Lesson Research Proposal for 2nd Year Maths

For the lesson on 26th January 2018, Ms.O'Farrell's class, Coláiste na Toirbhirte, Bandon.

Lesson plan developed by: Lorna O'Farrell
Margaret Barrett
Sharon Kingston
Bernice O'Leary

1. Title of the Lesson: Make Up Money

2. Brief description of the lesson

In this lesson students will solve a problem involving saving money. They will be encouraged to use a variety of approaches to arrive at the solution. It will be expected that students will use trial and error, arithmetic, tables and graphs as well as drawing on their understanding of Functions, Algebra, Coordinate Geometry and Patterns.

3. Research Theme

At Coláiste na Toirbhirte we would like :

a)Students who reflect on their progress as learners and develop a sense of ownership of and responsibility for their learning.

b)Teachers who select and use planning, preparation and assessment practices that progress students' learning.

As mathematics teachers we will actively support the development of these goals by paying attention to the following entry points in our everyday classes.

a) Choosing problems which will encourage motivated engagement

Attempt to present problems that interest our students, thereby motivating them to engage with the process and stimulating them to consider the mathematical thinking they have engaged in.

b) Preparation is key

Carefully spend time considering our lesson content, preparing the structure of the lesson and the board work to be used and use Assessment for Learning techniques to ensure progress for all students.

4. Background and Rationale

Topic: Making connections between Functions, Algebra, Coordinate Geometry and Patterns.

a) Why we chose this topic.

This lesson is aimed at second year students. The teaching of functions is important subject material from the point of view that it brings together previously learned materials and extends students understanding of them to an even deeper level. At this stage students will have studied Coordinate Geometry, Patterns and Algebra and this provides an opportunity to link these topics to the concept of Functions. The link between these four topics is not often explored.

Students experience difficulty in changing 'real' situations into mathematical statements. Seeing the links which connect Patterns to Algebra and studying these under the lens of Functions should improve understanding. This understanding should be further enhanced by graphing and recognising the correspondence between Functions and Coordinate Geometry. By second year differences in students' abilities become more pronounced and different learning styles are recognisable. This approach will accommodate a differentiated teaching and learning styles.

b) Research Findings

Through discussion, the Maths Department realise that our teaching in general is imbalanced towards procedures and we do not always establish the clear links between topics.

In designing the research lesson we believe that it is important to engage students enthusiastically with exploring and discovering these links for themselves.

It is important to give students the opportunity to solve problems using a variety of methods. This will instil the confidence in students to persist with a problem they might have otherwise given up on.

5. Relationship of the unit to the syllabus

Related prior learning Outcomes	Learning outcomes for this unit	Related later learning outcomes
The Primary School Mathematics curriculum encourages children to recognise patterns from an early stage in their learning and continues this through to sixth class. In **first through to sixth class** students learn to: • *Recognise and create mathematical patterns and relationship.* • *Apply concepts and processes in a variety of contexts.* • *Select and apply appropriate strategies for completing a task or solving a problem* • *Justify the processes and results of mathematical*	Connect the idea of Functions to the earlier concepts of Algebra, Coordinate Geometry and Patterns. If a student can develop a firm understanding of linear Functions then they will be able to transfer the skills into many areas of the course. The application of these skills are seen throughout Functions, Algebra, Coordinate Geometry and Patterns. This lesson was developed in line with the general objectives as described in the Junior Certificate Syllabus. a) They should have an ability to recognise patterns relationships and structures. b) They should be able to	**In third year** we review and extend second-year work to include: • Quadratic Patterns, Functions, expressions and equations • Recognition of exponential functions • Transformation of functions In Senior Cycle we review and extend Junior cycle work to include: • Cubic patterns, functions, expressions and equations

activities. In **First Year** Students learn that: • The topics and strands should not be treated in isolation; where appropriate, connections should be made between them. Students examine patterns and the rules that govern them and so construct an understanding of a relationship as that which involves a set of inputs, a set of outputs and a correspondence from each input to each output. Students examine relations derived from some kind of context – familiar, everyday situations, imaginary contexts or arrangements of tiles or blocks. They look at various patterns and make predictions about what comes next.	translate information presented verbally into mathematical forms and present it in different ways. c) They should engage with the concept of independent variable as an input and dependant variable as an output. The mathematics syllabus also states that students should learn a number of key skills when studying mathematics, irrespective of the content. These include: – explore patterns and formulate conjectures – explain findings – justify conclusions – communicate mathematics verbally and in written form – apply their knowledge and skills to solve problems in familiar and unfamiliar contexts – analyse information presented verbally and translate it into mathematical forms – devise, select and use appropriate mathematical models, formulae or techniques to process information and to draw relevant conclusions.	• Log and Exponential functions • Further transformation functions

6. Goals of the unit

a) Students will understand that some types of problems can be solved using a variety of methods.
b) Students may apply their prior knowledge of Functions, Algebra, Coordinate Geometry and Patterns to write the relationships as mathematical statements and to represent them in tables and graphs.
c) Students will understand that situations involving linear relationships may be expressed in a variety of ways.

d) Students will understand the characteristics of Functions, in terms of inputs and outputs and/or independent and dependent variables.
e) Using their prior knowledge, students should be able to extend their approach to deal with a greater variety of problems.

