

Lesson Research Proposal for 2nd Year Higher Level Topic – Simultaneous Equations

For the lesson on 16th of January 2018.
At Manor House School, Ms O'Neill's class.
Instructor: Ann Marie Guinan.
Lesson plan developed by: Aisling O'Neill,
Ann Marie Guinan,
Maura Cunningham

1. Title of the Lesson: How much is the special offer?

2. Brief description of the lesson

Students will be presented with a real life problem verbally and visually. During the class, students will explore the problem set to them and use active methodologies to discover a method of coming up with a solution. The overall objective for the lesson is for student to recognise how to solve a simultaneous equation using elimination.

3. Research Theme

As teachers in Manor House School we aim to improve the learners experience by;

- a) Engaging students purposefully in meaningful learning activities
- b) Allowing students to grow as learners through respectful interactions and experiences that are challenging and supportive.

We as teachers will support our goals by;

- a) Developing strategic approaches to match the learning outcomes of the lesson to meet the learning needs of the students.
- b) Differentiate content and activities in order to cater for the varying needs and abilities of students.
- c) Listening to students opinions and feedback, to modify our teaching methods to enable the students to grow as learners, and address any limitations.
- d) Regularly providing students with constructive feedback through questioning and oral feedback on their work.

4. Background & Rationale

Justify

This lesson is aimed at 2nd Year mixed ability Higher Level Maths class. The teaching of simultaneous equations is a topic that causes a lot of confusion for students. They find it very difficult to solve for two variables at one time. We wish for students to connect the relationship between algebra, co-ordinate geometry, functions and patterns.

Misconceptions

Firstly students lack the comprehension in relation to the elimination process. Students do not recognise we must solve for both variables. The concept of having the same coefficient value of one variable with a different sign.

Secondly, students do not realise that multiplication of equations may be required to solve. This can also result in students not multiplying all terms of the equation.

Group Discussion and Professional Findings:

When teaching this topic we cannot teach it as a procedure, rather students need to have a good understanding of why we solve simultaneous equations, and their application in the real world and links to other topics in the syllabus.

Our research findings:

Through general discussions with maths teachers, most teachers agreed they taught the procedures, i.e. the steps for solving the equations. This method did not lead to long term understanding of why they carry out such steps, and hence the students forgot the steps over a period of time.

The problems we wish the students to internalise when teaching simultaneous equations are in the areas of cancelling, to eliminate a variable, and the solving of an equation to find the second variable.

Simultaneous equations have significant links to many other topics on the curriculum and real life situations. For this reason, we have chosen to take a visual approach with the teaching of simultaneous equations. The class chosen was a mid-ability 2nd Year class. This topic chosen fits in with the 2nd Year Scheme of work, in the area of the intersection of two lines and solving algebra equations.

5. Relationship of the Unit to the Syllabus

Related prior learning Outcomes	Learning outcomes for this unit	Related later learning outcomes
<p>In Primary school, students were taught;</p> <ul style="list-style-type: none">● simple substitution of values <p>From 1st Year students were;</p> <ul style="list-style-type: none">● introduced to solving linear equations● introduced to the concept of equality of equations● manipulation of equations● order of operations	<p>Students will be able to;</p> <ul style="list-style-type: none">● form equations● manipulate equations● eliminate one variable and solve for the other variable● apply knowledge to real-life situations	<p>Students should in the rest of the Junior Cycle be able to;</p> <ul style="list-style-type: none">● work with the inclusion of fractions in equations; change to standard form● relate algebraic methods of solving simultaneous equations to graphing equations● translate word problems to mathematical equations● deal with two equations given two unknowns in other strands

6. Goals of the Unit

From this lesson, students;

- should be able to use their prior knowledge in solving equations to solve two equations with two unknowns.
- should recognise that there are multiple solutions for each of the linear equations. However there is only one solution that satisfies both equations at the same time, i.e. simultaneously.
- understand one variable must be eliminated in order to find the second variable.
- recognise this method for solving in algebra can be applied to other strands, e.g. co-ordinate geometry, patterns, functions, etc.
- recognize the application of simultaneous equations in real-life

7. Unit Plan

Lesson	Learning goal(s) and tasks
1 The Research Lesson	Introduce the concept of simultaneous equations to the students by; <ul style="list-style-type: none"> - presenting the problem and allowing the students to work through it - translating the words into two mathematical equations - students present their solutions and answers to the class The overall aim is to have at least one student come to the conclusion that through the elimination of one variable they can find the other variable.
2	Provide another problem and allow them to develop the method of solving <ul style="list-style-type: none"> - prompt students to try to solve the equations
3	Introduction of “steps” for solving
4	Practice of solving simultaneous equations
5	Representation of simultaneous equations graphically Link the algebraic method of solving to graphically
6	Introduction of simultaneous equations in solving Quadratic Patterns.
7	Finding Tn of Quadratic Pattern simultaneous equations
8	Further practice and consolidation. Revision.

