

Group 34:

Names: Tommy Lyons, Siobhán Crowe

Topic Chosen: Problem Solving, Simultaneous Equations

Drafter: Tommy Lyons, Siobhán Crowe

Delivery of lesson: Tommy Lyons

Title of Problem: Enter the Matrix.

Brief Description of Lesson:

Students will use their problem solving skills to find the value of different variables leading them to identify simultaneous equations as a useful method.

Aims:

- I'd like my students to appreciate that algebra is a tool for making sense of certain situations
- I'd like my students to become more creative when devising approaches and methods to solve problems
- I'd like to emphasise to students that a problem can have several equally valid solutions
- I'd like my students to connect and review the concepts that we have studied already.

Learning Outcomes

- To engage students in problem solving
- To introduce the topic of simultaneous equations into problem solving
- To get students to initiate the use of simultaneous equations to solve the problem.
- To solve the problem using multiple solutions

Resources:

- 3 different shapes representing 3 different variables
- 4x4 grid box to arrange shapes
- Show me boards
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Background and Rationale

This section typically discusses:

- (a) What the students need to learn according to the syllabus;

As this is a transition year group there is no set syllabus for the students. As a group we are trying to use the student's previous knowledge to solve a problem. Also for them to identify there are a number of methods to solve the same problem.

- (b) Difficulties students have had in the past with the subject matter

- Visualising the problem
- Identifying the variables from a problem
- Forming simultaneous equations

Research

As simultaneous equation applies to both higher and ordinary level students. It is required for a number of topics within each stand e.g. geometry and algebra to name a few.

Strand 4: Algebra – Ordinary level and Higher level

4.2 Solving equations

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 2 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

Higher Level

- simultaneous linear equations with three unknowns

As part of our research the questions that are going to be used in the class were given to 5th year higher level students. Students solved the problem using trial and error. (Alternative solution) However through questioning they did identify that the problem could have been solved using simultaneous equations.

The main resource is a problem solving book which has a number of differentiated problems which uses shapes as variables and you are required to find the value of the sum of a number of shapes. We also used the Leaving Cert Math's books as a resource.

Flow of the Unit:

Handbooks would be useful here

Prior Knowledge

Students should have covered Algebra for their Junior Certificate regardless of their level. This would include topics that are relevant to solving these problems such as:

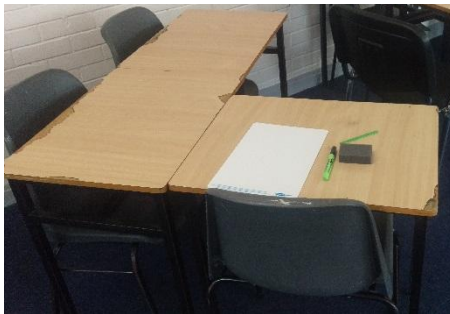
1. *Simultaneous equations*
2. *Manipulating formulae*

The idea of the lesson is allow the students time to attempt the problem solving exercise after completing the above relevant topics. The main idea is not to allow the students enough space to identify a solution to the problem without any direction from prior knowledge. It is a different approach but an approach which gets the best out of the students as there will hopefully be a better variation of answers.

Teaching Activity	Points of Consideration
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1. Introduction (3 mins)

Students when entering the class will take a colored lollypop stick and sit at the appropriate table. This is to avoid students sitting with their friends.



At each table there will be a show me board and markers to display their solutions as well as the problem.

Get the students to identify a recorder, a spokesperson and a chairperson.

Inform the students that they have 10 minutes to complete the problem.

Set the timer for 10 minutes.

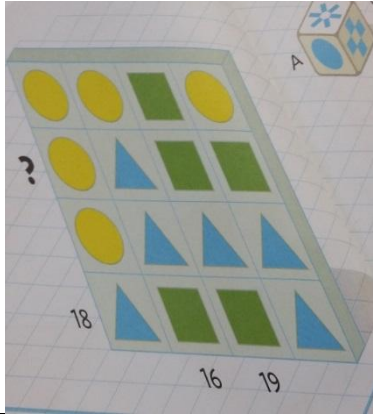
Groups of no more than 3

No calculator or iPad's are permitted.

Explain the role of each member in the group.

Have extra problems for groups that may finish the task before the end of the time allocated.