7. Unit Plan

Lesson	Learning goal(s) and tasks
1	Describe visual patterns in relation to position and repetition. Describe number patterns introducing the concept of the first term being position 1(Term 1)
2	Display the number pattern in table form. Introduce General Term of a Linear Pattern Relate this back to Linear Expressions in Algebra and to Coordinate Geometry of the line.
3	Use the General Term to find specific terms. The idea of variables and constants in relation to Algebra and slope and y intercept in the area of Coordinate Geometry can also be connected here.
4	Introduce Functions, mapping inputs(Domain) to outputs(Range)
5	Introducing the notation necessary to represent Functions and use the terminology of input and output.
6	Introduce Graphing of Linear Functions using a table for representation.
7	Link the graph of Linear Functions to Coordinate Geometry of the Line.
8 The Research Lesson	**Problem: 'Make Up Money'** Sinead has €12 in her piggybank. She decides to save €5 euro extra each week. How many weeks will it take her to save for a Jaclyn Hill palette which costs €52. Solve in as many ways as you can. Students will understand that situations involving linear relationships may be represented in a variety of ways.

8. Goals of the lesson

a) Mathematical Goals

1. Students will understand that situations involving linear relationships may be represented in a variety of ways.
2. Freedom to explore different ways of solving a problem gives students the opportunity to develop confidence in their own abilities.

b) Key Skills and Statements of Learning

In the planning and design of this lesson the Junior Cycle Key Skills and Statements of Learning have been considered. This lesson will implement and promote JC Key Skills in the following ways:

1. Being Literate: Students will have the opportunity to express their ideas clearly and accurately.

2. Being Numerate: Students will see patterns, trends and relationships.
3. Managing Myself: Student's will have the opportunity to reflect on their own learning.(tell the missing student what happened in the lesson)
4. Staying Well: Students' confidence and positive disposition to learning will be promoted.
5. Communicating: Students will present and discuss their mathematical thinking.
6. Being Creative: Students' will explore options and alternatives as they actively participate in the construction of knowledge.
7. Working with Others: Students will learn with and from each other and respect difference perspectives.

This lesson is also designed to meet the following JC Statements of Learning in particular:

1. The student communicates effectively using a variety of means in a range of contexts.
15. The student recognises the potential uses of mathematical knowledge, skills and understanding in all areas of learning.
16. The students describes, illustrates, interprets, predicts and explains patterns and relationships.
17. The students devises and evaluates strategies for investigating and solving problems using mathematical knowledge, reasoning and skills.

9. Flow of the Research Lesson:

Steps, Learning Activities Teacher's Questions and Expected Student Reactions	Teacher Support	Assessment
Introduction Today you are each going to use your mathematical knowledge to solve a problem. You're going to try to solve the problem by yourselves in as many ways as you can. Then we're going to come together as a class and look at all your methods. I want you to think about the topics that have been covered to date. **What are the topics that we have covered in second year so far?** Algebra, Functions, Patterns, Coordinate Geometry		Do students look interested? Are the students identifying the topics covered?
Posing the Task: Make Up Money Sinead has €12 in her piggybank. She decides to save €5 euro extra each week. How many weeks will it take her to save for a Jaclyn Hill palette which costs €52. Solve in as many ways as you can. Let's go over the problem. ▪ How much has she now? €12	Use PowerPoint on the board as an illustration to make the meaning of the problem easier to understand. Have the problem available for students to paste into their	Do students understand the task?

<table>
<tr>
<td>

- How much does she save per week?
€5
- How much will she have by next week?
€17
- Do you agree with this answer? Why?

- Will she have enough in 3 weeks? No
- Do you agree with this answer? Why?
- How many ways do you think that this problem can be solved?

</td>
<td>copybooks

Distribute the sample money, a copy of the problem and paper to students.</td>
<td>Are students eager to solve the problem?</td>
</tr>
<tr>
<td>

Student Individual Work
<u>Student Response 1:</u> “Manipulating Money”

Students count out the money representing each week.


