Lesson Details	Lesson Study Group
Name of lesson: Across the Divide **Topic:** The line as division **Year group:** Second Years **Level:** Common	**School Name & address:** Moyle Park College, Clondalkin, **Advisor:** Marilyn O'Riordan **Teachers:** Colin McCarthy, Roisin McGowan, Colm Dee

Research Theme

At Moyle Park College, a focus of our Strategic Development Plan is to improve student engagement and motivation with a view to increase uptake and attainment at HL. Being creative enhances student motivation. The development of the Digital Learning Plan can feed into creativity and motivation as we implement more digital strategies in the classroom.

As a Mathematics Department we value our professional development and have engaged in Lesson Study as a means of developing Collaboration within the department, which is also a focus of our Strategic Development Plan. To support student engagement through the means of creativity and new digital strategies, as Mathematics teachers we aim to:

- be creative in developing lessons that engage the students and motivate them to learn
- Work with teachers in other departments to identify the difficulties that students have with numeracy skills in their subjects
- encourage teachers to view collaboration as a means of enhancing their professional development and improve student learning

Background & Rationale

A whole school approach towards implementing Numeracy across the curriculum has provided some rationale for the topic chosen for this Lesson Study. To date there has been little engagement with developing numeracy across the school.

Currently our school is developing a Numeracy Committee and work is being done towards a whole school focus on Numeracy. Within the Mathematics classroom, teachers have noticed that students have difficulty with basic fractions and about what the line in a fraction actually represents. By distributing a survey to the whole school and gathering data on student and teacher understanding of fractions, the mathematics department hope to address these difficulties and encourage students to learn a variety of approaches and methodologies in the division of fractions so that it can be applied to problems involving simple fractions; speed, distance, time; the slope; BODMAS and algebraic fractions. The use of the calculator can enhance division of fractions.

As outlined in the Looking at our school 2022: A quality framework for Post-Primary schools document, highly effective practice is when '*teachers plan collaboratively for learning activities that enable students to make meaningful **and progressively more challenging** connections between learning in different subjects'* and when '*students demonstrate high levels of motivation, and **enjoy engaging in and persisting with** increasingly challenging tasks'.* The mathematics teachers at Moyle Park College will plan a research lesson that will move their students through the different stages of Bloom's Taxonomy while acquiring skills in fractions that can be applied and demonstrated through both the Junior and Senior cycles.

Relationship of the Unit to the Syllabus		
Prior Learning	**Current Learning**	**Future Learning**
p88 place value - read, write and order whole numbers and decimals - identify place value in whole numbers and decimals - round decimals	**N1** investigate the representation of numbers and arithmetic operations so that they can: **d** calculate and interpret factors(including the	**3.1 Number Systems** revisit the operations of addition, multiplication, subtraction and division in the following domains: •N of natural numbers • Z of integers • Q of rational numbers

- divide a four-digit number by a two-digit number, without and with a calculator

p89 fractions 2-12
- compare and order fractions and identify equivalent forms of fractions
- express improper fractions as mixed numbers and vice versa and position them on the numberline
- add and subtract simple fractions and simple mixed numbers
- multiply a fraction by a fraction
- express tenths, hundredths and thousandths in both fractional and decimal form
- divide a whole number by a unit fraction

p106-107
-explore value for money
- convert foreign currencies to Irish pounds and vice versa

highest common factor), multiples (including the lowest common multiple), and prime numbers

e present numerical answers to the degree of accuracy specified, for example, correct to the nearest hundred, to two decimal places, or to three significant figures

N2.investigate equivalent representations of rational numbers so that they can:
a flexibly convert between fractions, decimals, and percentages
b use and understand ratio and proportion
c solve money-related problems including those involving bills, VAT, profit or loss, % profit or loss (on the cost price), cost price, selling price, compound interest for not more

• R of real numbers and represent these numbers on a number line
- develop decimals as special equivalent fractions strengthening the connection between these numbers and fraction and place-value understanding
- calculate percentages

3.2 Indices
solve problems using the rules for indices

3.3 Arithmetic
solve problems that involve
• calculating cost price, selling price, loss, discount, mark up (profit as a % of cost price), margin (profit as a % of selling price)
• compound interest, depreciation (reducing balance method), income tax and net pay (including other deductions)
• costing: materials, labour and wastage

