summarise what each pair did, what was the most popular method and what the class decided was the best method.	

Heading For Trouble?

A plane is flying along the line 3x-y=18. The edge of the air space[i] of its enemy country is defined by $y = x^2 - 8x + 12$.

If the plane flies through this air space it will be detected by radar and will get shot down. If it misses the air space or just touches off the edge of the air space, it will escape detection and will not get shot down.

If the plane continues along this line, would you advise the pilot to change direction? Why/ why not?
Find as many ways as you can to answer this question

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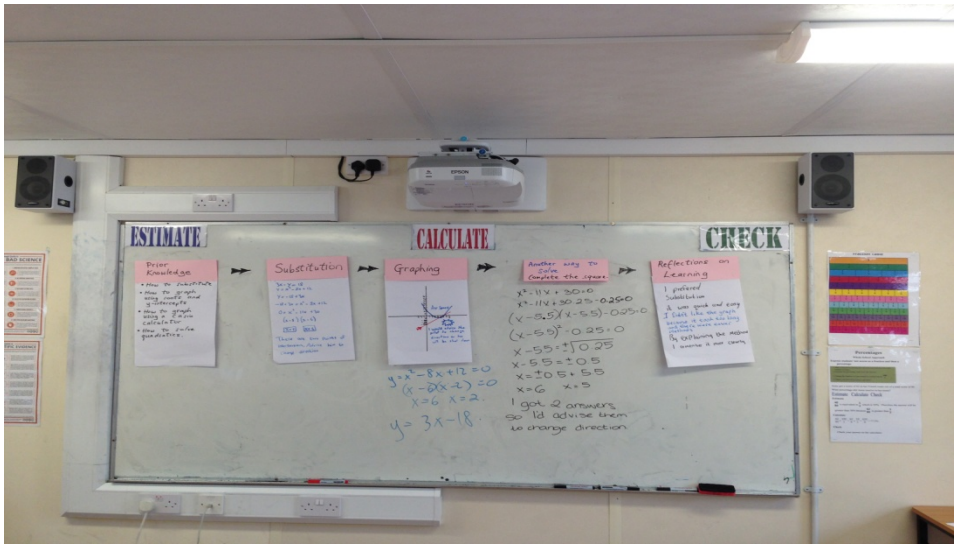
[i] Air space is the space above a country where planes need permission to fly through.

