Lesson Plan for *Second Year Maths class*

For the lesson on [14/01/15]
At Killarney Community College, Co Kerry
Teacher: Mike Lynch
Lesson plan developed by: Mike Lynch, Martina Hegarty, Lorraine Crowley

1. **Title of the Lesson:** Descrambling Algebra

2. **Brief description of the lesson:**
   A group work lesson designed to break down the steps involved in solving linear equations with particular emphasis on understanding the skills and operations involved.

3. **Aims of the Lesson:**
   To develop the listening and critical thinking skills of the students.
   To provide students with an understanding of the algebraic skills and operations required to solve linear equations.
   To consolidate the previously learned algebraic skills of simplification and distribution.
   To introduce and develop the concept of Inverse Operations as a method for solving equations.

4. **Learning Outcomes:**
   Following this lesson, students will be able to:
   - Apply the distributive law.
   - Reduce algebraic expressions to their simplest terms.
   - Solve linear equations through use of inverse operations.

5. **Background and Rationale**
   (a)According to the syllabus, students need to be able to;

Section 3.1 Number Systems
-consolidate the idea that equality is a relationship in which two mathematical expressions hold the same value
-analyse solution strategies to problems

Section 4.1 Generating arithmetic expressions from repeating patterns
-generalise and explain patterns and relationships in words and numbers

Section 4.2 Representating situations with tables diagrams and graphs

-develop and use their own generalising strategies and ideas and consider those of others

-present and interpret solutions, explaining and justifying methods, inferences and reasoning.

Section 4.6 Expressions

-demonstrate transormational activities: collecting like terms, simplifying expressions, expanding

-add and subtract simple algebraic expressions

-use the associative and distributive properties to simplify expressions.

Section 4.7 Equations and Inequalities

-identify necessary information to represent problems mathematically.

-consolidate their understanding of the concept of equality.

-solve first degree equations

Section 4.8 Synthesis and problem solving skills

-explore patterns and formulate conjectures

-explain findings

-justify conclusions

-communicate mathematics verbally and in written form

-apply their knowledge and skills to solve problems

-analyse information presented verbally and translate it into mathematical form

In my experience as a teacher and an examiner, solving equations has always presented problems to students. Without a doubt the most common problem is that of transposition. It is very clear that this "crossing the equals" is the most misunderstood concept of equation solving. Teaching students "what" to do instead of "why" they are doing it has been the cause of these transposition errors. This lesson sought to increase student *understanding* of the algebraic skills required to solve simple linear equations. It was alarming in researching this lesson, to discover the number of textbooks which still provide examples of the transposition method.

6. Research

Project Maths Handbooks, various textbooks to see how the topic of inverse operations is dealt with, internet and google images.

7. About the Unit and the Lesson

The main focus of the lesson was designed around section 4.7 on pg 29 of the syllabus, which deals with the concepts of equality and solving first degree equations. Traditionally these concepts would have been approached by teaching how to solve equations, i.e. what to do!!! This would generally be a teacher example followed by

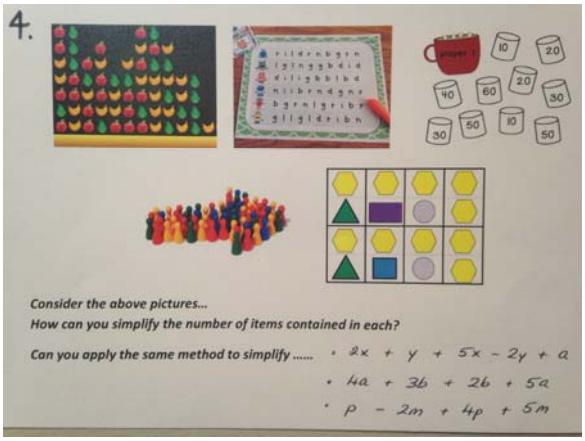
student practice. Although this method has its own merits, it would only cover a learning outcome or two from the new syllabus.

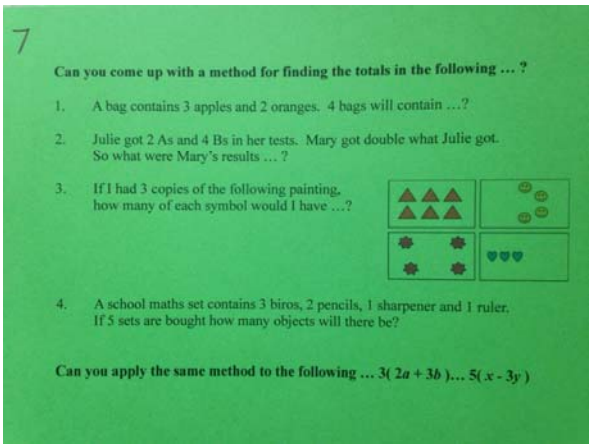
This lesson was designed around a group work activity where students get to work on problems which they could solve easily, with a view to seeing that similar strategies are actually involved in solving simple first degree equations.

