Lesson Plan for [Second Year, Distributive Property]

For lesson on 29/1/15

At St. Mogue's College,

Mr. Larry Carolan's 2nd Year Class

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1. Title of the lesson: Using the distributive property to simplify such expressions as: $(x + a)(x + a)$ or $(\mathrm{x} + \mathrm{a})^2$, where a ϵ Z

2. Brief description of the lesson: To help students understand that:$(x + a)(x + a) = (\mathrm{x} + \mathrm{a})^2$ and enable them to expand this expression.

3. Aims of the lesson:

   I would like my students to appreciate that maths can solve real life problems.

   I would like my students to appreciate that algebra is a tool for making sense of certain situations.

   I would like to foster my students to become independent learners.

   I would my students to become more creative when devising approaches and methods to solve problems.

4. Learning outcomes:

   As a result of studying this topic students will be able to:

   (i) Use the distributive property to show $(\mathrm{x} + \mathrm{a})^2$=$(x + a)(x + a)$

(ii) Select suitable strategies to expand an expression of the form $(x + a)^2$

(iii) develop and use their own generalising strategies and ideas and consider those of others

(iv) use the representations to reason about the situation from which the relationship is derived and communicate their thinking to others

(v) the use of diagrams and manipulatives to represent and analyse algebraic expressions

(vi) apply their knowledge and skills to solve problems in familiar and unfamiliar contexts

(vii) analyse information presented verbally and translate it into mathematical form

(viii) devise, select and use appropriate mathematical models, formulae or techniques to process information and to draw relevant conclusions.

(ix) make use of letter symbols for numeric quantities

(x) emphasise relationship-based algebra

(xi) connect graphical and symbolic representations of algebraic concepts

(xii) use real life problems as vehicles to motivate the use of algebra and algebraic thinking

(xiii) explain findings

(xiv) justify conclusions

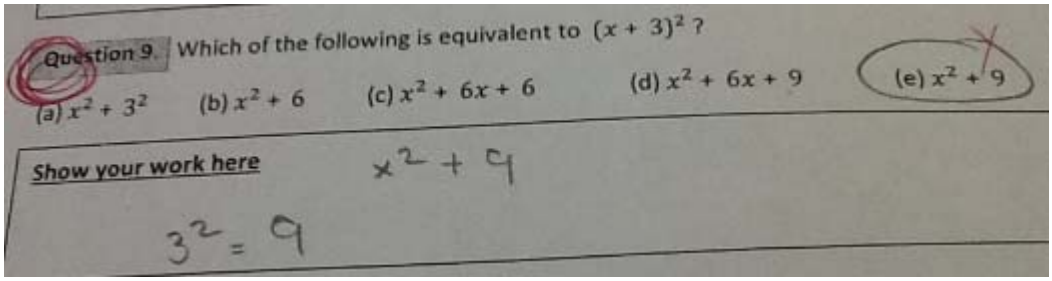
(xv) communicate mathematics verbally and in written form

5. Background and Rationale:

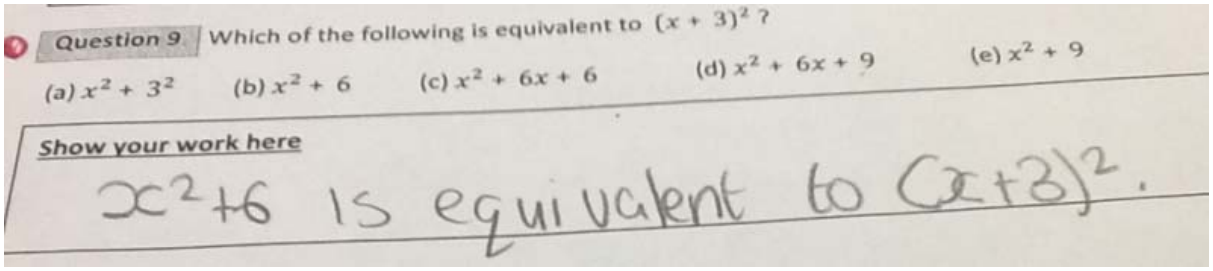
a) Syllabus requirements

b) Difficulties= Common misconceptions in expanding $(x + a)^2$, students most common answers from the Maths Competency Test in our school were:

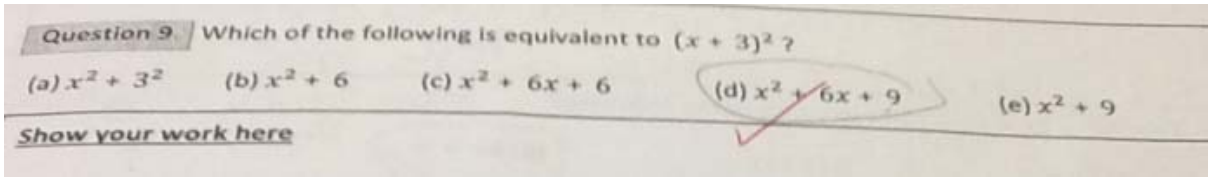
1. $(x^2 + a^2)$



2. $(x^2 + 2a)$



3. $(x^2 + 2ax + a^2)$



Students have difficulty seeing the connection with area or real life situations, they tend to jump to conclusions without any real analysis on the problem, they over rely on learning a rule and their memory thereof.

c) Thematic focus: that algebra is a tool for making sense of the connections between graphical, symbolic and algebraic representations.

6. Research

(i) Mathematics Syllabus-Junior Certificate: Evaluating expression of the form $(x + y)(x + y)$

(ii) Second year handbook p.15 'Use the distributive property to simplify such expressions as: $(x + y)(x + y)$ (e.g. using models such as the array model or algebra tiles)

7. About the Unit and the Lesson

1) Help students to realize that$(\mathrm{x}+\mathrm{a})^2=(x+a)(x+a)$, and select suitable strategies e.g. using array models or algebra tiles to expand an expression of the form$(\mathrm{x}+\mathrm{a})^2$.
2) Pose the following written problem to the students.

Ann and Barry bought a new house that is square shaped. They liked the shape but would like to put an extension to it. They decide to increase the length by 3m and the width by 3m.

3) Hand out the written version of the question and a resource pack to students, containing whiteboards, algebra tiles. Ask students to work in pairs, discuss the problem and represent the problem with a diagram.
4) Help students realise they are using area and models to solve the problem.

In this lesson the focus is not only students being able to expand an algebraic expression but rather identifying that this expression is connected to area.

8. Flow of the Unit:

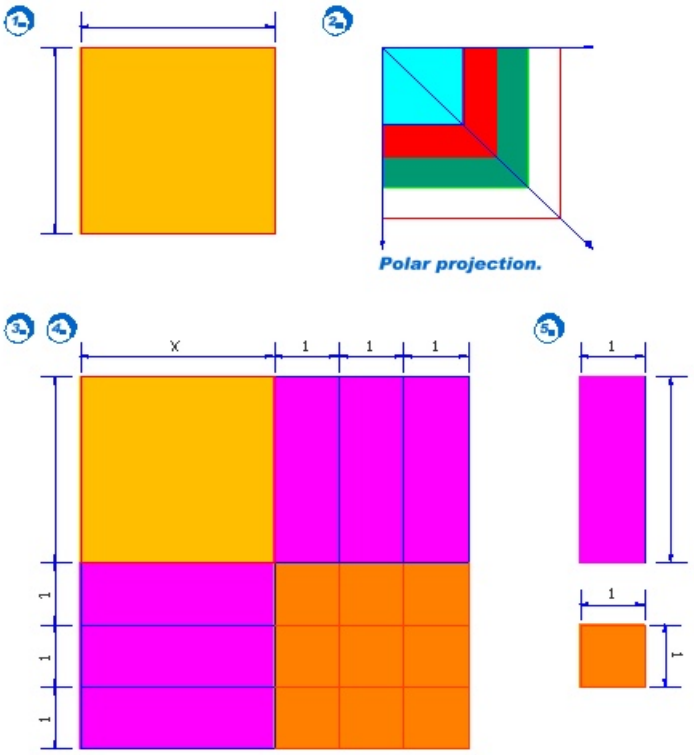
Lesson		**No. of lesson periods**
	Title: Revision 1st year Algebra	
1.	Applied measure 2 - area and volume	6 x 35 minutes
2.	Investigating rules for indices	3 x 35 minutes
3.	Revision and extension of algebraic expressions and simple linear equations from first year	4 x 35 minutes
4.	Algebraic factors	8 x 35 minutes *(1 x research lesson)
5.	Adding algebraic fractions	2 x 35 minutes
6.	Linear equations, linear inequalities and simultaneous linear equations	8 x 35 minutes