8. Goals of the Research Lesson:

Mathematical Goals

Students will understand how to create two linear equations, how to manipulate these equations to eliminate a variable, and the solving of an equation to find the second variable. Students will recognise why they must carry out these steps in order to solve the equations.

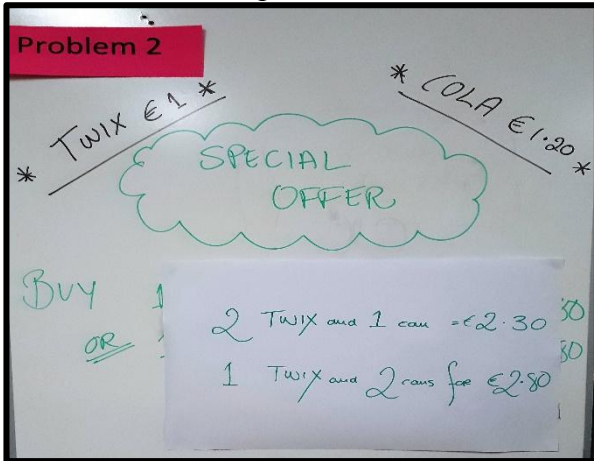
Key Skills and Statements of Learning

- communicates effectively using a variety of means in a range of contexts
- recognise the potential uses of mathematical knowledge, skills and understanding in all areas of learning
- describes, illustrates, interprets, predicts and explains patterns and relationships
- devises and evaluates strategies for investigating and solving problems using mathematical knowledge, reasoning and skills
- 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
<p>Introduction Explain to students the activity for the day, dividing the students into groups where they were given a whiteboard, markers and the props. The teachers board was set up prior to the class.</p> <p>The problem was put to the class.</p>	<p>Teacher had the key words lined up for the lesson to use as a hint to guide the students.</p>	<p>To clarify the problem in English.</p>
<p>Posing the Task Today in Johns Cafeteria there is a special offer of "One twix and one can of coke for only €1.80 or one twix and two cans of coke for €2.80" What is the price of a can or a bar?</p> <p>Students will come up with different answers for the price of the items</p> <p>Student A; Can is €1 and a bar is 80c. Student B; Can is 80 cent and a bar is 60c each, etc.</p> <p>Clarify the problem; Is there only one answer? <i>No, students can come up with multiple answers for the different values for the items.</i></p> <p>Can you use a calculator? <i>If the student feels they need to they can.</i></p> <p><u>Students will be given a second equation.</u> "A new offer of 2 twix bars and 1 can from John, and he charged me €2.30 or 1 twix and 2 cans for €2.80. Can you use this new information to work out the cost of a bar and a can?" "Can you use what we have already discussed to come up with a method to solve this problem?"</p> <p><i>Now, we have a second equation. Will all of our previous answers work?</i> <i>No.</i></p> <p><i>Can you come up with possible solutions?</i> Students can work in groups using their</p>	<p>The initial problem will be posted on the board. Students will use their whiteboards and resources to come up with an answer/multiple answers.</p> <p>The teacher will encourage all answers for B (bars) and C (cans) to be displayed on one side of the board.</p> <p>The conclusion desired by teachers is for the students to notice there is not only one solution.</p>	<p>The teacher will walk around the class looking for students to;</p> <ul style="list-style-type: none"> - form two equations - solve using trial and error - some attempt at solving the equations

resources to come up with a solution.



Student Individual Work

Ceardaíocht /Comparing and Discussing

- Some students try trial and error (picture)
- Some students created equations with variables (picture)
- Some students made initial attempts to solve the equations
- Some students tried multiplying equations to get coefficients of variables same.
- One student actually solved the problem.

We gave a third problem

"Can you use what we have already discussed to come up with a method to solve this problem?"

The next day John has a new offer "A two can of cokes and two twix bars for only €3.00 or three cans of coke and four twixs for €5.10"
What is the price of a can or a bar?

"Again is there only one answer for the price of a can and a bar?"

"What possible solutions can we come up with now?"

Use this new information to try and find the price of each.

Responses that the teacher will look for and the order of responses required;

- Trial and error to find answers that satisfy both equations
- LCM to get the co-efficient of one

"What was important in helping us solve this problem?"
"Why did we not like this method?"
"Did it take a long time?"
"What do we call putting in for B and C(Bars and Cans)?"-(Variable / Substitution/ equation)
"What do we call it when we use an equals?"

"Why do we think the student A multiplied everything by 2?"

The teacher will prompt and encourage the students to;

- find the relationship between the two offers
- establish the difference between the two equations
- look for the LCM of one of the variables in order to eliminate
- solve for the other

Looking for someone to recognise the co-efficient of one variable must be the same.