4.1 Expressions

	than 3 years, income tax (standard rate only), net pay (including other deductions of specified amounts), value for money calculations and judgements, 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)	-evaluate expressions given the value of the variables - add and subtract expressions of the form $$\dfrac{a}{bx + c} \pm \dfrac{p}{qx + r}$$
	N3 investigate situations involving proportionality so that they can: **a** use absolute and relative comparison where appropriate **b** solve problems involving proportionality including those involving currency conversion and those involving average speed, distance, and time	

| | AF2 investigate situations in which letters stand for quantities that are variable so that they can: **a** generate and interpret expressions in which letters stand for numbers **b** find the value of expressions given the value of the variables **c** use the concept of equality to generate and interpret equations **U1,2, 5-13** | |

Goals of the Unit

- To be comfortable working with fractions, decimals and percentage
- To develop students' problem solving skills in thinking ahead
- To be able to solve money related problems
- Solving problems involving proportionality and currency conversions
- To interpret bills linking with real life Mathematical problems
- To calculate percentage profit and loss
- To solve money related problems including those involving bills, VAT, Profit or loss, % profit or loss (on the cost price) , cost price, selling price, compound interest for not more than 3 years, income tax (standard rate only), net pay (including deductions), value for money calculations and

judgements, mark up (profit as a % of selling price), compound interest, income tax and net pay (including other deductions).

Unit Plan	
Lesson	**Brief overview of lessons in the unit**
1	Currency exchange and conversions. Spending money in a foreign country
2	Percentage profit and loss
3	Distinguish between the terms profit, loss, cost and selling price. Recognise how to work with ratios
4	Relationships between percentages fractions and ratios
5	Practice VAT calculations Reading electricity and phone bills
6	Distinguish between wages, salaries, Gross pay, Net pay, income tax, USC and PRSI
Research Lesson	Applying problem solving skills on an Arithmetic worded problem.

Goals of the Lesson
A problem was created so that students can demonstrate previous skills developed in financial maths. The goals of the lesson are to:

- understand the different ways that the operation of division can be asked in a worded problem
- apply previous knowledge to a real-life problem
- complete calculations relating to money
- calculate one quantity as a percentage of another
- calculate percentage profit
- comparison calculations to determine value for money
- apply formulas such as speed, distance, time
- currency exchange

Key skills:

<u>Being Numerate</u>: By engaging in suitable tasks, students will develop a positive attitude towards investigating, reasoning and problem solving.

<u>Working with Others</u>: Students will use the think,pair,share,square approach to learn from each other by discussing different approaches to problem solving.

<u>Communicating</u>: During Ceardaíocht, students will communicate their findings, discuss their mathematical thinking and question for understanding.

<u>Managing myself</u>: Students will have the opportunity to reflect on their own learning at the end of the lesson.

<u>Managing Information and Thinking</u>: Students will have to think critically when engaging with the worded task.

<u>Being literate</u>: Students will engage with a worded problem, explain their thinking and justify their reasoning using mathematical language.

Flow of the Lesson

| Timing, activities, steps, resources, problems	Teacher support, activity	Assessment, questions, comments, strategies
Introduction: (10 mins) Recap on individual theory. Speed,distance,time; currency conversions. What do you remember? Individual tasks. **Posing the task: (25 mins)** Introduce as a story, setting the scene and then give the sheet with three individual problems. Students are going to work through the task individually, pairs, square…	Quick quiz - timed activity with 7 quick questions which they can answer on whiteboards.	Students will write their solutions on the mini whiteboards and hold up the whiteboards so that the teacher can assess the solutions. Go over answers prepared on powerpoint. (Have visuals on the board)

	8	Explanation of the cheat sheet.
Ceardaiocht: (20 mins)		
Solution 1:		
Student has worked out percentage of amount, subtraction:	All solutions are going to be written on A3 paper for display purposes and then shown on the board.	Are students motivated to begin work on the problem? Is there understanding of what is expected of them?
1 a €15 x 0.2 = €3 or		
15/ 5 = €3 or		
15/100 x 20 = €3		
b €15 - €3 = €12		
Solution 2:		
Students can multiply and apply division from worded questions:		Observes students' interactions and discussions, noting any general misconceptions.
1 c €12 x 3 = €36		
d 36/1.13 = £31.86 or		
€1.13 = £1		
€36 = £X		
Solution 3:		Can a student explain back to the class what another student has done?
Students can understand the word 'per' and divide:		
2 a. £16.50 / 3 = £5.50		
Solution 4:		
Students who can apply speed, distance, time formula:		
Solution 5:		

Students who calculate the cost of A: 23/4 = £5.75 £23 - £5.75 = £17.25 **Solution 6:** Students who can calculate Offer B and the difference: 8.50 x 2 = £17 17/100 x 5 = 0.85 £17 + 0.85 = £17.85 17.85 - 17.25 = 0.60 **Solution 7:** Students who calculated the percentage left over. Total = 64.39 + 12 + 18 + 17.25 = 111.64 200 - 111.64 = 88.36 88.36 /200 x 100 = 44.18%	Students will write this on post-its and a google form.	
Reflection: (10 mins) Exit ticket to write down something that you learned today that you have not learned before.	Recapping and reinforcing ideas from the lesson.	Students will write up a reflection of what they learned from today's lesson. Students will also reflect upon any area of the lesson that they had difficulty with & / need more clarification on.