9. Flow of the Lesson

Instructional Activity	Points of Consideration
1. Introduction We have a problem that we are going to work on today and we are going to develop a strategy for problem solving. Your homework will be to prepare a key note presentation of your work in class today	
2. Posing the Task-question Pose the following written problem to the students. "Ann and Barry bought a new house that is square shaped. They liked the shape but would like to put an extension to it. They decide to increase the length by 3m and the width by 3m". (i) Write an expression for the area of the existing house. (ii) Write an expression for the area of the new house. (iii) Simplify the expression	Each of you has a pack that will assist you solving this problem. Teacher circulates and asks open ended questions.
3. Anticipated Student Responses 1.There are no measurements 2. How do you get area? 3.How can we get the area when we don't have any numbers 4. I'm finished 5. How do I show the extension?	Can we draw a picture of this? How can we represent an unknown value? Area of a Square: L x W What is special about a square? Board work Students who finish early proceed with the next task Can you use the algebra-tiles here?
4. Comparing and Discussing Students display their work on	Teacher prompts students to establish the new length and width

whiteboards Capture image of Algebra-tiles using iPads and show teacher Teacher asks a student to display their work on the black/white board. Possible misconceptions: x^2 written as $2x$ $(x+3)$written as $3x$ *or* $x3$ Students write down $(x+3)(x+3)$ Students arrive at expression	of the house in terms of x. Teacher circulates to see if students realise area of the extension is displayed in the Algebra-tiles. Teacher displays polar projection of a square to explain increasing area on black/whiteboard board and further highlight the use of indices. Apply this information to solve the problem Teacher circulates to see students workings Teacher questions class as to areas that are emerging using the algebra tiles Teacher prompts class to simplify
5. Summing up	
Use algebra-tiles to alter their models to create expression for $(x+3)^2$, and simplify.	

Blackboard writing plan



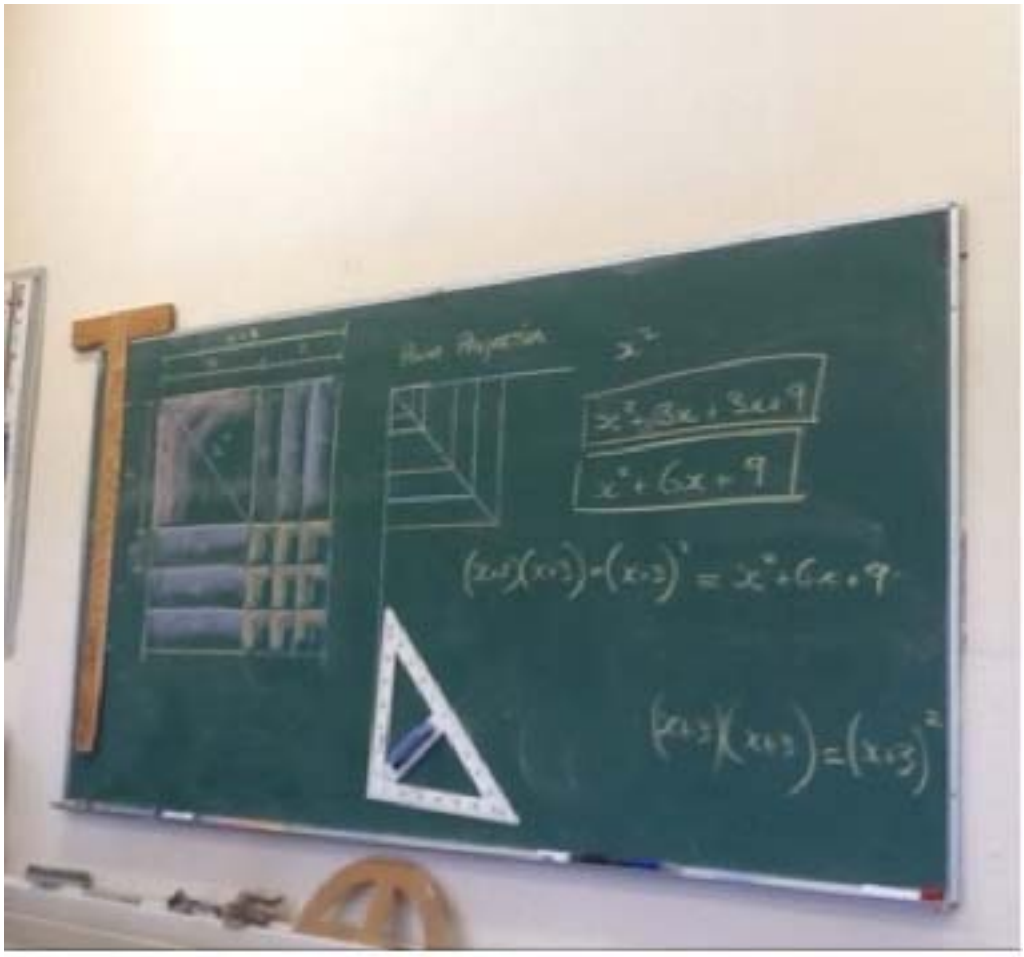
1. AREA OF A SQUARE = LENGTH x WIDTH.
   = X x X
   = X^2
   AREA OF A RECTANGLE = LENGTH WIDTH.
2. POLAR PROJECTION.
3. ALGEBRA TILES.
4. AREA OF EXTENDED SQUARE IS (X=3) (X+3).
5. AREA OF YELLOW SQUARE = X x X = X^2
   AREA OF PURPLE RECTANGLE = X x 1 = X
   AREA OF ORANGE SQUARE = 1 x 1 = 1
6. TOTAL AREA = $(X + 3)(X + 3) = (X + 3)^2$
   $(X + 3)^2 = X + 6X + 9$

