

Lesson Research Proposal for 3rd Year Foundation/Ordinary Level, Time

For the lesson on 24/01/2017

At Presentation Secondary School Warrenmount, Dr. Jennifer Kelly's class

Instructor: Dr. Jennifer Kelly

Lesson plan developed by: Dr. Jennifer Kelly, Ms. Eilish Shanley

1. Title of the Lesson: Time for Telly

2. Brief description of the lesson

In this lesson students consider when a film of given duration will end if advertisements have to be included. This lesson has been designed to address the misconceptions that students have with regards to Time, calculating time and interpreting written problems. The class in question was mixed ability of mostly Foundation Level students but including some students who will pursue the Ordinary Level examination, students with SEN and students with behavioural issues.

3. Research Theme

As a school we wish to have:

Students' achievement in summative assessments, including certificate examinations, in line with or above expectations.

To give our students more confidence in Maths and as a result reduce the number students dropping levels in the exam years (Higher to Ordinary, Ordinary to Foundation in both JC and LC), experiences that are challenging and supportive and (ii) enjoy their learning, feel motivated to learn, and expect to achieve as learners".

To support this, as Mathematics teachers:

- Work with teachers in other subject departments to identify when and where students encounter numeracy skills in their subjects. We discuss strengths and weaknesses that students may have with regards to those numeracy skills.
- We create and develop engaging lessons including a range of activities in order to improve students' enjoyment of Mathematics. Students are therefore more motivated to learn.
- We regularly expose our students to questions and situations that require problem solving skills. As a result, we are equipping our students with the skills they need to contextual questions as presented in the Junior Certificate and Leaving Certificate course.

4. Background & Rationale

a) Why you chose the topic

This lesson is aimed at a group of Third Year Ordinary/Foundation level students including students with JCSP and SEN needs. As teachers we have found that students do not recognize the equivalence relationships between fractions and decimals. With this in mind, we considered real life situations in which both fractions and decimals are both frequently used. We identified Time as being one such situation. We have found that students often have misconceptions about how time is written i.e. 2hour 40 minutes cannot be recorded as 2.4hours, what it represents, the change between digital time and analog time. This can often lead to confusion reading timetables, statistical data, distance time graphs and arithmetic questions such as distance speed time. We wish to address this as they need this functional skill going forward into life. We believe that by choosing an appropriate question we can address misconceptions to do with Time.

Students are aware that they should know how to work with Time from covering it previously in Primary School and are reluctant to draw attention to their difficulties. We are choosing this topic in order to give students a chance to openly discuss Time in a way that will clarify any misunderstandings they have and to develop one or more strategies for dealing with this problem in the future.

b) Your research findings

This is a cross curricular problem and is a whole school numeracy issue. This numeracy skill is applied in a number of subjects e.g. Home Economics, Business Studies etc., and through inter departmental discussion it has been brought to our attention that this is an ongoing problem.

SNAs that engage with our students have highlighted this issue from a very practical point of view. Students find it very difficult to manage and plan their time properly.

A disproportionately large amount of resource hours has likely gone into dealing with this issue.

The JCSP Maths statement refer to Time. In order for students to meet the Statements they must:

1. Make conversions from the 12-hour clock to the 24-hour clock and vice versa
2. Convert hours to minutes and vice versa
3. Add time values
4. Subtract time values
5. Identify the start time and finish time of television programmes from television guides and calculate the duration of specified programmes.
6. Discover the departure time, arrival time and duration of a journey from bus, train and plane timetables
7. Find the time a film ends, given the start time and the duration of the film

Without addressing misconceptions and difficulties with time our students will not gain the necessary skills to meet these statements.

Problems are encountered when time is asked as part of LCA Mathematical Applications. Students are asked to use time in a number of ways, e.g. distance/speed/time, payslips etc. To give our students the best opportunity for future development at LCA we must address numeracy issues at Junior Cycle.

When we assess our students work, through summative assessment, we have noticed that when responding to a question that requires a student to add or subtract time they do not all have the understanding to choose the appropriate strategy e.g. calculator, column method, partitioning, estimation. They do not understand the proportionality of minutes as part of an hour.

In examinations, questions involving time can often be presented in lengthy word problems which exasperates the situation.