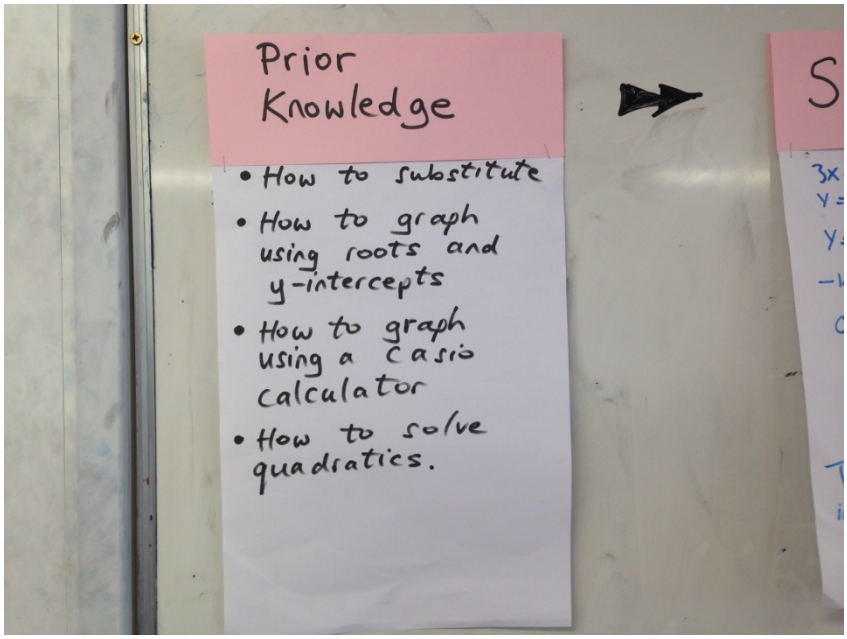
10. Evaluation

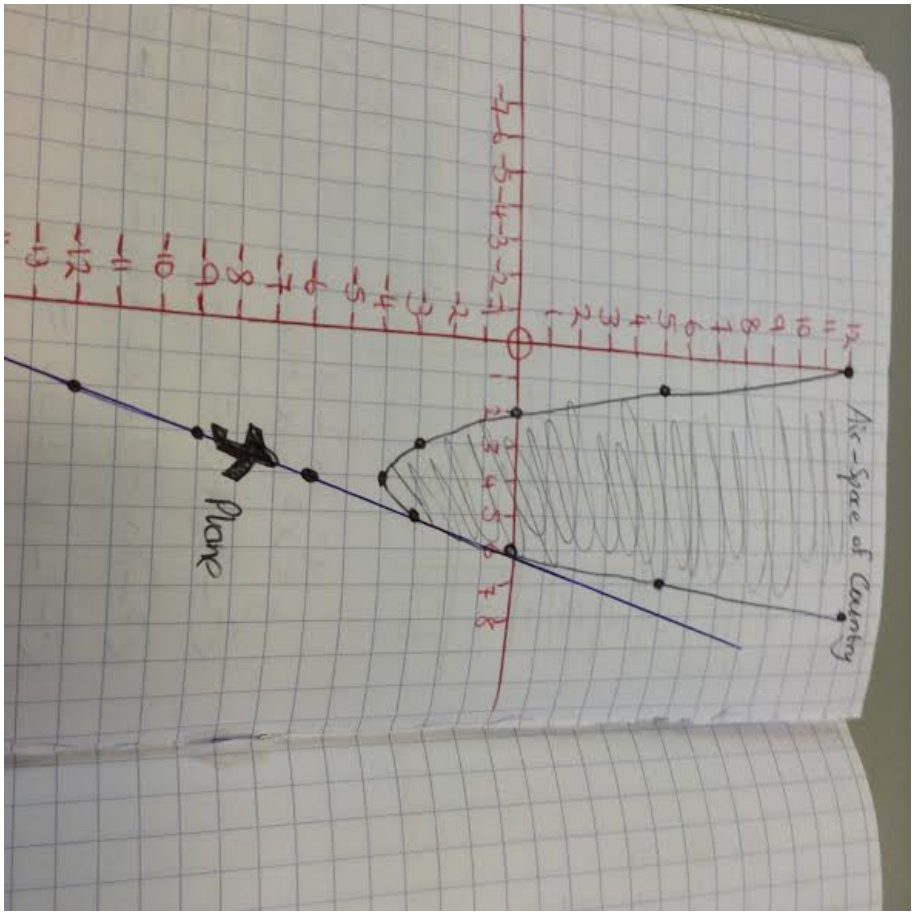
- The 4 team members will stand in different sections of the room to observe th students at work.
- Data will be recorded in Notepad. One observer will record the questions they ask, one will record the methods they use, another will observe the use of mathematical language and student interactions with each other..
- Observers will be watchful for different methods and will communicate this to the teacher.
- The observers will collect all evidence of student work on paper and on the board.