10. Evaluation

We plan to observe students during the lesson. Each teacher will observe a group of 3-4 students. A student observation template has been drafted and will be filled in by the observing teachers during the class. This will record questions asked, diagrams drawn and discussions on problems, responses and approaches to tasks. Evidence will be collected by the students through images using iPads. Observation will focus on visual stimulation used by students and their engagement in problem solving.

A teacher observation template has been drafted and will be filled in also.

11. Board Plan



12. Post-lesson reflection

One of the major patterns observed during the lesson was that students wanted a visual stimulus. Most groups drew a diagram initially on their whiteboards with one group using algebra-tiles from the off-set. The algebra-tiles allowed for more co-operative and discursive work between the students and created a physical environment for learning. The different colour of the tiles helped lead the students to form an expression quickly.

We would recommend however, that time is spent showing students how to use algebra tiles correctly. Incorporating the use of a cross to demonstrate the position of the tiles is very important. See (*Figure 1*). In addition it would be important to use different orientations of the tiles to enable students to move flexibly in different scenarios (see Figure 2 and 3).

The use of polar projection during the lesson to demonstrate the notion of 'squaring' reinforced students understanding.

Throughout the lesson students took images of their work on their devises and this was a very effective use of IT. Their homework was then to create a presentation of how they engaged in the problem solving task.

Students conveyed confusion when multiplying $(x)(x)$ where they answered $2x$. This misconception was discussed and demonstrated by resorting to examples using numbers.

We feel the students achieved the learning goal of the lesson where they used the distributive property to show $(\mathrm{x}+\mathrm{a})^2$=$(x+a)(x+a)$. Students used various strategies to expand an expression of the form $(\mathrm{x}+\mathrm{a})^2$.

Finally, during the summation of the lesson students were able to state that their result was a quadratic trinomial. More examples were used to reinforce this concept and students were able to convey their understanding that their results would always be a quadratic trinomial.

On reflection we would change our question cards at the start of the lesson to include the expressions that were required from the students. This we feel would allow for more discussion among the students in the groups.

We feel 'time' is key to planning within a department and the main focus of our departmental meetings should be on teaching and learning strategies. In order to enhance teaching and learning within the subject, schools need to be provided with the resources, both time and monetary to create and purchase equipment.

Finally, we feel this project was very worthwhile and an eye-opening experience for our Maths Department. The process of engaging as a team in planning a lesson gave insights into different methodologies and collaboration on differentiated learning within a lesson.

Evaluation of Lesson Being Observed

Beginning of lesson:

-Observe the level of difficulty with homework.

Comments:

_____
_____
_____

-Note comments made by students in relation to tasks

_____
_____
_____

Lesson Introduction:

Scale:

Poor=1, Satisfactory=2, Good=3

Observation	Student A	Student B	Student C
Discussion of question			
Drawing the diagram			
Questions asked by students			
Responses by students			

Body of lesson:

Observation	Student A	Student B	Student C
Area of a square			
Represent unknown variable			
Area of a rectangle			
Use of algebra-tiles			
iPad images			
Forming an expression			

Conclusion:

Observation	Student A	Student B	Student C
Expanding the expression to get the result $(x+3)(x+3) = x^2+6x+9$			
Notion of squaring			
$(x+3)^2 = x^2+6x+9$			

Homework:

Student responses/comments:

_____

_____

Any other observations:

_____

_____

_____

Evaluation of Lesson Being Observed (T)

Scale: Poor=1, Satisfactory=2, Good=3

Timing	**Introduction**	**Observations**
2 Minutes	AFL/Homework/Student Packs/Problem Solving	
2 Minutes	Teacher inputs/prompts	
Timing	**Body of Lesson**	**Observations**
10 Minutes	Teacher observation of group work/interaction	
5 Minutes	Teacher's questions	
10 Minutes	Teacher's board plan/explanations/polar projection	
Timing	**Conclusion**	**Observations**
5 Minutes	Summation	
1 Minute	Keynote reminder	