“Performance was more mixed when candidates had to read the time from an analogue clock (Question 1(e)(i)), with many candidates mixing up the hour and minute hands, or giving an answer of 2:45 instead of 1:45.” *Junior Certificate Examination 2015, Mathematics, Chief Examiner’s Report*

5. Relationship of the Unit to the Syllabus

Related prior learning Outcomes	Learning outcomes for this unit	Related later learning outcomes
<p>Second Class</p> <p>read time in hours, half-hours and quarter-hours on 12-hour analogue clock</p> <p>read time in hours and half-hours on digital clock</p> <p>Third Class</p> <p>rename minutes as hours and hours as minutes confine work to five-minute intervals 70 min = 1 hour 10 min 11 – 2 hour = 1 hour 30 min = 90 min • read dates from calendars and express weeks as days and vice versa collect and record significant personal dates and dates in life of school and family</p> <ul style="list-style-type: none"> • solve and complete practical tasks and problems involving times and dates practical problems that can be readily checked by measurement. <p>Fourth Class</p> <ul style="list-style-type: none"> • rename minutes as hours and hours as minutes • read dates from calendars and express weeks as days and vice versa • solve and complete practical tasks and problems involving times and dates and the addition and subtraction of hours and minutes practical problems that can be readily checked by measurement add hours and minutes separately 4 hours 45 minutes + 3 hours 25 minutes — ----- ----- = 7 hours 70 min 8 	<p>In this Unit:</p> <p>Learners are expected to be able to use calculators appropriately and accurately, as well as carrying out calculations by hand and mentally.</p> <p>appreciate the order of operations, including the use of brackets</p> <p>Calculate interpret and apply units of measure and time.</p> <p>Solve problems that involve calculating average speed, distance and time</p> <p>use the equivalence of fractions, decimals and percentages to compare proportions</p> <p>consolidate their understanding of the relationship between ratio and proportion justify approximations and estimates of calculations</p> <p>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)</p>	<p>LC Syllabus – Foundation</p> <p>Solving everyday problems, including problems involving mobile phone tariffs, currency transactions, shopping, VAT, meter readings, and timetables</p> <ul style="list-style-type: none"> - calculate, interpret and apply units of measure and time – solve problems that involve calculating average speed, distance and time <p>LC Syllabus – Ordinary</p> <p>calculate average rates of change (with respect to time)</p> <p>Leaving Certificate Applied Module 1 Unit 3</p> <p>The student will be able to:</p> <ol style="list-style-type: none"> 1. differentiate between twelve hour and twenty four hour time systems and convert between them 2. convert minutes to decimal of hour and seconds to decimal of minute format and vice versa 3. interpret information from calendars, timetables, schedules, rosters, timesheets, cooker timers, etc. and calculate intervals using twelve or twenty-four hour systems 4. convert between days, weeks, months and years 5. compute or compare the time in different time zones and apply to real situations. <p>Module 1, Unit 4 Fractions, Decimals, Percentages and Ratio: relate to money, measurements and time</p> <p>Module 2, Unit 1: calculate gross wages and salaries derived from time at a</p>

<p>hours 10 minutes</p> <p>rename minutes before subtraction 3 hours 30 minutes = 2 hours 90 min – 1 hour 40 minutes ----- ----- 1 hour 50 minutes.</p> <p>Fifth Class</p> <ul style="list-style-type: none"> • read and interpret timetables and the 24-hour clock (digital and analogue) bus, train, air, ship, films, theatre, school, class • interpret and convert between times in 12-hour and 24-hour format 10:30 p.m. = 22:30 hours 07:50 hours = 7:50 a.m. <p>Sixth Class</p> <p>The child should be enabled to</p> <ul style="list-style-type: none"> • explore international time zones identify and discuss the need for time zones calculate time differences between Ireland and other countries • explore the relationship between time, distance and average speed measure, using a stop-watch, the time taken for short journeys to be completed or short distances to be covered and compile database to examine averages. <p>First Year</p> <ul style="list-style-type: none"> • Units of measure, time, mass in context • Problems involving average speed, distance and time 		<p>rate per hour, overtime, piecework, allowances (shift work etc.), bonuses and expenses</p> <p>solve wage calculations using time including conversion of minutes to decimal of an hour</p> <p>use of actual time cards, time sheets, payslips, TFA certificates, P60, P45 etc</p> <p>solve wage calculations using time including conversion of minutes to decimal of an hour</p> <p>The student will be able to:</p> <ol style="list-style-type: none"> 1. identify units of distance, time and speed and analyse the relationship between distance, time and speed 2. use formulae to calculate distance, time and speed
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6. Goals of the Unit

- Students will revise applied arithmetic (financial, DST, Time Graphs, Statistics) in preparation for their Mock Examinations.
- Students will be better at interpreting problems presented in literary format and be able to select the key pieces of information as well as the most appropriate method to solve the problem.
- Students will be able come to a conclusion from their calculations and will be able to articulate why they came to that conclusion.
- Students will have an opportunity to use critical thinking and group skills.