The "Will students be able to fill in the final sheet?" note appears in the right column aligned with Solution 6/7.

Board Plan

The board work captured the progression of students' learning throughout the lesson. It allowed students to explain their thought processes as they worked their way through the problem and it gave an opportunity for other students to question the different methods used to solve the problem. Students felt a sense of pride in displaying their work. Having their names attached to their contribution heightened their sense of achievement. Where written communication was minimal. oral explanations confirmed understanding of the problem.
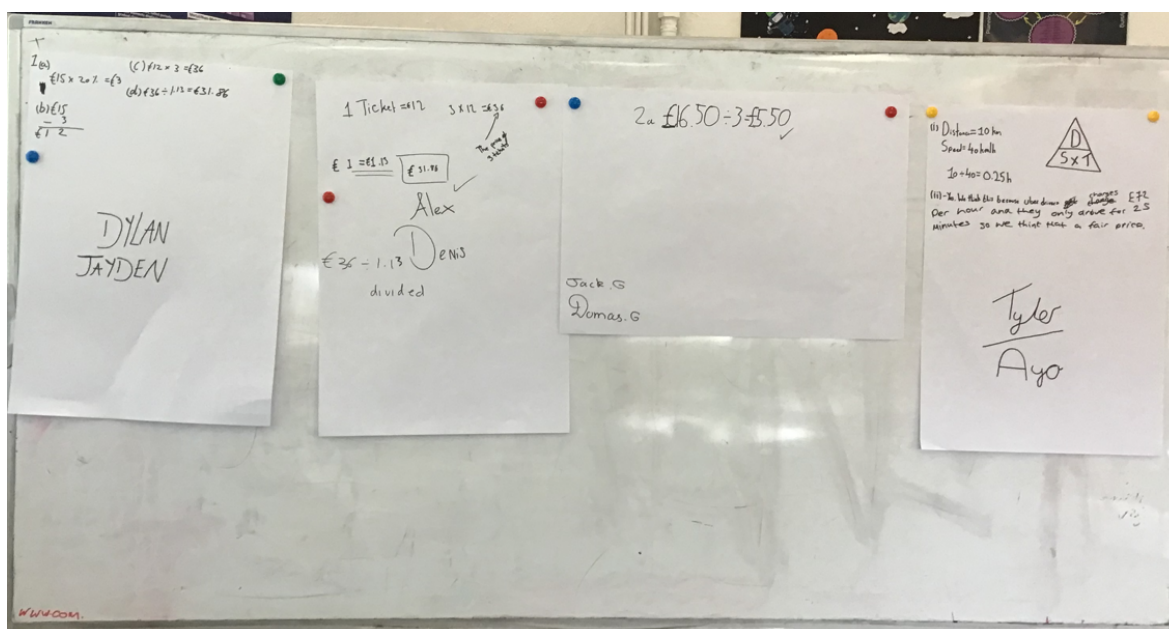
Evaluation of Lesson

From the outset students were engaged with the problem. Giving students an opportunity to work individually on the introduction and display their answers on mini whiteboards increased confidence. Some students were able to query answers that they were unsure about.

Once the task was introduced, students took time to read the problem posed but quickly moved into working with others as they were 'trying to understand the question'. Lots of discussions were had on how to find a percentage and trial and

error was used to verify answers when it came to currency exchange. This problem not only generated mathematical discussions but also got students talking about the real life context of the problem as well.

While working on this problem students fell easily into a collaborative way of working where they were confident to share their answers- 'let's understand this together' and question other students' work - 'And you got this how?'. Some students were unsure of their answers and sought clarification through comparing answers.

In order to facilitate a valuable post lesson discussion and reflection , observing teachers focused on retrieving information on student learning based on the following questions:

- Were students able to read the problem and understand what was expected of them?
- Did students work independently on the task?
- Did students ask questions and receive feedback from their classmates?
- Were all students engaged in the group work?
- Did students appreciate different ways of approaching problems?
- Were students able to communicate their workings on paper?
- Did students understand which operation to apply at different times when solving the problem?

