

Enhancing problem-solving in mathematics through lesson study: Budgeting in the real world

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Abstract: This report presents a lesson study conducted with Year 3 students at St Francis of Assisi Primary School (Qawra) focusing on mathematical problem-solving and budgeting skills. The lesson study provided hands-on learning experiences using real money to bridge the gap between abstract mathematical concepts and real-world applications. Teachers collaboratively designed and trialled a lesson in which students engaged in budgeting within a fixed amount, integrating digital tools and cooperative learning strategies. Observations yielded valuable insights into student engagement, the influence of external observers, and the role of technology in mathematics learning. Reflections from both educators and students underscore the importance of collaboration, differentiated instruction, and building students' confidence in problem-solving. The report concludes with recommendations to improve future lesson studies and enhance student participation.

Keywords: Budgeting; lesson study; primary school students; problem-solving; real-life

Introduction

During the lesson, the students applied their 21st century skills as they used their critical thinking skills as they needed to budget their money appropriately to reach their goal, whilst communicating and collaborating during the process. The children interacted in teams and supported each other.

The problem posed was that of creating a 'Thinking of You' card (see Appendix 2), but first students had to 'buy' the objects needed to make this card within a budget of 99c. In this way students had to use their

reasoning skills to choose objects wisely and finding totals and change from 99c.

The research lesson

The lesson was chosen to expose the students to a real-life situation utilizing real money. Nowadays children are being brought up in a society where plastic money dominates real money.

Through problem-solving and mathematical computations, the students needed to budget the money provided to achieve the final product. This encompassed 2 tasks using concrete-pictorial-abstract (CPA) approach. This lesson also enabled the students to use hands-on approach as well as technological resources.

In this lesson, the teachers sought that students learn about the value of money and understand the concept of change, whilst planning an activity within a given budget. The following learning outcomes were targeted:

- I can handle small amounts of money in classroom situations (e.g. keeping track of money collected from small change for charity money collections).
- I can plan an activity within a given budget (e.g. using tickets, travel brochures, price lists, menus...).
- I can use receipts, simple menus, entrance tickets to work out totals and change.
- I recognise that prices marked as €0.99 are a marketing strategy to make prices more attractive
- I can use assistive technology (e.g. tablets & computers) and other resources (e.g. array cards, base 10 blocks, Cuisenaire rods, fraction wall, euro coins, ten frames, Unifix cubes) appropriate to this level to calculate and to learn about numerical calculations.

The lesson study context

The school

St Francis of Assisi Primary School (Qawra) forms part of Maria Regina College and is the largest primary school on the Maltese island. It accommodates around 990 students ranging from early years to year 6 from diverse cultural backgrounds fostering an inclusive learning environment.

The school strives to give its students a holistic educational experience through a friendly, safe, fun and eco-sustainable environment. The aim of the school is to cater for the individual needs of all students throughout the scholastic year whilst fostering a collaborative atmosphere where all stakeholders – children, parents and educators – are given their due consideration. Multicultural experience and a problem-based approach will assist students achieve their full potential and nurture the love towards lifelong learning.

The students

The achievement levels in this Year 3 class vary widely, with some students performing well above the expected grade level, while others are struggling to grasp fundamental concepts. This division can be influenced by various factors, including prior knowledge, learning styles, and external support. For the students who are excelling, maths can be a source of confidence, and they are often seen helping peers or tackling more complex problems. On the other hand, those facing challenges may feel overwhelmed, which affects their ability to keep up.

The most prominent challenge in this class seems to be a lack of foundational understanding for some students, which creates a barrier to mastering more advanced topics. Additionally, there are often challenges related to learning strategies; students who don't receive individualized attention or differentiated instruction can find it hard to keep pace with the curriculum. These gaps in learning may be a result of inconsistent instruction, differing home environments, or various learning difficulties. Maths anxiety also plays a significant role, as students may develop negative feelings about the subject due to past failures.

This class was chosen for its dynamic mix, providing a unique opportunity to observe how students at different achievement levels interact with the material and each other. By focusing on this group, it becomes possible to develop and implement strategies that cater to a range of needs whether it's providing extra support to those struggling or offering enrichment for advanced students. The goal is to foster a more inclusive learning environment where all students can experience success and begin to build more positive associations with Maths.