7. Unit Plan

Lesson	Learning goal(s) and tasks
1	Calculator Skills, Order of operations
2	Fractions – simplifying.
3	Percentages. FDP equivalences.
4	% increase/decrease, VAT, discounts, profit etc.
5	Research Lesson – Time.
6	Time questions, DST problems.

8. Goals of the Research Lesson:

The Goals of the lesson should refer to:

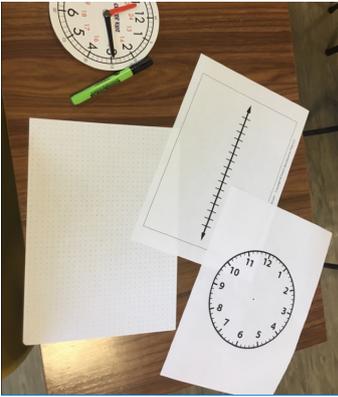
a) Mathematical Goals

- Students will be able to carry out operations of time.
- Students will convert between minutes and hours.
- Students will be able to use their calculator as a tool for time operations.
- Students will be able to work between digital and analog time.
- Students will be able to use correct notation for digital time and analog time.
- Students will be able to work out proportions i.e. parts of an hour.
- Students will be able to use the appropriate language of time, proportion etc. to communicate their approach with confidence.

b) Key Skills and Statements of Learning

- Using language
- Using Number
- Performing and presenting
- Listening and expressing myself.
- Being literate
- Learning with others
- Expressing ideas mathematically
- Being creative
- Thinking creatively and critically
- Knowing myself
- Reflecting on and evaluating my learning
- Developing a positive disposition towards, reasoning and problem solving
- Respecting difference
- Recognizes the potential uses of mathematical knowledge, skills and understanding in all areas of learning.
- Observes and evaluates empirical event and processes and draws valid deductions and conclusions.

9. Flow of the Research Lesson:

<p>Steps, Learning Activities Teacher's Questions and Expected Student Reactions</p>	<p>Teacher Support</p>	<p>Assessment</p>
<p>Introduction Students arrive at class and take their seats.</p> <p>Teacher explains what they will be doing in class. Teacher suggests they take out all their equipment including calculator.</p>	<p>Teacher welcomes students to class and settles them in their places. Given behavior/needs of the students it may be necessary to reassure students about extra people being in the class, different materials, expectations etc.</p>	<p>Are students reacting well to the alterations made to their environment? Can anything be done to make the process easier for students?</p>
<p>Posing the Task A TV channel has a policy that for every hour of TV, 48 minutes must be programmes and 12 minutes must be ad (commercial) breaks. If a film is 1 hour 51 minutes long and starts at 18:00 what time does it finish?</p> <p>Clarifying the problem: There are a selection of resources available for you to use. You can as many as you want or maybe none at all. There are clock faces and timelines.</p> <p>We will clarify through discussion what an advertisement is and that it takes longer to watch a film as a result of the advertisements. How many minutes are in an hour?</p>	<p>Problem printed on A3 on the whiteboard. Printouts on the desk (Girl with visual impairment).</p> <p>Resources:</p> <p>Clock faces with moveable arms, paper clock faces, time lines divided into 12 minute intervals, fraction wheels, blank circles.</p>  	<p>Do students understand the problem? What questions do they ask in order to clarify the problem?</p> <p>Do we need to remind students of the number of minutes in an hour?</p>

Student Individual Work

1. Adds 18:30 without adverts.

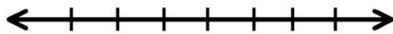
$$18:30 + 1:51$$

Students may do this using:

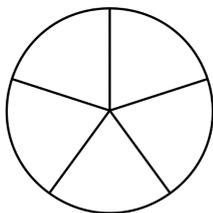
- a) Column method
- b) Incorrectly using decimals on the calculator otherwise,
- c) DMS method.