Overall the main goals of the lesson were largely achieved but the misconceptions that arose around language such as 'three for two' will be addressed in subsequent lessons.

Summary of Key Learning	
Meeting 1	Familiarisation of the strategic plan of the school.
	A need to develop numeracy across the curriculum.
	Discussions on division led to what the line means for students.
	Find out how others are dealing with the division of the line.
Meeting 2	More discussion around the topic
	Concluded Financial Maths with 2nd years would be the preferred topic.
	Referred to specifications for prior, current and future learning.

| Meeting 3	Discussions were had around prior learning and the content of the research lesson, the size of the group, the type of problem that the students could manage. Group looked over teacher slides to complete the Unit Plan and worked on creating a problem for the class to solve in the live research lesson. Content of the problem was teased out and division aspects were discussed. Date of the live lesson was confirmed.
Meeting 4	Much discussion was had around developing the task e.g. how many parts should there be to the problem; what will the starter activity look like; what size the groups will be; how can students' motivation be sustained.
Meeting 5	Discussions and adjustments to the task. Give to students as three/four separate sheets. Planning the flow of the lesson - starter task, the task, ceardaiocht and reflection. Distribution of tasks to be completed before the live lesson - finalisation of question, board space, resources etc.

Final Reflection
While the mathematical focus of our lesson study was the dividing line , the ultimate purpose for engaging with lesson study was to improve teacher collaboration and enhance student learning experiences in our school. *Lesson observations:* Unanimously, both the observing teachers and the facilitating teacher agreed that student engagement in this activity far exceeded their expectations of what was anticipated prior to the live lesson. It was evident from the atmosphere in the room that the students enjoyed the group discussions and there were valuable mathematical conversations happening throughout the class. Students responded positively to the timing of each task and were ready to move on naturally to the next section of the task when guided by the teacher.

It was agreed that there was good use of mathematical language in conversations and students were able to express their thought processes orally. However, more work will be needed to develop written communication among students. While it was agreed that students were able to move through tasks in the time allowed, the overall planning of the lesson did not allow for students' extended conversations.
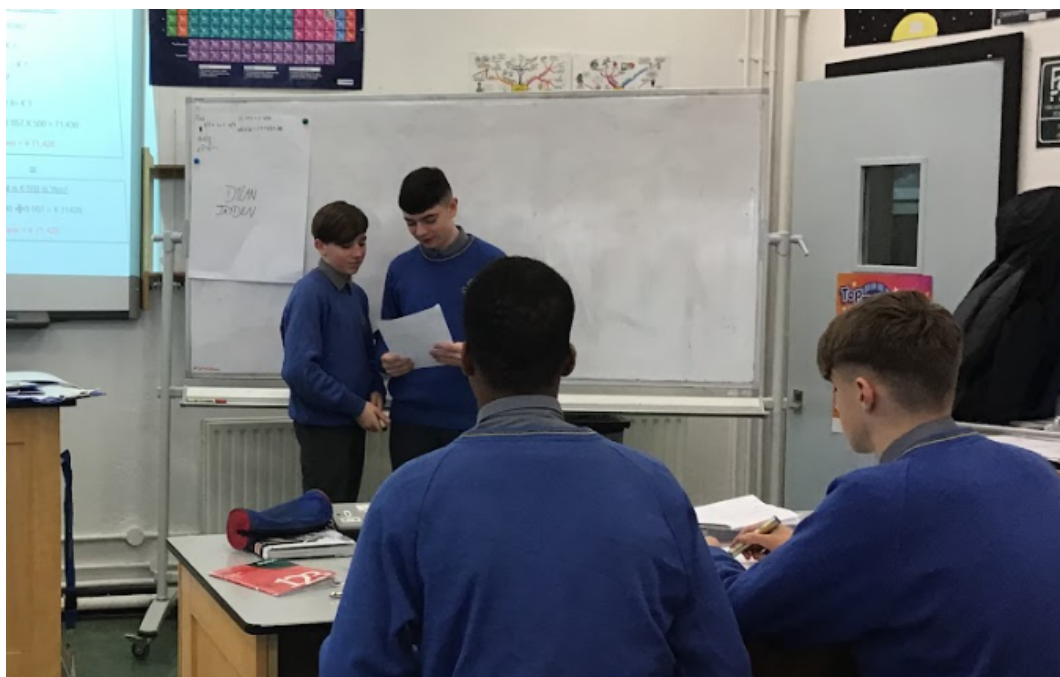

Future Study:
Teachers agreed that when carrying out this lesson with other classes that the content of what is to be achieved can be reduced without taking away form the overall goals of the lesson.

