Lesson Research Proposal for 2nd Year VAT

For the lesson on 28/1/18
At Donabate Community College, Ms Baylys class
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1. Title of the Lesson: Pythagoras Percentages Predicament

2. Brief description of the lesson

Students will have prior knowledge coming into this lesson on how to calculate a percentage of a number. This lesson will build on this knowledge by now calculating VAT on items. This topic often causes confusion with students, up until now, feeling that we can only get up to 100% of a number and no more. During this lesson, students will be introduced to the topic using problem solving, will work both on their own and in groups, as they maneuver their way through this topic and debunk some of their prior theories.

3. Research Theme

- Students enjoy their learning, are motivated to learn and expect to achieve as learners.
- Students reflect on their progress as learners and develop a sense of ownership of and responsibility for their learning.

Supporting our goals:
As a Mathematics Dept. we will support these Standards by:

- Providing problems that have a clear sense of attainment and challenging learning outcomes.
- Clearly planning and identifying learning intentions that are contextualized relevantly to student needs.
- Use feedback to work with students on clear strategies for improvement.
- Engage with student opinions and modify our teaching practice and build on opportunities for students to reflect on their progress as learners

4. Background & Rationale

(a) Why we chose this topic

This lesson is aimed at second year students. The teaching of the VAT is a very important topic from the point of view that it builds on their knowledge of previously learned material such as percentages, fractions and decimals and extends the students understanding of these operations to a higher level.

There are a number of common misconceptions among students from that you can't have more than one hundred percent on one hand to finding the percentage required and subtracting; rather than the percentage being over one hundred. Students also experience a lot of confusion learning and remembering this topic. Word problems can cause them difficulty.

When teaching this topic, we cannot teach it as a procedure, rather students need to have a conceptual grounding onto what VAT and percentages actually are. We need to give them a good understanding of the various applications across the syllabus. They need to understand that for VAT there are many different variations and not just one size fits all.

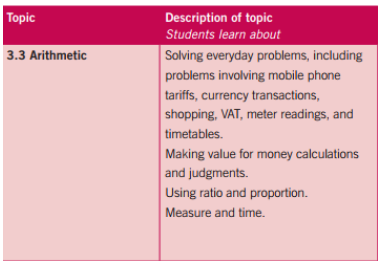
(b) Our research findings

Through general discussions of our Maths teachers, it was found that after the teaching of VAT is taught as a procedure rather than with depth of understanding hence students have difficulty applying it to other concepts. The type of problems in which they encounter in VAT would be in percentage increase/decrease, profit and loss, marginal error and household bills to name a few.

Because of the importance and the wide impact that VAT has across the curriculum and in everyday real life, we have decided to take a common approach in our dept. to the teaching of VAT. This topic has relevance cross curricular in subjects such as Business Studies, Home Economics and many other practical subjects. It also compliments the numeracy policies within the school.

In designing the lesson, we believe it is important to devise creative ways so that students are motivated to learn through having a clear sense of attainable and challenging learning outcomes, so that they can comprehend the relationship between the Maths and real life.

5. Relationship of the Unit to the Syllabus

Related prior learning Outcomes	Learning outcomes for this unit	Related later learning outcomes
In third class students learn to: • They identify fractions and equivalent forms of fractions. • They compare and order fractions. • Develop an understanding between the relationship of fractions and division. • They identify tense and express in decimal form. They order decimals on numberline and solve problems involving decimals. In fourth class students learn to:	In second year, students learn to: • Solve problems that involve finding profit or loss, percentage profit or loss, percentage discount, selling price, compound interest for up to three years, income tax and net pay (including other deductions). • Solve problems that involve cost price, selling price, loss, discount, mark up (profit as a percent of cost price), margin (profit as a percentage of selling price), compound interest, income tax and net pay including other deductions.	In Leaving cert, students learn to: • Costing; materials, labour and wastage. • They use present value when solving problems involving loan repayments and investments. • They calculate percentage error and tolerance and accumulative error (by addition or subtraction only). 

Topic	Description of topic *Students learn about*
3.3 Arithmetic	Solving everyday problems, including problems involving mobile phone tariffs, currency transactions, shopping, VAT, meter readings, and timetables. Making value for money calculations and judgments. Using ratio and proportion. Measure and time.