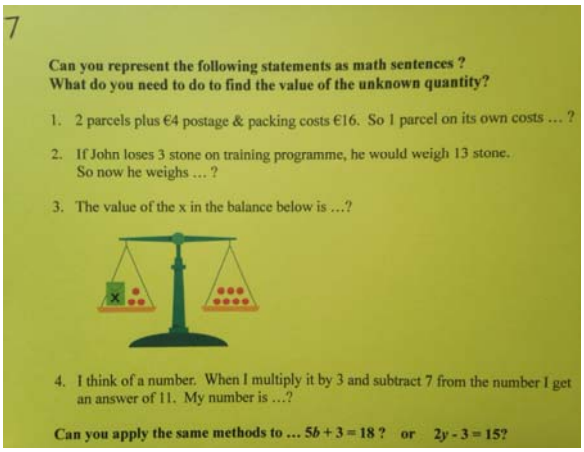
This group work strategy allowed students to actively engage in a significantly larger number of learning outcomes as set out in the syllabus, which I have highlighted above in section 5 of this report. I didn't even realize how many of the learning outcomes I was hitting after the lesson had been designed, such is the nature of this group work strategy.

In the lesson, the class is presented with an equation to solve. Each student is then given one of four task cards to master, first individually and then to discuss it within a group of students who also had the same task. Once mastered, each student is reassigned to three other students so that a new group of four is formed where each group now has a student who has mastered a particular skill. Each student in turn explains their skill until they all have the four skills. The four skills were necessary to solve the equation that was posed at the start of the lesson.
The main thrust of this lesson is that students already understand the skills required, i.e. simplification, distribution, equality, but this is rarely highlighted during similar lessons on equations. We call this "building on prerequisite knowledge" and it is such a powerful way to teach when used.

The group work strategy allowed students to engage in many of the more broad learning outcomes particularly those in section 4.8 on synthesis and problem solving.







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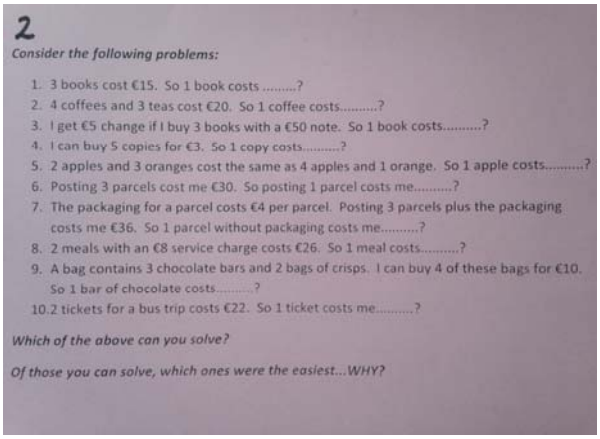
Can you represent the following statements as math sentences ?
What do you need to do to find the value of the unknown quantity?

1. 2 parcels plus €4 postage & packing costs €16. So 1 parcel on its own costs … ?
2. If John loses 3 stone on training programme, he would weigh 13 stone. So now he weighs … ?
3. The value of the x in the balance below is …?

4. I think of a number. When I multiply it by 3 and subtract 7 from the number I get an answer of 11. My number is …?

Can you apply the same methods to … $5b + 3 = 18$? or $2y - 3 = 15$?



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Consider the following problems:

1. 3 books cost €15. So 1 book costs .....?
2. 4 coffees and 3 teas cost €20. So 1 coffee costs.....?
3. I get €5 change if I buy 3 books with a €50 note. So 1 book costs.....?
4. I can buy 5 copies for €3. So 1 copy costs.....?
5. 2 apples and 3 oranges cost the same as 4 apples and 1 orange. So 1 apple costs.....?
6. Posting 3 parcels cost me €30. So posting 1 parcel costs me.....?
7. The packaging for a parcel costs €4 per parcel. Posting 3 parcels plus the packaging costs me €36. So 1 parcel without packaging costs me.....?
8. 2 meals with an €8 service charge costs €26. So 1 meal costs.....?
9. A bag contains 3 chocolate bars and 2 bags of crisps. I can buy 4 of these bags for €10. So 1 bar of chocolate costs.....?
10. 2 tickets for a bus trip costs €22. So 1 ticket costs me.....?

Which of the above can you solve?

Of those you can solve, which ones were the easiest...WHY?