The team members

Name	Role at school	Role in lesson study
Miriam Chetcuti	Head of Department (Maths)	Facilitator
Amanda Cilia	Maths Support Teacher	Facilitator
Nadine Cauchi Briffa	Teacher	Team member + taught the 1 st lesson trial
Natasha Calleja Decelis	Teacher	Team member
Daniela Farrugia	Teacher	Team member
Christine Tanti	Teacher	Team member
Matthew Joe Spiteri	Teacher	Team member + taught the 2 nd lesson trial
Ruth Vella	Teacher	Team member
Maria Grima	Deputy head of school	Team member
Moira Xuereb	Deputy head of school	Team member
Connie Bonnici	Digital Literacy Support Teacher	Knowledgeable other
Marica Saliba	Head of Department (Digital Literacy)	Knowledgeable other



The lesson study process

The meetings

Date	Points discussed
19/11/2024	<ul style="list-style-type: none">• Discuss rules and roles• Discuss the 'research focus' and identify ways of gaining a better understanding of the focus• Explore what is teaching through problem solving
25/11/2024	<ul style="list-style-type: none">• Discussing and deciding upon the teaching through problem solving aspect to focus on during the lesson study
26/11/2024	<ul style="list-style-type: none">• Make a timeline• Distribute roles• Discuss the 'research focus' and identify ways of gaining a better understanding of the research• Go through the lesson plan template
03/12/2024	<ul style="list-style-type: none">• Discussing the research focus• Deciding on the task/problem to use for the lesson study
04/12/2024	<ul style="list-style-type: none">• Identify the class in which the lesson study will take place• Go through all the 'research focus' and decide which is the most suitable for the selected class• Discuss the possibility of having a videographer during the delivery of the lesson
10/12/2024	<ul style="list-style-type: none">• Discussing the main activity.• Discussing the steps to follow in the lesson plan
08/01/2025	<ul style="list-style-type: none">• Continue working on the Lesson Plan
09/01/2025	<ul style="list-style-type: none">• Meeting with Ms. Marica, Digital Literacy Support Teacher, to work on Task 2 activity
16/01/2025	<ul style="list-style-type: none">• Discuss and go through the digital task created by the digital literacy support staff
21/01/2025	<ul style="list-style-type: none">• Going through the online task – is there a need to repeat the physical and online task?• Suggest giving one tablet per group, students work simultaneously using tablet and physical worksheet.• Going through the Lesson Plan
23/01/2025	<ul style="list-style-type: none">• Working on the lesson plan and amending as per feedback sent by Ms. Amanda and Ms. Miriam.• Amending the worksheet as per feedback sent by Ms. Amanda and Ms. Miriam
24/01/2025	<ul style="list-style-type: none">• Discuss online game and worksheet• Add lesson details

The problem-solving task

Maths Word Problem

You need to create a 'Thinking of you' card for the children in care homes.

You have a budget of 99c to be spent on stationery to design the card.

Find the **total cost** of the items chosen and write the answer.

Work out the **change** from 99c.

Grade 4 - Year 3 Term

Steps to solve a Maths problem

Understand
Read the problem
What am I looking for?
What do I know?

Plan
Choose a strategy

Answer
Show all your work
Label your answer

Check
Explain & Justify

The lesson plan

<i>Phase 1: Introduction</i>	
<p><i>How will the lesson be introduced? What will you say and/or do to get them interested?</i></p>	<p>Initiate the lesson by enquiring the students if they ever used money in their real-life and their experiences with it.</p> <ul style="list-style-type: none"> • <i>Have you ever used real money at a shop?</i> • <i>What was your experience whilst using it?</i> • <i>Those that didn't use real money, tell us why?</i> • <i>Do you usually spend all your money or less? (stay within budget).</i> <p>Think-pair-share their experiences.</p> <p>Following, the students' feedback the teacher will lead the lesson into the scenario. The scenario will be introduced by viewing a short 30 second video clip about the Children in care homes. The video will expose the students to the life inside one of the children care homes in Malta. Following this, it will explain to them how we can make them feel more loved and included in the community.</p> <p>The educator will exhibit and explain the learning intention on the PowerPoint as well as the whiteboard:</p> <ul style="list-style-type: none"> • The value of money • The concept of change • Planning an activity within a given budget <p>Consequently, the Maths word-problem will be presented and discussed with the class. Furthermore, the problem will be written on the whiteboard and shown on the PPT.</p>

	<p>Maths word problem</p> <p>You need to create a ‘Thinking of You’ card (see Appendix 2) for the children in care homes.</p> <p>You have a budget of 99c to be spent on stationery to design the card.</p> <p>Find the total cost of the items chosen and write the answer.</p> <p>Work out the change from 99c.</p>
<p><i>What difficulties might students encounter?</i></p>	<p>Some of the students might have never been exposed to real money, but mostly plastic money or nothing at all. They might not know the actual value of the coins. The total value of the coins against the quantity of the coins. To be able to choose the best value for money and stay within budget.</p>
<p><i>How do you intend to address these difficulties?</i></p>	<p>Use prompting questions:</p> <ul style="list-style-type: none"> • How you decide which coins you should use? • What will you do if you notice that you do not have enough money? <div data-bbox="557 1055 1248 1570" data-label="Image"> </div> <p>Expose the students to real money while doing hands-on Explain the value of the coins (visual of coins on the ppt, coin flashcards, coins in a container and poster) Showing them a jar with coins of 1c versus a jar with 10c coins and emanate the answers from the students Whilst arranging the coins from smallest to largest in pairs</p>

Phase 2: Students' work

How will students work? Will they be involved in individual work? Or will they be asked to work in pairs or within a small group of 3 or 4 students? Explain how this will be done.