2. Posing the task (3 mins)



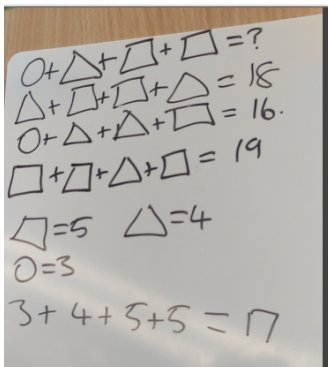
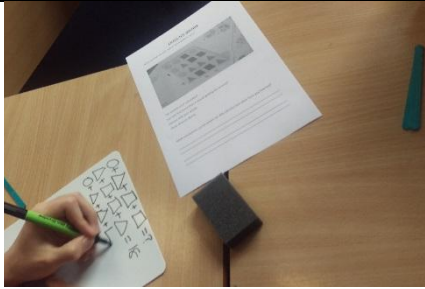
The following problem will be presented to the students:

Question:

What number should replace the question mark?
Calculators are not permitted when completing the task. If you have completed the task within the ten minutes, can you identify another way of doing it? The students will write their answers on the whiteboard and discuss with their assigned group.

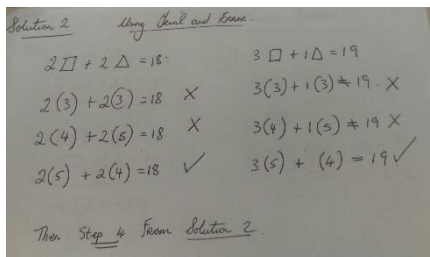
3. Students individual work (10 minutes)

Teacher circulates the room assessing students work.
Teacher will record a variety of answers developed by students and choose which students (groups) will present their work to the rest of the class. This is to avoid the same answers being discussed.



4. Anticipated Student Responses

We anticipate that students will use trial and error to solve this problem.



They may use their boards to write out the calculations that they make or to draw diagrams to help them solve the problem.

Possibly some of the higher thinking students will use simultaneous equations. All groups will be asked to give feedback on how they solved the problem.

Some groups will use the same approach to solve the question.

Time needs to be allocated for alternative solutions that has not considered by the teachers.

Using Simultaneous Equations

Solution 1

Step 1

$$\begin{array}{r} 3\Box + 1\Delta = 19 \quad (\times 2) \\ 2\Box + 2\Delta = 18 \\ \hline -6\Box - 2\Delta = -38 \\ 2\Box + 2\Delta = 18 \\ \hline -4\Box = -20 \\ \Box = \frac{-20}{-4} \\ \Box = 5 \end{array}$$

Step 2

$$\begin{array}{r} 3\Box + 1\Delta = 19 \\ 3(5) + 1\Delta = 19 \\ 1\Delta = 19 - 15 \\ \Delta = 4 \end{array}$$

Step 3

$$\begin{array}{r} \bigcirc + 2\Delta + 1\Box = 16 \\ \bigcirc + 2(4) + 1(5) = 16 \\ \bigcirc + 8 + 5 = 16 \\ \bigcirc + 13 = 16 \\ \bigcirc = 16 - 13 \\ \bigcirc = 3 \end{array}$$

Step 4

$$\begin{array}{r} 2\Box + 1\Delta + 1\bigcirc = ? \\ 2(5) + 1(4) + 1(3) = \\ 10 + 4 + 3 = \underline{17} \end{array}$$

Each group will have to discuss how they arrived at their solution and answer any questions posed by the teacher or the other students.

4. Comparing and Discussing

Each reporter will share with the class the answer their group arrived at. They will explain how they came to this conclusion. Identify the method they used.

Right and correct

$$\begin{array}{r} \Delta + \Box + \Delta = 18 \\ \bigcirc + \Delta + \Box = 16 \\ -\bigcirc + \Delta + \Box = 2 \end{array}$$

$\Box = x$
 $\Delta = y$
 $\bigcirc = z$

(Students board work shown above)

After each group has shared their solution they will discuss which method would be the fastest method to use when trying to find the value for a number of variables.

$x + y = 18$
 $-y + y =$

The teacher needs to write down all the correct methods used for solving the problem on the board and keep a tally as to which methods the students used.

The teacher needs to probe students so that they will arrive at the conclusion that when there are more than two variables simultaneous equations would be the fastest method to find the value of the variables.

5. Summing up (3mins)

Teacher will recap on the solutions that were presented on the board. Then students will write down what they have learned from this class on their worksheet.

The teacher will also present students with a similar problem for homework to attempt.

This conclusion may not be achieved at the end of the lesson. A question for the students must be prepared for the students to attempt at home and for the discussion to continue in the next lesson.

Evaluation

Introduction, posing the task section:

There was no need for the teacher to recap or use the student's prior knowledge as a problem was posed to the students which could of been solved using a number of possible solutions.

All groups solved the problem using the trial and error method. We had anticipated that some of the higher order thinkers would have identified that simultaneous equations as an alternative method.