<u>Student Response 2:</u> “Using Arithmetic”
Because the amount grows by €5 at a time
Week 1 12 + 5
Week 2 17 + 5= 22
Week 3 22+5 = 27
Week 4 27+5 =32
Week 5 32+5=37
Week 6 37+5=42
Week 7 42+5=47
Week 8 47+5=52

Or
52-12=40
40/5=8

<u>Students Response 3:</u> “Using a Table”

Week Number	Total
1	17
2	22
3	27
4	32
5	37
6	42
7	47
8	52

<u>Student Response 4:</u> “Solving an Equation”
Students form an Algebraic expression

</td>
<td>

The teacher makes class rounds looking for good examples of the various methods and notes the order in which she will need to call students to the board.

Students who are stuck might need encouragement and students who finish early can be encouraged to try other methods.

Students who are manipulating actual objects and using a table could be asked: “Are there any faster methods to solving the problem?”

Other students, who are using arithmetic could be asked: “Can you think of a way the contents of the piggy bank could be directly expressed in a mathematical equation?”

Students might be reminded to consider the use of patterns as another method for representation of the problem.

</td>
<td>

Are students able to tackle the problem?
Do the manipulatives help students gain insight into the problem?

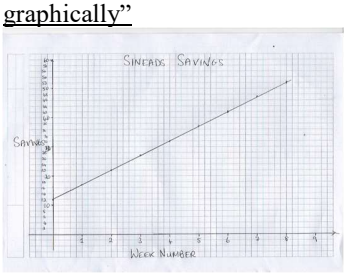
Do students understand that the difference between each week’s balance increases by 5 euro?

Are students able to provide more than one method of finding the solution?

Can students convert the word problem into a mathematical expression/equation?

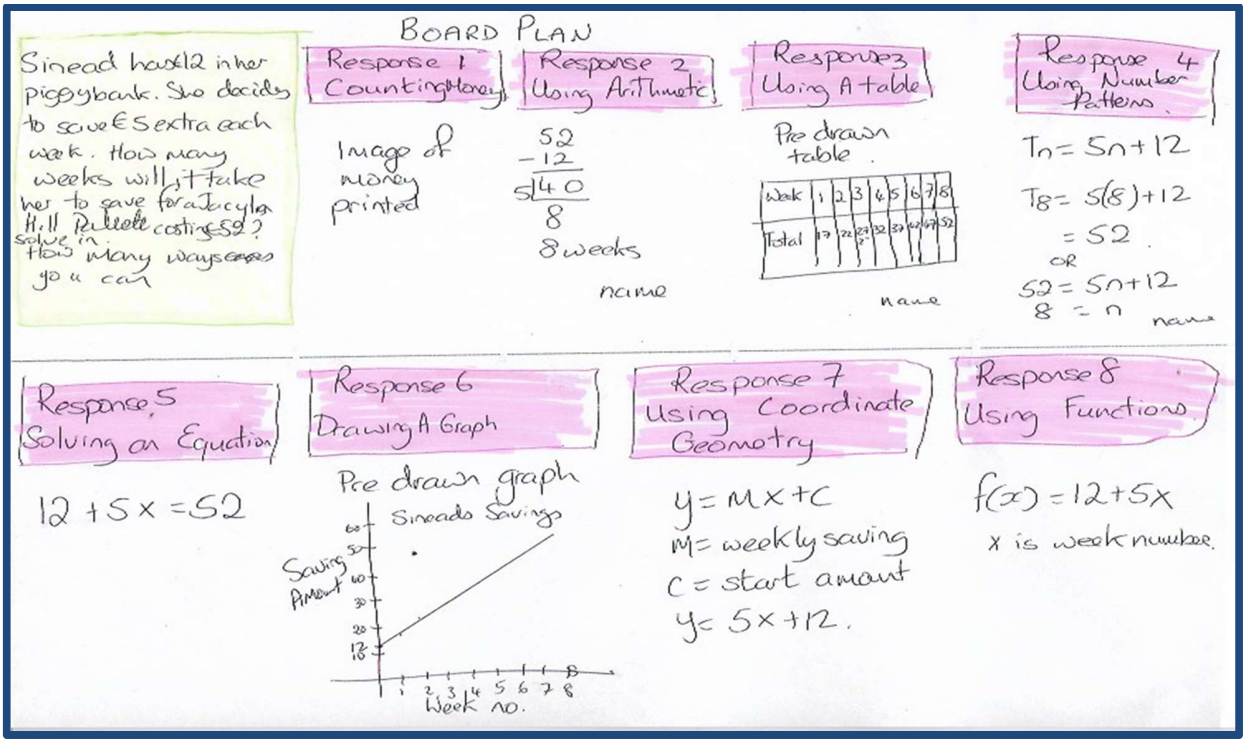
Can students recognise the pattern in this