<p>variable the same</p> <p>c. Difference between the two equations. d. End up with one equation and one unknown. e. Find the value of one variable. f. Substitute to find second variable.</p>	<p>variable</p> <p>Students who use trial and error; “did your prices work? If not, what did you notice and what could you do different?”</p> <p>Students who cannot see the relationship between the two equations; “Can you notice any similarities or difference between the two offers?” “Is there any way we could eliminate either the twixs or the cans?”</p> <p>For the students who successfully solved the third problem, they will be encouraged to help other students in the class to solve the problem.</p>	
<p>Summing up & Reflection</p> <p>We need two equations to find two unknowns</p> <p>The number in front of either B or C must be the same</p> <p>The difference between the two equations creates a new equation, which is easy to solve.</p>		

10. Board Plan

Problem 2

* TWIX €1 * * COLA €1.20 *

SPECIAL OFFER

BUY 1 OR 2

2 Twix and 1 can = €2.30

1 Twix and 2 cans for €2.80

Students Work

Louise's group
 Deal 1
 $1 \text{ Twix} + 1 \text{ Cola} = €1.80$
 $1 \text{ Twix} + 2 \text{ Cola} = €2.40$
 $1 \text{ Twix} = €0.60$
 $1 \text{ Cola} = €1.20$

Emily's grp.
 $1 \text{ Twix} = €1$
 $2 \text{ Cola} = €1.20$
 $1 \text{ Twix} + 2 \text{ Cola} = €2.40$
 $€1 + €1.20 = €2.20$
 $€1.20 + €1.20 = €2.40$

Victoria's grp
 $1.7 = €1.80 = 90c \text{ each}$
 $1 \text{ Twix} = €0.80$
 $2 \text{ Cola} = €1.80$
 $1 \text{ Twix} + 2 \text{ Cola} = €2.60$

Oke's Group
 $2 \text{ Twix} + 1 \text{ Can} = €2.30$
 $1 \text{ Twix} + 2 \text{ Cans} = €2.80$
 $2t + 1c = 2.30$
 $t + 2c = 2.80$
 $t + c = 1.50$
 $2t + 2c = 3.00$
 $2t + 2c = 3.00$

Method Labels: Trial and Error, Form an Equation, Substitution, VARIABLES

Kate + Alex

$2 \text{ Twix} + 1 \text{ can} = €2.30$
 $1 \text{ Twix} + 2 \text{ cans} = €2.80$
 $4 \text{ Twix} + 2 \text{ cans} = €4.60$
 $4 \text{ Twix} + 2 \text{ cans} = €4.60$
 $1 \text{ Twix} + 2 \text{ cans} = €2.80$
 $3 \text{ cans} = €1.80$
 $1 \text{ can} = €0.60$
 $1 \text{ Twix} = €0.80$
 1.10

Method Labels: Multiply, Elimination

Conclusion

Form Equation with VARIABLES

- Multiply if necessary to eliminate one variable
- Solve

VOCABULARY: Trial + Error, Variable, Elimination, Substitution

Problem 2

* TWIX €1 * * COLA €1.20 *

SPECIAL OFFER

BUY 1 OR 2

2 Twix and 1 can = €2.30

1 Twix and 2 cans for €2.80

Students Work

Louise's group
 Deal 1
 $1 \text{ Twix} + 1 \text{ Cola} = €1.80$
 $1 \text{ Twix} + 2 \text{ Cola} = €2.40$
 $1 \text{ Twix} = €0.60$
 $1 \text{ Cola} = €1.20$

Emily's grp.
 $1 \text{ Twix} = €1$
 $2 \text{ Cola} = €1.20$
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Conclusion