The students will be doing the tasks in 4 separate groups. Each group will have 4 students of mixed abilities and whom will be working collaboratively.

The task will have an approximate time of 15 minutes. First each group will be given a learn pad, and the students need to scan QR Code 1. The QR Codes will be both presented in the PowerPoint. The online game will reflect the hands-on activity.

The teacher will explain and demonstrate the rules of the game. The game will consist of:

- Selecting the stationery items that they wish to use for the 'Thinking of You' Card. Such items need to be dragged to the trolley side.
- The items that are not needed for the card will be dragged to the shop side.
- The students will have a budget of **99c**, and they cannot exceed it.

During the activity the students need to use the whiteboard to work the Maths problem and to refer to it for QR code 2.

As soon as the activity is completed, each group needs to take a screenshot of their work.

Following the above, the group will scan QR Code 2.

This will consist of an online worksheet, which the group must fill in according to the items chosen in QR Code 1 (refer to their whiteboard). They need to fill the quantity, the total cost per item, the total cost of the card and the change. The workings can be done on the mini whiteboard. A screenshot will be taken again to be presented during the discussion stage.



Following the online task, each group will go for the hands-on activity. The group needs to select any stationery items that they have on the desk to assemble a 'Thinking of You' card for the children's care home. The stationery chosen can be different than that chosen in the previous activity.

A sample of the card will be shown to the kids.

	<p>The group will have all the stationery on their desks, with price tags. They need to choose the best value for money when buying the stationery within their budget.</p> <p>They will have real money to use. In the purse they will have a budget of 99c – made up of different coins.</p> <p>A team member will be selected to act as a cashier and handle the purchase of the items, whilst the entire group discuss and handle the change.</p> <p>The group will use the white board to add or subtract the items chosen to be able to purchase them and calculate their change.</p> <p>A worksheet will be utilised for the kids to tick the items, insert the quantity per item, insert the total quantity and check if they will have any change. All workings will be shown.</p> <p>The worksheet will have a challenge box. This will include a picture of a real receipt, and the students need to draw the coins to show the amount on the receipt, using the least possible number of coins.</p> <p>Page 2 of the worksheet will consist of a task in which the students have to choose different stationery using the same amount of money. This task will be targeted for the high ability students.</p> <p>Questions during the main task:</p> <ul style="list-style-type: none"> • What do you need to keep in mind while choosing the stationery items? Why? • Is it important to check the price tags? Why? • Can you give less money than the total price? Why? • Can you give more money than the total price? Why? <p>To conclude the tasks, each group will have to present their online work as shown from the screenshot, as well as their hands-on worksheet activity. The educator will write the totals and change of each group on the whiteboard to demonstrate to the class if there are any mistakes.</p> <p>Additionally, they will explain their outcome.</p>
<p><i>What difficulties might students encounter with the set task/s as they start working on it?</i></p>	<p>The challenge of the value of coins, during the online game and the hands-on activity.</p> <p>Maths computations, whilst adding the coins and subtracting for the change, as well as to understand the word problem.</p> <p>Some students might need very basic instructions to be able to follow through with the tasks given.</p>

	<p>Teamwork; communication; collaboration (highflyers will take over the students with lower abilities).</p> <p>More time might need to be allocated to the task for some students to be able to finish the activity.</p> <p>Not all the students might agree on the design and items chosen to create the 'Thinking of You' card.</p> <p>Over excitement when using the learn pad and whilst playing the online game, especially since they are in year 3 and they do not yet have a learn pad.</p> <p>Technical difficulties, such as faulty learn pad, no internet connection or issues arising with the QR Codes.</p> <p>They might be shy to present their work, due to fear of public speaking.</p>
<p><i>How do you intend to address these difficulties? What kind of help do you intend to provide?</i></p>	<p>Pre-done activities and explanation will address the challenge of the value of coins and using real money.</p> <p><u>Maths computations</u>: assistance will be provided by the class educators whilst the students will be working in a team and supporting each other.</p> <p>Problem solving strategies such as the bookmark resource (see Appendix) will be used in each group.</p> <p><u>Teamwork</u>: Outspoken students might hinder the proper collaboration and teamwork; hence the educator will set up the groups with mixed abilities for better sharing of skills. The educator will constantly monitor smoother collaboration within the team.</p> <p><u>Time</u>: the educator will show a timer on the interactive board as well as reminding them verbally.</p> <p><u>Design disagreement</u>: the educator encourages the skill to compromise and reach a solution, by posing some suggestions.</p> <p>The educators must demonstrate the use of the learn pad during the explanation. Furthermore, the students will have been exposed to other online games on the same learn pad.</p> <p>If technical difficulties arise all groups will do the hands-on activity and complete the task 2 on the worksheet.</p> <p>The educator will facilitate the process, with constant support and motivation, as well as support from their team.</p>