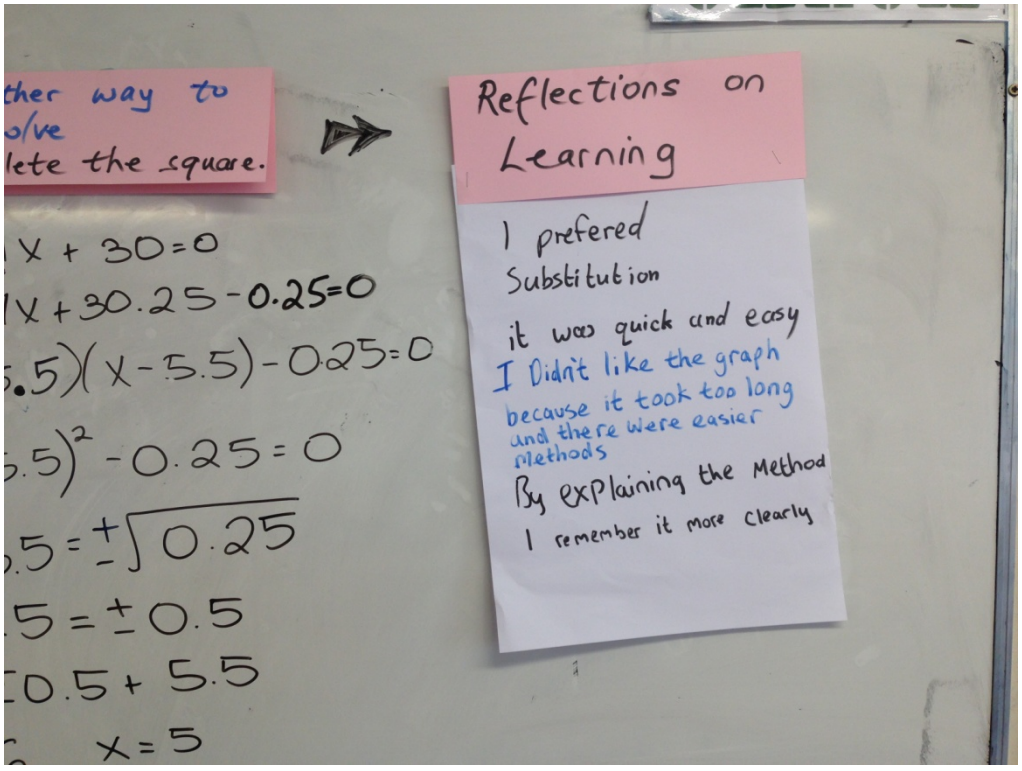
11. Board Plan

There will be one main board and 5 small whiteboards around the room.
The headings on the boards will be: Prior Knowledge, Substitution, Graphing, Other Method, Reflections on Learning.






Plane
Air-Space of Country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olve
lete the square.
X + 30=0
X+30.25-0.25=0
.5)(X-5.5)-0.25=0
.5)²-0.25=0
.5=±√0.25
5=±0.5
0.5+5.5
x=5
Reflections on Learning
I prefered Substitution
it was quick and easy
I Didn't like the graph because it took too long and there were easier methods
By explaining the Method I remember it more clearly

3. If you worked with others, how did you benefit from working with them? Or did you teach someone something? (Give as much information as you can.)

I taught someone substitution and how to interpret the graph. It helped me fully understand what I was doing saying it aloud to someone rather than just in my head. They taught me the perfect square and I wouldn't have gotten 2 answers if they didn't remind me to use ±.

Reflection on Learning

1. Which method do you prefer? Why?

I Prefer the substitution method as it gives you the values in a less time period. But it gets you a true value quickly