All students found the task to be very clear. Each group was coloured coded, a task sheet was given to each group as well as a show me board and a marker. There were no grey areas with this task. One group did however ask,

How do we write it out?

The teacher answered

Draw out the information you have.

Otherwise, there was no other questions asked.

Individual/ Group Work

All groups used trial and error to solve the task as stated previously. No unanticipated solutions were used by the students. The teacher did use prompts to help the students to identify that simultaneous equations could have been used to solve the problem. The teacher identified that the shapes were representing unknown values, a student responded that they were the *variables*. They also identified that we would use letters instead of shapes e.g. *x, y and z*. The equations were rewritten using letters. The teacher asked

Should I preference any of these equations a student responded with *the one with the two variables*.

The follow up question from the teacher *what can I use to solve these equations* resulted in a student identifying **Simultaneous Equations**.

The students were given 10 minutes to solve the task at hand which they all did showing that the time allocation was adequate. They were given an extra 5 minutes to see if they could identify that simultaneous equations could also be used.

The only question that was asked by students was to recall how to complete simultaneous equations. Some students could not remember but once shown the first steps they recalled

simultaneous equations and completed the task using the method.

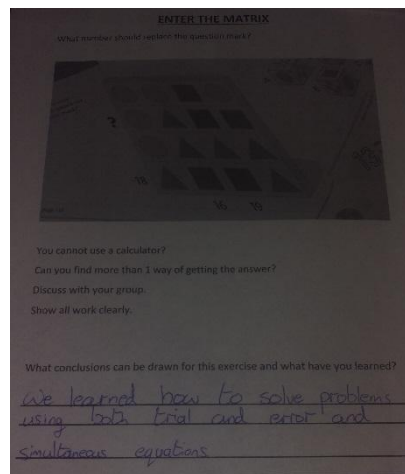
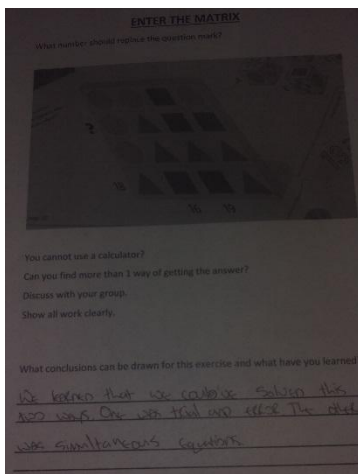
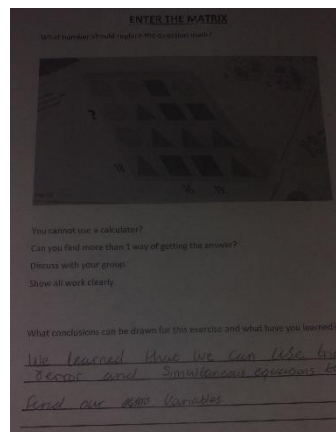
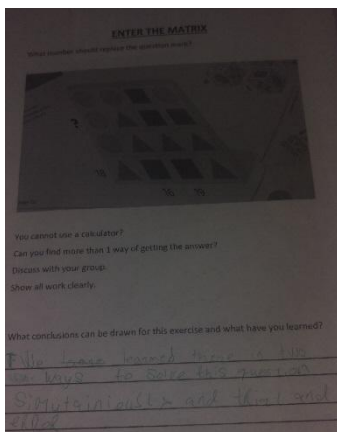
All groups continued with the task without any extra encouragement or involvement from the teacher. The teacher during remained passive in their role while the students were working.

Discussion

One group presented to the rest of the class as all groups used the same method to find the value of the question mark. The rest of the students were very attentive when the presentation was going on. The student presenting the solution explained it very clear and precise. At the end of the presentation, there was no questions from the class but from the teacher. The teacher asked if there was another method, other than the solution presented. This lead to a discussion about variables, how to represent variables, and rewrite the problem using equations.

The discussion did promote student learning as they arrived at the conclusion that they could have used simultaneous equations to solve the puzzle.

As part of the worksheet, the participants had to write a conclusion to the task. Three out the four groups identified that 'trial and error' and 'simultaneous equations' were the methods that used to solve the task. One group used the term variable that both methods used found the variable.



Conclusion

Over the course of the lesson the students became aware that there were a few different methods that they could implement to solve the problem. This was achieved through questioning and a discussion lead by the teacher. On reflection, If this lesson was to be repeated extra problems would be used with more than two variables in each equation, making it harder to solve by trial and error. Thus forcing the students to consider another method and hopefully allowing the students to arrive at the conclusion that simultaneous equations could be used.