</td>
</tr>
</table>

12 + 5x where x is the week number and equate it to 52 Student Response 5: "Using number patterns" Students represent the weekly saving as a linear sequence and generate a general term $T_n = 12 + 5n$ where n is the week number. Student Response 6:"Representing the savings graphically"  Student Response 7: "Writing the savings as a function" f(x) is the function representing the amount of money that is in Sinead's piggy bank at the end of each week f(x) = 12+5x where x is the week number Student Response 8: "Using Coordinate Geometry" y = mx + c represents the amount of money that is in Sinead's piggy bank at the end of each week		problem?
Ceardaíocht /Comparing and Discussing Response 1: "Manipulating Money" Response 2: "Using Arithmetic" Response 3: "Using a Table"	For each method a student who used this method is called to the board and asked to explain their use of it to the rest of the class. Remaining students are asked who also used this method. A student who did not use this method is then asked to explain back to the class their understanding of the method. Response 1 and 2. Did many people use this method? Why?/Why Not? Would it always be a good method to use? Response 3. Why did you choose to draw a table?	Are students explaining their own ideas? Are they engaging with each other's ideas? Can students recognize similarities between solution methods?

Response 4: "Solving an Equation" Response 5: "Using number patterns" Response 6:"Representing the savings graphically" Response 7: "Writing the savings as a function" Response 8: "Using Coordinate Geometry'	Response 4. What prompted you to choose algebra? Will we always get the correct answer using algebra? Response 5. Was it easy to see the pattern? If you were to draw this pattern what would this look like? Response 6. How did drawing a picture make the problem clearer? Response 7. Do you all have the same function? Response 8. What do the m and the c correspond to in this equation	
Summing up & Reflection We learned that: • situations involving linear relationships may be represented in a variety of ways • there is a link between Functions, Algebra, Coordinate Geometry and Patterns Ask students to write a reflection	The teacher may use the layout of the board work to help provide students with a summary of the progression in their learning. (the eight responses will be on the board) Question: Let's say we change the situation slightly. Instead of buying the palette Sinead continues saving for a holiday to Disneyland costing €2000. How many more weeks will it take her to save this amount? Would you stay with the approach you adopted initially or on the basis of all these options that you see on the board, would you take a different approach? Students will be given a page of paper with the following written on it: *Gemma was absent today, write to Gemma to explain to her what learning she missed from class today.*	Do students' reflections represent the teacher's intended Learning Outcomes for the lesson?

10. Board Plan



11. Evaluation and Reflection

Q.1 Were the goals and research theme of the lesson met?

- All: yes they were. This can be seen from observing the class but especially be seen from the students' reflections.

Q.2 What methods did the students use?

- From our lesson proposal, all of the methods were used, except one – Functions.
- Students didn't apply functions to the question.

Q.3 What comments or questions did the students have?

- Some students wanted reassurance that their method was correct, asking "Am I right?".
- However, most students were very happy to follow instruction and to try as many methods as they could think of.

Q.4. What were the common misconceptions and misunderstandings?

- Some students made the mistake of starting at (1,12) with resulted in 9 weeks, instead of starting at (0,12) which resulted in the correct answer of 8 weeks.
- This happened on the graph also.

- It was noted that Lorna's language was very good when testing the students before they began, prompting them by saying variations of "after one week, how much will she have in her piggy bank?"
- Some students struggled with the scaling of the axes and deciding on which one to put the domain and range

Q5. How and when did the students understanding change?

- When they tried the different methods.
- As the class progressed, the board work grew and students' learning was evident.

Q6. Did the students' presentation and discussion promote their thinking and learning? Definitely!

- Lots of variety, with student participation instead of teacher all of the time
- Shy and weak students got the opportunity to present which promoted their teaching and learning.
- Stephen: "Students were very good at presenting"
- It was noted that there could be "more over and back" between the students.

Q7. Was the flow of the lesson coherent?

- Structure was excellent.
- Great Flow
- Great planning and very well executed.

Q8. Did the students display a positive disposition?

- Students were very positive. They kept trying to come up with new methods to solve the problem.

Q9. Did the activities support the goals?

- Yes, the goals outlines in the lesson proposal ere met, preparation was key to this.
- The real life problem was engaged.

Appendix 1: PowerPoint Image

Sinead has €12 in her piggybank. She decides to save €5 euro extra each week. How many weeks will it take her to save for a Jaclyn Hill palette which costs €52.