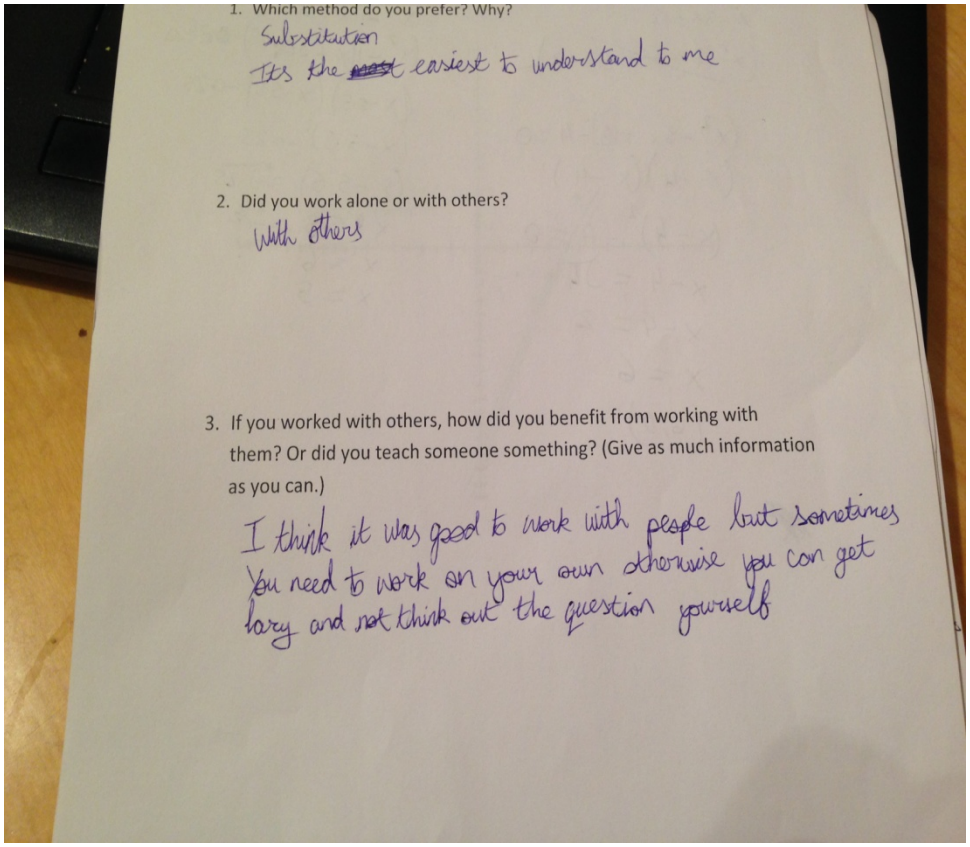
2. Did you work alone or with others?

I worked ~~both~~ partically with others and by myself ~~alone~~

3. If you worked with others, how did you benefit from working with them? Or did you teach someone something? (Give as much information as you can.)

I taught the other students to use the -b formula as a different method.

I also reseaved the factorisation method from the person sitting beside me



1. Which method do you prefer? Why?

Substitution

Its the ~~most~~ easiest to understand to me

2. Did you work alone or with others?

With others

3. If you worked with others, how did you benefit from working with them? Or did you teach someone something? (Give as much information as you can.)

I think it was good to work with people but sometimes you need to work on your own otherwise you can get lazy and not think out the question yourself

2. Post-lesson reflection

- Directly after the lesson the teachers had a post-lesson discussion.
- The students were a little hesitant about starting as they were very aware of being observed. Some were familiar with quadratics but less familiar with lines
- They mainly worked in twos or threes.
- There was a lot of variation in ability and enthusiasm within the class.
- Two of the students who had come from the higher level class opted immediately for substitution but were unsure about linking their answers to the word problem. Their algebra was good. Later during the discussion it occurre to them how to relate their two x values to the word problem when they were asked why.
- The students who used the Casio calculator to generate the y values of the quadratic and the line very quickly drew a graph and could link it to the question they were being asked. Some students had poor scales on their graphs which led to them assuming that the line intersected the curve at only

one point. They showed a quicker better understanding of the word problem than the two higher level students. They were also better communicators.

- Most students opted to factorise and solve the quadratic. Some made a quick sketch of the curve on the mini-whiteboards and were discussing the slope and y-intercept but did not reach a conclusion.
- Many of the students wanted to be told what to do and what method to use. A the beginning they were slow to start because they were used to being told what to do rather than create a solution themselves.
- The students were exposed to the idea that a problem can have more than one solution and to a real-life application of algebra. They did engage in mathematical discussions and explain ideas to each other and learn from eac other. In their review afterwards they said that they found it more interesting and challenging than usual even though it was initially confusing. Many of them did not solve the problem but during the discussion they were exposed t their peers who had solved it and could explain it to them. Most students agreed that the graph method was the best method for understanding but substitution was quicker.
- One student who had recently changed class from the higher level class solved the quadratic by completing the square. The rest of the class found thi too difficult and decided that factorising was easier.
- All of the teachers felt that this question was a very good lesson on drawing a accurate graph as the two solutions were very close. A poor scale meant that the student thought that the line cut the curve at only one point.
- The change that is probably needed is for all of us teachers **to allow student the time to be confused** and to discuss options before we give them the solution.
- We need to give students class time to teach each other. They can learn very well from each other.