• Reinforce their learning on the topic. • They expand on their denominators in fractions. • They add and subtract/multiply and divide decimals. In fifth and sixth class students learn to: • They should be adding and subtracting fractions and mixed numbers. • They multiply fraction by whole number and fraction by fraction. • They develop an understanding of simple percentages and relate them to fractions and decimals. • They compare and order fractions, decimals and percentages. • They solve problems involving operations with whole numbers, fractions, decimals and simple percentages and solve problems relating to profit and loss, discount, VAT, interest increase and decrease. In first year students learn	**3.3 Applied arithmetic** Solving problems involving, e.g., mobile phone tariffs, currency transactions, shopping, VAT and meter readings. Making value for money calculations and judgments. Using ratio and proportionality. – solve problems that involve finding profit or loss, % profit or loss (on the cost price), discount, % discount, selling price, compound interest for not more than 3 years, income tax (standard rate only), net pay (including other deductions of specified amounts) – **solve problems that involve cost price, selling price, loss, discount, mark up (profit as a % of cost price), margin (profit as a % of selling price) compound interest, income tax and net pay (including other deductions)**	**Learning outcomes** *Students should be able to* – solve problems that involve finding profit or loss, % profit or loss (on the cost price), discount, % discount, selling price, compound interest for not more than 3 years, income tax (standard rate only), net pay (including other deductions of specified amounts) – calculate, interpret and apply units of measure and time – solve problems that involve calculating average speed, distance and time

to: • They investigate models to help think about the operations of addition, subtraction, multiplication and division of rational numbers. • They calculate percentages. • They use the equivalents of fractions, decimals and percentages to compare proportion.		

6. Goals of the Unit

- Students will understand how to solve problems involving financial transactions e.g. mobile phone tariffs, currency transactions, shopping, VAT, meter reading, income tax and net pay.
- Students will understand how to apply their prior knowledge of percentages and ratio and proportion in solving these problems
- Students will be able to make 'value for money' calculations and judgements.
- Students will understand how to 'reason check' their answers.

7. Unit Plan

Lesson	Learning goal(s) and tasks
1 The Research Lesson	Introduce VAT in a problem-solving context • Prior knowledge will be accessed on calculating percentages. • In investigating the properties calculating VAT, the students will understand that the VAT on an item is interchangeable. • They will recognize how to find a percentage and when to add on/subtract
2	• Household Bills • Solve problems involving billing with VAT problems. • Bills that involve meter readings.

3	• Percentage profit and loss • Relate to percentage increase and decrease • Calculating profit margins
4	• Compound Interest and Depreciation • Finding the rate and the principal
5	• Compound Interest and Depreciation for up to 2 years • Calculating depreciation
6 and 7	Income tax • Calculating the standard rate and higher rate of tax. • Distinguishing between net pay and gross pay and calculation of same • Using the tax credit • Calculating other deductions
8	• Currency exchange • Multiplication and division of the ratio

8. Goals of the Research Lesson:

a) Mathematical Goals:

- Students will have a deeper understanding of percentages and an appreciation of different methods that could be considered when finding a percentage.
- Students will understand how to solve problems where VAT is inclusive of the price.

b) Key Skills

1. Communicating: Students will share their ideas and express their mathematical thinking.
2. Being numerate: Order of operations, number systems and algebra will be practiced.
3. Being literate: expressing ideas clearly and accurately and developing mathematical language.
4. Being creative: Imagine and explore options and investigate alternative solutions.
5. Managing myself: students will make considerate decisions and will have the opportunity to reflect on their own learning.
6. Working with others: Students will collaborate and learn from their peers.
7. Managing information and thinking: Students will be encouraged to think creatively and critically.
8. Staying well: Students confidence and positive attitude to learning will be promoted.