8. Flow of the Unit

Lesson	Section 4: Algebra	# of lesson periods
1	Revision of variables, constants, expressions, simplifying and distribution.	4 lessons
2	Algebraic Factors	4 lessons
3	Introduction to linear equations.	3 lessons [Research lesson #1]
4	Quadratic equations...1 by Factors ...2 by Formula	5 lessons
5	Equations in rational form	3 lessons
6	Word problems leading to equations	5 lessons

9. Flow of the Lesson

Teaching Activity	Points of Consideration
1. Introduction Immediately pose the problem that students need to be able to solve by the end of the lesson.	The unfamiliar problem may put students off. Students should be familiar with solving equations from Primary School and 1st Year.
2. Posing the Task 1 Done as part of the introduction. Each student is handed an envelope and told that there are four key steps involved in solving the equation. One of the steps is contained in their envelope. Their 1st task is to read their card and try to answer the problems on it and come up with a common strategy used to complete the problems.	Some students may approach this as a challenge and others may see it as being confusing and uncertain. Students may need guidance and have their card explained further.
3. Anticipated Student Responses (i) I can't do no. 2 ! (ii)Is the answer to no. 10 = €11 ? (iii)What must I do? (iii)What do you mean by simplify?	It's not about the answer, it's about which ones can be done … and why? Get students to write out their answers but they must state how they got their answers. Are students able to communicate verbally the common strategy they see in their card? Avoid showing students possible solutions.
Posing the Task 2 Reorganise the class with all students with the same coloured card to get together. Each in turn is to explain to their group how they completed their task.	Ensure room is laid out to accommodate group work. Everyone must get a chance to speak.

Come up with a group consensus as to what their skill is…i.e. how they tackled the task. Then they must agree on the message they are bringing to the other groups. Each group to create similar questions on a sheet that they will use to teach their next group.	Does the group have a strategy in words? Each student must have a sheet of their own.
Anticipated Student Responses Pink Card… Easy to solve ones with only one thing. A number of things equals something Peach Card … Count the ones which are the same Green Card … Multiply everthing by the number Yellow Card … Work backwards, do opposite	Get random students to explain to you what they understand as being their skill. Can students verbalise their thinking. Make sure they show their workings.
Posing the Task 3 Get each student to note the number on their card and then all no. 1s regroup, no. 2s regroup etc. Each student in turn, (following a specific order of colour given by the teacher), proceeds to explain their task card and give their questions to the others. Each group must now create a summary table of the four skills they have worked on.	Ensure students are now in groups of four, one from each card colour. Has each student given their questions to the group? Have they compiled a final grid with a statement of all the skills on it?
Anticipated Student Responses Responses here should be better than at the start of class as they have now the benefit of discussing the card with others and prepared the new questions themselves.	How comfortable are students at teaching each other? Ask random students from each group to explain what skill was covered on a card which they did not have from the start.

Summary Grid: Pink … Easy to solve when unknown = known Peach … Only *same* things can be grouped Yellow … You must do the same thing to each side of a balance. Green … Everything in a bracket is multiplied by the number that's outside.	e.g. someone with a green card to explain the peach card. Does each group have a completed grid.
Final Task Reintroduce the original equation and ask each group to use the 4 skills to try to find the value of *x*. Get each student in the group to attempt a skill which was not their own. Put their solution on a sheet and display their answers at the end.	Has each group correctly applied the relevant skills in the correct order? Is each student active in the solution or is any one student writing out the solution? Let students display their completed solutions.

10. Evaluation

- *What is your plan for observing students?*
  As this lesson is not the usual "teacher led instruction" type of lesson, I myself will be free to observe students by moving around the groups, listening to their discussions and throwing in the odd question or hint. Ms Crowley will observe the dynamics, student engagement and activity, how the group work strategy fares out in comparison to individual work, and record photos of student work.

- *Types of student thinking and behaviour observers will focus on?*
  As this lesson focuses on understanding skills of algebra, the student work will be observed to check for the frequency of the usual errors of simplification, distribution and solving equations.
  The discussions and group teaching will also be observed to determine how well the broader learning outcomes and understanding of concepts are achieved.

- Additional kinds of evidence to be collected At the end of the lesson, all work done by students on sheets during the class will be collected and used to assess how well the main learning goals were met.

11. Board Plan

The board will only be used to display the tasks of the lesson on powerpoint.
It will also possibly be used to display a summary grid at the end of the lesson.