The value of group work for this lesson was so impactful that teachers would like to embed this approach to teaching into their own practices and across the wider school community.

Teacher felt that going forward more emphasis needs to be placed on written communication. By writing down their thought processes more clearly, students could retain understanding for longer periods of time.
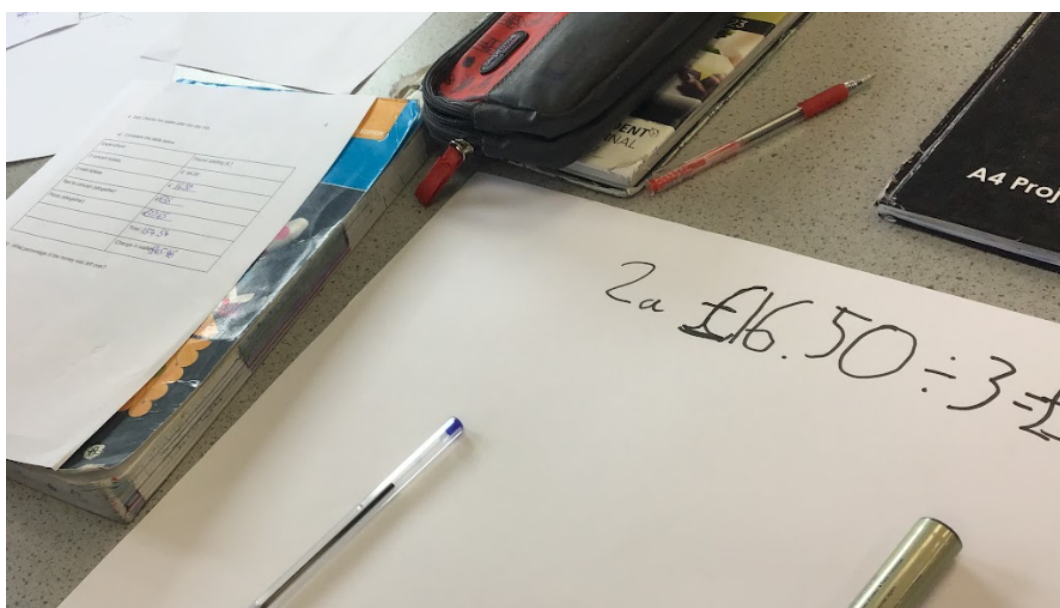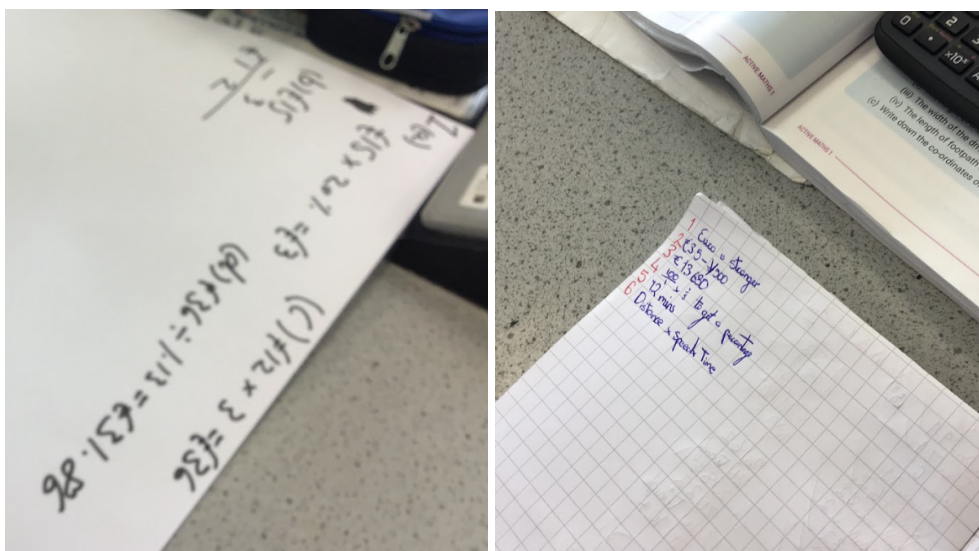
Lesson Study Process:

As a process, teachers felt that Lesson Study proved invaluable in building collaborative relationships among the Mathematics teachers. Having the space to share and explore new ideas which can lead to bigger learning was acknowledged as the most positive outcome. Being able to enhance student learning experiences

by discussing and understanding students' prior learning, as well as through collaborative planning of rich Mathematics tasks meant that teachers found value in Lesson study as a form of professional development and will engage in this process again.