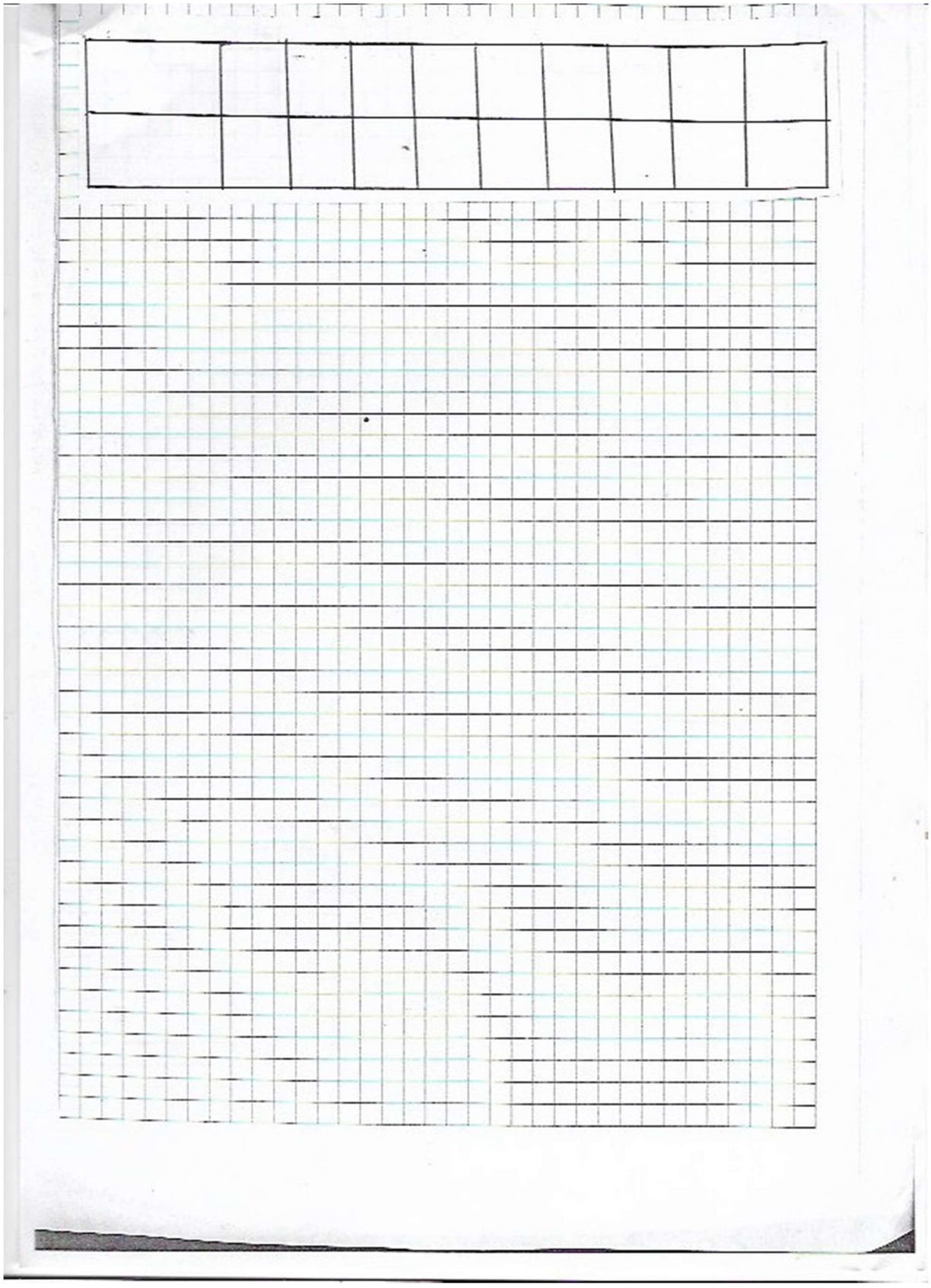
Solve in as many ways as you can.

Appendix 2: Student Documents

Sinead has €12 in her piggybank. She decides to save €5 euro extra each week. How many weeks will it take her to save for a Jaclyn Hill palette which costs €52.

Solve in as many ways as you can.

1



Reflection:

Gemma is absent from school today.

Write a text to Gemma outlining what you learned in Maths class.

Appendix 3: Homework Question

HOMEWORK QUESTION

Instead of buying the palette Sinead continues saving for a holiday to Disneyland costing €2000.

How many more weeks will it take her to save this amount?

Appendix 4: Final Board Image