Any other comments:

Figure 1:

Rotating the tiles can enable students to move flexibly in different scenarios

E.g.: $(2 + x)(3 + x)$

Always emphasise to students we must form a rectangle/square

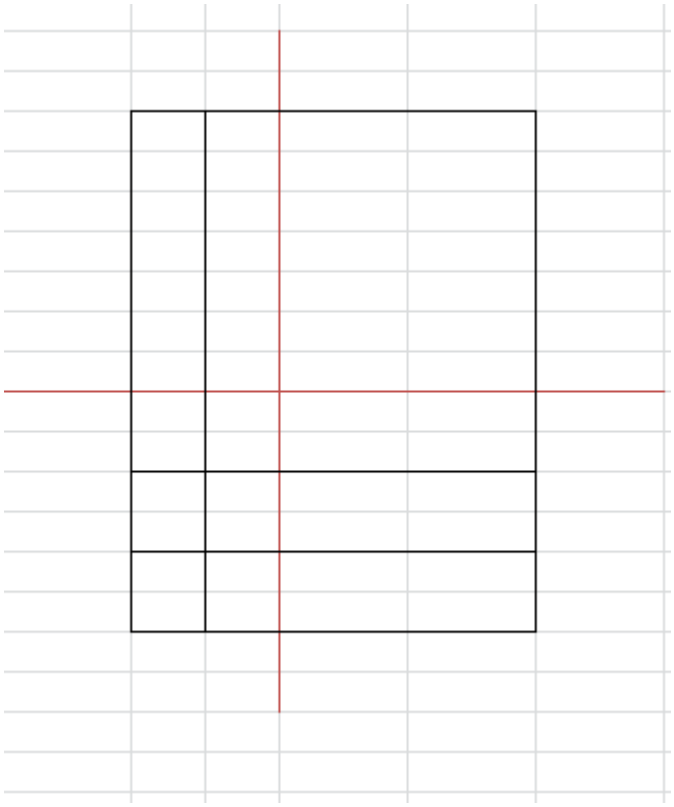
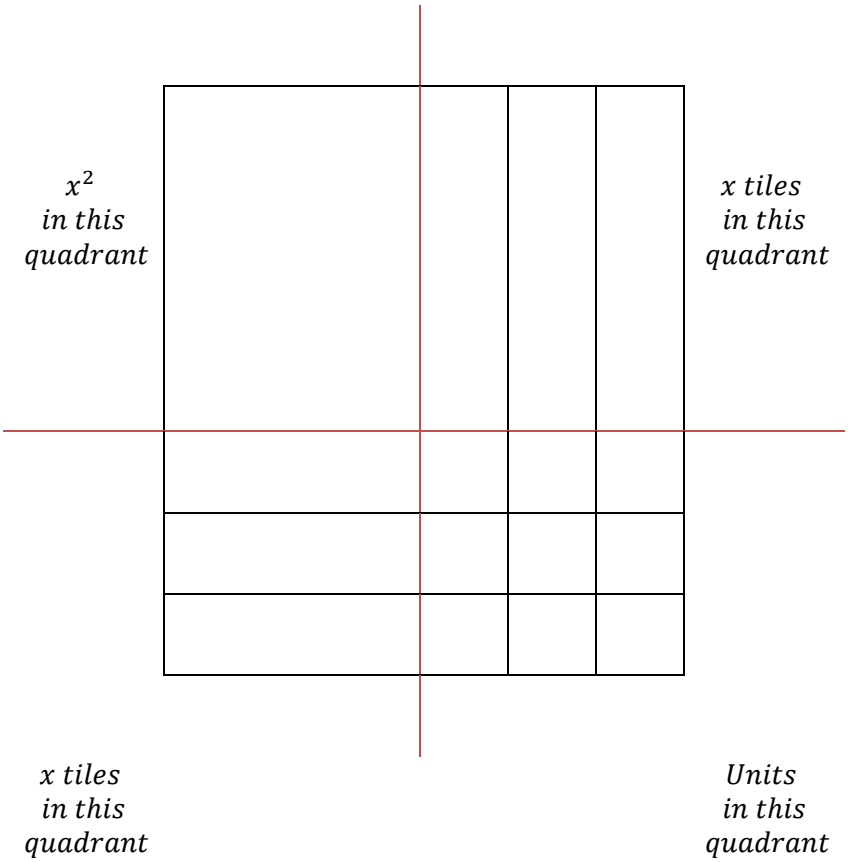


Figure 2:



Encourage students to rotate later so they can see $(3 + x)^2 = (x + 3)^2$

Figure3