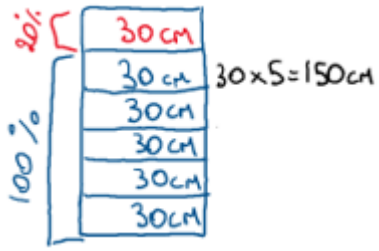
The lesson is also designed to meet the following JC statements of learning

1. Communicates effectively using a variety of means in a range of contexts in L1
15. Recognises the potential uses of mathematical knowledge, skills and understanding in all areas of learning
16. Describes, illustrates, interprets, predicts and explains patterns and relationships

17. Devises and evaluates strategies for investigating and solving problems using mathematical knowledge, reasoning and skills
23. Brings an idea from conception to realization

9. Flow of the Research Lesson:

Steps, Learning Activities Teacher's Questions and Expected Student Reactions	Teacher Support	Assessment
Introduction Today we are going to use our mathematical knowledge to solve a problem. We're going to try to solve the problem by ourselves and then we're going to come together as a class and use all your knowledge to learn something new…		Are students motivated?
Posing the Task John lives in a terraced house. He has a neighbor that has a dog called Pythagoras. The dog loves to jump into John's garden to bury bones. To stop this happening John increased the height of his walls. He increased the wall where Pythagoras is by 20% to make it 180cm. What was the original height of this wall? Try to solve this in as many ways as possible **Clarifying the problem:** "Let's go over the problem. What is the total height of the wall?" ♦ 180cm "Super. So how many blocks is this? So what the measure of one block?" ♦ There are six blocks, each block is 30cm. "So what percentage have we added on?" ♦ 20%	Present on the board an illustration to make the meaning of the problem easier to understand.  Make blocks and pretend money available at the top of the class	Do students understand the task? (if they don't, it's probably not a good idea to move on) Are students eager to solve the problem? Do students understand that both heights can be written in cm or m? Do Students understand the wall was not just 80% before the add on?
Student Individual Work Student response 1: Using a diagram	As one makes their way around the classroom, take not of the array of different methods that are used.	Can the students recognize the different units it can be measured in are all the same?

 Student response 2: Using fractions $180\text{cm} = \frac{6}{5}$ of the total amount $\frac{1}{5} = 30\text{cm}$ $(180 \div 6)$ $\frac{5}{5} = 150\text{cm}$ (30×5) Student response 3: Using percentages 180cm = 120% of the total amount 180 ÷ 120= 1.5 cm → 1% of the total amount 1.5 x 100=150cm →100% of the total amount Student response 4: Using percentages 2 180cm = 120% of the total amount 180 ÷ 6 = 30cm → 20% of the total amount 30 x 5 = 150cm → 100% of the total amount		Can the students see the different way, decimals, fractions, percentages, are all related?
Ceardaíocht /Comparing and Discussing Student response 1: Using a diagram Student response 2: Using fractions	Response 1: Please raise your hands if you used this method, or if you would like to use this method. Why? How many of you are there?" Response 2: Please raise your hands if you used this method, or if you would like to use this method. Can you think of how	Are students defending their ideas? Are they responding to each other's ideas?"

Student response 3: Using percentages	relatable each way is? Response 3: Please raise your hands if you used this method, or if you would like to use this method? So what is the total percentage of the wall? So we can have more than 100%?	
Student response 4: Using percentages 2	Response 4: Please raise your hands if you used this method, or if you would like to use this method. Why? Is it not very similar to the last?	
Extending students' learning **Problem 2** John found out that the cost for the blocks in the extension of the wall cost included VAT of 25% on the original price of the blocks. How much was the original price of the blocks before VAT?	So VAT was added onto the price of the wall, so looking at just the extra part that was added on, how much was it before VAT was added on?	Can students recognize we are now looking at the whole wall including the add on? We now have introduced VAT as an add on to an original price, can the students recognize now the total is over 100%?

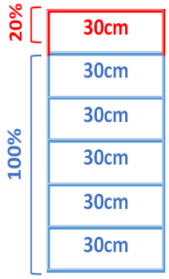
Summing up & Reflection What have we learned? • We can have more than 100% • There is more than one way to solve a problem • Students will have understood how to calculate VAT. • Students will have understood how to solve problems where VAT is exclusive or inclusive of the price.	Worksheet on VAT now handed out Clarify what method they feel would work best	Do the students' reflections represent the teacher's view of the lesson?

10. Board Plan

Problem 1

John Lives in a terraced house. He has a neighbour that has a dog called Pythagoras. The dog loves to jump into Johns garden to bury bones. To stop this happening John increased the wall where Pythagoras is by 20% to make it 180cm high.
What was the original height of the wall? Solve this in as many ways as possible.