<i>Phase 3: Summary and closure</i>	
<i>How do you intend to bring the lesson to a closure?</i>	<p>The educator will use the exit cards. Consequently, the educator will ask:</p> <div data-bbox="580 434 1219 1032" style="text-align: center;"> <p>3 Things I learned today</p> <p>2 Things I want to learn more</p> <p>1 Question I have</p> </div> <p>The conclusion will take around 5 minutes.</p>
<i>What difficulties might students face during this phase of the lesson?</i>	<p>The students may demonstrate that they didn't understand parts of the lesson.</p> <div data-bbox="568 1216 1238 1715" style="text-align: center;"> </div>
<i>How will you try to address these difficulties?</i>	<p>The educator will ask the students to re-explain and demonstrate any difficulties mentioned, while facilitating the process to address such challenges, with constant support and motivation.</p>

Post-lesson reflections

A challenge faced by teachers: Due to the large group size, it was challenging for teachers to meet all together. Despite the Senior Leadership Team (SLT) doing their best, this was not always possible. One participant felt that she missed out on some of the important steps of the lesson study due to this.

Thinking outside the box: Teachers met online to keep everyone updated as much as possible, turning the best from the worst situation.

Teachers' feedback following the delivery of the lesson: The students enjoyed using tablets, which was a positive aspect of the lesson. They were very eager to participate during this part. However, students were not their usual selves, appearing shy and possibly pressured by the presence of many observers. The teacher delivering the lesson felt that the lesson did not flow as expected. Student participation was not as high as during usual lessons. Students were unusually quiet and passive.



Student engagement: Students were engaged, understood the value of money, and learned about budgeting. They focused most of the time and looked forward to the activities. Passive students and those finding the concept challenging were helped by other group members. The tablets kept the students very engaged.

Lesson's intention: The lesson was designed to be delivered by different teachers. Although the students were quiet, they were able to stick to a budget, do the necessary computations, and work in teams without disagreeing.

Teacher's dilemma: The teacher delivering the lesson felt unsure about making changes during the lesson delivery to some parts of the lesson since the process to plan the lesson was a team effort.

Success of the bookmark: The bookmark was successful and will continue to be used in the future. It was agreed that each student should have a bookmark for individual use during problem-solving in mathematics.

Main takeaways

Reflections and adjustments: If the lesson was to be redone, the teacher would separate the tablet activity and the following activities over two days to avoid rushing and thus have more time for the hands-on activities, including using and handling the actual coins. The tension from having many observers and a videographer was felt by both the teacher and the students, affecting the lesson delivery.

Recommendations: Introducing the observers to the students before the lesson could help them feel at ease and understand the observers' purpose. Success criteria for group work should be better explained, not only for mathematics. Teachers should communicate their expectations during group work, how to work in groups, and the value of giving and challenging ideas within a group.

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University of Malta



UNESCO Office in Venice



Huawei Technologies



Appendices

Appendix I – Bookmark

Steps to solve a Maths problem

Understand
Read the problem.
? What am I looking for?
Highlight the question.
K What do I know?
Circle the keywords and numbers.

Plan
Choose a strategy.
• Draw a Picture or Make a Table


Answer
Show all your work.
Label your answer.

$$\begin{array}{r} 3 \\ +5 \\ \hline 8 \end{array}$$
 Crayons

Check
Explain & Justify

Is your answer REASONABLE?

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Appendix 2 – 'Thinking of You' card

Handling money by planning an activity with a given budget, recognise prices marked €0.99 and using receipts while giving change as necessary.

Group Number: _____

Creating a 'Thinking of You' Card.

You have a budget of 99c to be spent on the stationery below to create a 'Thinking of you' card. Find the total cost of the items chosen and write the answer.

Item	Price	Quantity of each item	Total Amount in cents
	15c each		
	1c each		
	20c each		
	2c each		
	10c each		
	5c each		
			Whole Total
<div style="border: 1px solid black; padding: 5px; display: inline-block;"> Work out the change from 99c and write your answer </div> ➔			Change



Draw the coins to show the amount on the receipt using the least number of coins possible.

Handling money by planning an activity with a given budget, recognise prices marked €0.99 and using receipts while giving change as necessary.



Option 2

Choose different things using the same amount of money.

Task 1:

I have 99c in my pocket. What different things can I buy with this amount?

Task 2:

If I want to make two cards, how much money do I need to spend?



Well done!

Now go back and check your work!