Form Equation with VARIABLES

- Multiply if necessary to eliminate one variable
- Solve

VOCABULARY: Trial + Error, Variable, Elimination, Substitution

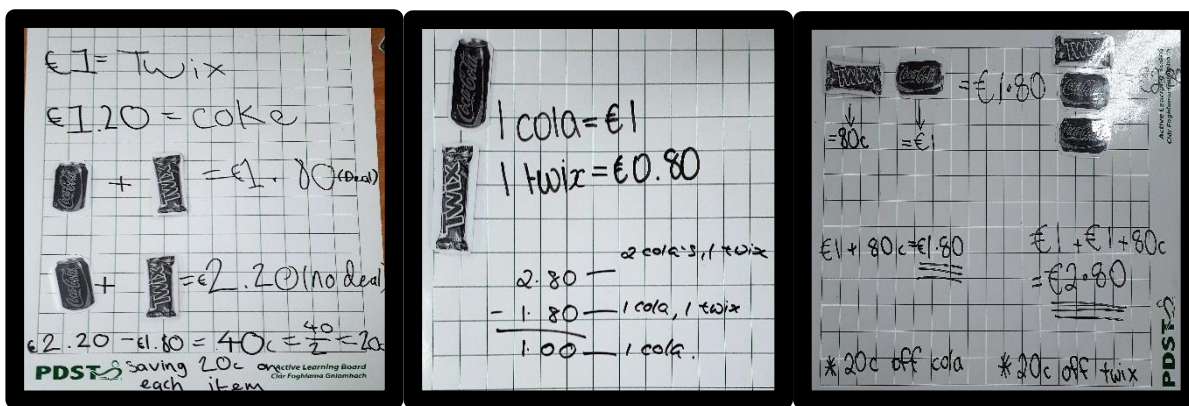
11. Evaluation

The overall objective for the lesson is for student to recognise how to solve a simultaneous equation using elimination. It was found that the approach we used supported this aim and improved the learners experience. Students were engaged in the learning activities presented to them. All students worked well in groups and were challenged and supported in their approaches to the problems given. The activities presented catered for the varying abilities of each student and the students were encouraged to solve the problems through peer discussions.

However, as the lesson was student focused, we found that students did require a lot of guidance and support from the teacher to approach the problem. The presentation of the first question, where prices were given on the teacher board, appeared to confuse students. When using this lesson in future, it is important that the information given is clear.

Throughout the lesson, students used various methods ranging from trial and error, creating equations and multiplying the equations to solve the problem. Only one group solved the problem by using the elimination method. Our lesson was for 40 minutes but a full hour should be given to allow for more students to successfully discover and use the elimination method.

Our overall aim was to have at least one student come to the conclusion that through the elimination of one variable they can find the other variable. We were successful in achieving this.



12. Reflection

The team hoped the students would come up with “the steps” for solving simultaneous equations. The lesson was planned for an hour class but due to timetabling constraints within the school it was not possible for all the team and their classes to be covered for the hour. This resulted in the third and final problem not being completed in class. However, the work done in the forty minutes provided a basis upon which to build in the next class, at which stage they did complete the aim of the lesson.

During the lesson, the students were very engaged and appeared to enjoy it. They participated well in groups, sharing their ideas and working together to come up with a solution. Students presented their work to the class, explaining their method. Misconceptions were identified and corrected by the teachers as the lesson progressed. After working out the problem correctly some students tried to solve the problem in other ways, demonstrating their engagement in the lesson.

Overall this was a very worthwhile experience and the students responded positively. They appeared to have assimilated the learning and enjoyed the lesson. The teachers involved will definitely use the teaching and learning methodologies in future.

Junior Cycle Key Skills and Statements of Learning

Key Skills

KS1	Managing myself
KS2	Staying well
KS3	Monitoring information & thinking
KS4	Being numerate
KS5	Being creative
KS6	Working with others
KS7	Communicating
KS8	Being literate

Statements of Learning

	The student
SL1	communicates effectively using a variety of means in a range of contexts in L1*
SL2	listens, speaks, reads and writes in L2* and one other language at a level of proficiency that is appropriate to her or his ability
SL3	creates, appreciates and critically interprets a wide range of texts
SL4	creates and presents artistic works and appreciates the process and skills involved
SL5	has an awareness of personal values and an understanding of the process of moral decision making
SL6	appreciates and respects how diverse values, beliefs and traditions have contributed to the communities and culture in which she/he lives
SL7	values what it means to be an active citizen, with rights and responsibilities in local and wider contexts
SL8	values local, national and international heritage, understands the importance of the relationship between past and current events and the forces that drive change
SL9	understands the origins and impacts of social, economic, and environmental aspects of the world around her/him
SL10	has the awareness, knowledge, skills, values and motivation to live sustainably
SL11	takes action to safeguard and promote her/his wellbeing and that of others
SL12	is a confident and competent participant in physical activity and is motivated to be physically active
SL13	understands the importance of food and diet in making healthy lifestyle choices
SL14	makes informed financial decisions and develops good consumer skills
SL15	recognises the potential uses of mathematical knowledge, skills and understanding in all areas of learning
SL16	describes, illustrates, interprets, predicts and explains patterns and relationships
SL17	devises and evaluates strategies for investigating and solving problems using mathematical knowledge, reasoning and skills
SL18	observes and evaluates empirical events and processes and draws valid deductions and conclusions
SL19	values the role and contribution of science and technology to society, and their personal, social and global importance

SL20	uses appropriate technologies in meeting a design challenge
SL21	applies practical skills as she/he develop models and products using a variety of materials and technologies
SL22	takes initiative, is innovative and develops entrepreneurial skills
SL23	brings an idea from conception to realisation
SL24	uses technology and digital media tools to learn, communicate, work and think collaboratively and creatively in a responsible and ethical manner

L1 is the language medium of the school (Irish in Irish-medium schools). L2 is the second language (English in Irish-medium schools).