Solution 1: Using a Diagram



30 x 5 = 150cm

Solution 2: Using Fractions

$180\text{cm} = \frac{6}{5}$ of the total amount

$\frac{1}{5} = 30\text{cm}$ $(180 \div 6)$

$\frac{5}{5} = 150\text{cm}$ (30×5)

Solution 3: Using Percentages

180cm = 120% of the total amount

180 ÷ 120= 1.5 cm → 1% of the total amount
1.5 x 100=150cm → 100% of the total amount

Solution 4: Using Percentages

180cm = 120% of the total amount

180 ÷ 6 = 30cm → 20% of the total amount
30 x 5 = 150cm → 100% of the total amount

Solution 5

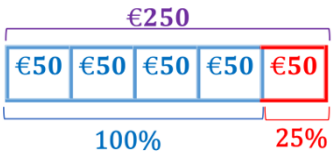
180 = 100% of the total amount

180 ÷ 100 = 1.8cm → 1% of the total amount
1.8 x 20 = 36cm → 20% of the total amount
180 – 36 = 144cm → 80% of the total amount

Problem 2

John bought bricks for the wall. The cost of bricks was €250. This €250 included VAT of 25% on the original cost. How much was the original price of the wall before VAT?

Solution 1: Using a diagram



€50 X 4 = €200

Solution 2: Using Fractions

$€250 = \frac{5}{4}$ of the total amount

$\frac{1}{4} =$ €50 $(250 \div 5)$

$\frac{4}{4} =$ €200 (50×4)

Solution 3: Using Percentages

€250 = 125% of the total amount

250 ÷ 125 = €2 → 1% of the total amount
2 x 100 = €200. → 100% of the total amount

Solution 4: Using a Table

Amount	Percentage
€50	25%
€50	25%
€50	25%
€50	25%
€50	25%

11. Evaluation

Did the lesson promote students taking a sense of ownership of their work?
The students were very eager to show off as many ways as possible in solving the problem. The students were individually very proud of their answers, especially when their answers were verified by somebody whom came to the board having the same one.
Were students motivated to learn?
They were very eager to learn new ways. The motivation levels seemed very high as the

lesson really engaged the learners.
Did the lesson promote student to student discussion?
Group work seemed to work very well for the second problem in this lesson. The students discussed and shared their solutions, explaining to each other why it was a valid way in solving.
Did students understand how to apply their prior knowledge of percentages and ratio and proportion in solving these problems?
Students were very abled to use their prior knowledge on finding a percentage. When probed to find other ways, allowing time for reflections seen the students come up with an array of solutions.

12. Reflection

Our hopes for this lesson were that the students would successfully engage with the lesson, come up with a variety of ways to solve the problems and understand you can have more than 1 or 100%. During the first problem, many students started off doing it wrong. It was only after clarifying the problem, using the probing questions in the flow of the lesson, that the students realized what exactly was being asked. Once this clarification was given, the students were able to come up with a variety of ways to solve the problem. During problem two, a similar problem was encountered as students once again seemed to dive straight into the problem. Only after clarification was given, and students were reminded that a link existed between the first problem and the second, that students successfully completed the problem in a variety of methods. Group work and peer to peer learning was especially evident here. The second problem was very much enjoyed by the students much more than the first as group work allowed them to discuss the problem and the variety of ways in which they could solve the problem and why they were correct. The students also used their solutions from problem one to solve problem two, with many finding the fractions solution the one they could apply to the problem successfully.
At first, we felt we had made a mistake by not clarifying the problem right from the start. Many students had ploughed ahead into the problem (one) without stepping back and planning on how to tackle it first. However, on reflection, it seemed to work the way it panned out; students incorrectly attempting the problem before clarification questioning gave the “aaaahhhhh” moment to the students.
The students used the props very well, especially the blocks which allowed them to explain the problem to each other and it helped with their solution involving the fraction. The money was used less by students. The worksheet that followed we felt could have been better, and the solutions on the board took longer than was planned so we ran out of time. Therefore, we could not see if their understanding was concrete or not. We also had the discussion what if the fraction was not as easily converted to ¾ or 4/5 would the students realise it would be over 100 or use a different method altogether? This was something we felt we could see in the worksheet and iron out any problems in subsequent classes.