12. Post-lesson reflection

Academic

1. How did students thoughts on Algebra change after the lesson?
   Did students begin to see algebra in a new light?
   Students are not used to this level of movement and group work in a maths lesson and so found the whole thing a bit confusing. They did manage to complete the activities and their written work showed that they did achieve the learning goals but the manner in which the lesson was presented caused some problems.
   They certainly seemed to gain an understanding that Algebra is actually a way of thinking and problem solving which they seem to do on a daily basis, and not just some sort of Maths that they have to learn in class.

2. What did students learn?
   From questioning students and their written work it was clear to see that they certainly gained an understanding of the key algebraic skills that were at the centre of the lesson.
   This initial understanding will be instrumental in improving students' skills of equation solving once followed with the rigor of practice.

3. Were students using the correct vocabulary
   In general, students found the peer teaching aspect of the lesson difficult. It was obvious that they are not used to this style of learning from each other in maths class. Many of the more abled students were verbally able to explain the various steps but did not initially use terms like distribution, expressions, etc. During the lesson I sensed that the groupwork model was causing confusion and so I decide not to burden them with these technical terms and to concentrate on understanding the concepts, with naming the concepts to follow at a later stage.

4. Were they actively demonstrating and explaining within their group?
   What were they saying? What were they doing?
   Each group needed quite a bit of support in terms of what each group task required them to do.
   Once the tasks were explained fully to them they did seem to work well in terms of summerising what each task card required. They were able to complete the cards, and come up with new questions, but it was the peer teaching which lacked some confidence.

Motivation

1. Were they asking questions of each other?
   I did observe some students actively listening to each other and a few questions did follow. I would however be confident to say that it was the more able student who engaged in questioning. Those who were a bit cofused with the group work style of learning for the most part just tended to sit back and observe.

2. Were they asking questions of the teacher?
   Initially the majority of the questions I received were clarifications about the tasks. Once the regrouping had taken place, qiute a number of students did ask questions which sought reassurance that they were on task."Is this the sort of question I need to ask?" "Is my teaching sheet ok?"
   "Is my card about counting all the ones that are the same?" etc.

3. Were they answering questions?
   The majority of questions were not posed by the teacher to the class, so there was very little of the normal question and answer moments. The questions were posed on the task cards, and for the most part, these were well answered by observing student work. I did have to work individually with some of the weaker students when they first received their task card and my leading questions were answered well. There were very few questions asked during the peer teaching phase as most just sat and listened to the student explaining their card.

4. Were there any 'aha' moments?
   Students are not used to seeing algebra taught in this manner. The link between the task card problems and standard algebraic questions did not occur early on. The "aha" moment generally kicked in for the class when the card summary was reconciled with the solution to the main equation and students saw how the four skills all contributed to the solution.

Social Behaviour

1. Frequency of interaction. Did students refer to and build on classmates comments?
   There was a lot of interaction during this class, such is the nature of group work. Some of the shy students found this difficult as they had no control over who was in their group and may have therefore ended up working with students that they would generally not interact with. This in itself is a huge social learning goal which is a by product of group work.
   The structure of the lesson was such that students were required to refer to and build on each others work and comments.
2. Did everyone value peer input?
   For the most part, students did enjoy working with each other as opposed to the normal individualised style of classwork. Each persons contribution was vital to the success of each group and so peer input was valued.

3. Was everyone participating?
   Yes, the class was certainly very active and each student had a specific role to play. Without this any group work activity would not be effective.

Student attitudes

1. What did they like most about the lesson?
   Students really enjoyed the freedom to chat and move around the room at times. The use of the sheets with markers was certainly a distraction from the normal copybook work. Many remarked that they did not even feel the double class going by because they were so busy. They got great confidence from the original coloured groupings where they got to discuss as a group what their card was about. This meant that they could, with the help of others, finally get the message that they were now responsible for taking into their new group.

2. What did they like least about the lesson?
   The real negative feedback was that it was very confusing at times. I would put this down to the nature of the strategy where they had to figure out for themselves. They see this as confusing whereas they really are just unsure that they are right. The moving around and forming groups probably added to the confusion.
   The other main negative was that they had to peer teach. Many felt really out of their comfort zones when asked to explain their card to others. A few just actually told the group what their card did,
   e.g. “in this card you have to multiply everything by the number…”.
   I would however feel that this negativity was due to the fact that the students are not exposed to this type of group work on a regular basis.

   On the whole the lesson went well with great success in solving the main equation posed. Many would argue that solving this type of equation could be taught in a lot less time by the standard teacher led examples followed by student practice. However the strength in this lesson is that students are engaging in activities which reinforce an understanding of the skills which in turn should lessen the frequency of the normal algebraic errors which students make. This lesson also forced students to deal with many algebraic concepts as opposed to just solving equations and probably more importantly, it pointed out that concepts like algebraic simplification and distribution are actually activities that they engage in regularly in daily life.