2. Uses a visual representation to communicate their understanding

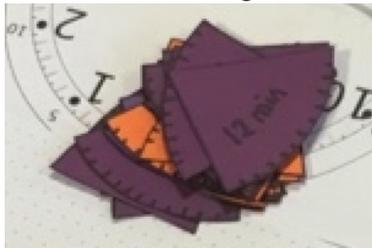
- a) Timelines.



- b) Fraction wheel (one fifths)



- c) 1/5 or 12 minute segments cut up.



- d) Rotation of hands on clock face.



- e) Any sketch of value closely linked to the above i.e. dividing hours into 12 minute intervals.

3. Adds one add break as they only see one complete hour.

$$18:30 + 1\text{hr}51\text{m} + 12\text{m}$$

4. Converts 1 hour 51 mins to 111minutes.

5. Adds $48\text{m} + 48\text{m} = 96\text{m}$

Takes 96m from 111m to get 15 minutes

6. Uses repeated subtraction

$$111\text{m}$$

$$\underline{-48\text{m}}$$

$$63\text{m}$$

$$\underline{-48\text{m}}$$

$$15\text{m}$$

If there are advertisements will the film still only be 1 hour 51 minutes long?

Have you looked at any of the resources? Can you see anything here that might be useful?

“If you include 12 minutes of ad breaks in the first hour, how many minutes of movies are there in the first hour? How many minutes are left?”

“How many minutes are in an hour?”

Can you think of how you could find the number of minutes left in the film after the first hour? After the second hour?

Teacher may spot mistakes in students work. Teacher can suggest how to improve it.

What does 0.10 represent in decimals? 10 out of one hundred? 10 minutes is 10 out of 60. Is that the same?

Do the students make this mistake? Why might they do that? Do students have a sound method for adding hours and minutes?

Do students use the resources? Do they need them? Are they over reliant on the resources? Which resources do they use.

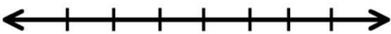
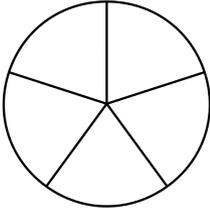
How do students come to the realization that there are 48 minutes of film for every hour of television? Do they work it out on paper, calculator or using one of the visual aids?

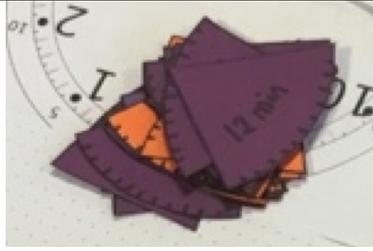
Do students realise that they will need to figure out ad breaks for the second hour?

What method do the students use? Is it procedural in nature? Do they understand how and why their chosen method works?

Do students convert hours to minutes? What do they do next?

How do students come to the realization that if

<p>7. Subtracts 48m twice from 1 hour 51minutes using column method.</p> <pre> H M 1 51 - 48 ----- 1 3 - 48 ----- 15 </pre> <p>8. Subtracts 48m twice incorrectly using decimals. 1.51 – 0.48 = 1.03 etc.</p> <p>9. Subtracts 48m twice from 1hr 51m using the DMS function on their calculator.</p> <p>10. Identifies that the remaining 15 minutes is part of an hour and uses proportion to identify the number of minutes of ad breaks needed to be assigned for that part.</p>	<p>Can you think of a method you have used before that is different to the method you have already used?</p>	<p>What method do they use for subtraction? Are they proficient in the procedure or are there any mistakes that reoccur during the task.</p> <p>Do students understand that, for example, 1hr51 minutes cannot be written as a fraction as 1.51 hours? Can they convert to decimals more efficiently?</p> <p>Do students have a method they can use on their calculator? Are they able to use it well or are there common mistakes?</p> <p>Do any students ask about the minutes left over after the second hour?</p>
<p>Ceardaíocht /Comparing and Discussing</p> <p>1. Adds 18:30 without adverts. 18:30 + 1:51 Students may do this using:</p> <ol style="list-style-type: none"> Column method Incorrectly using decimals on the calculator otherwise, DMS method. <p>2. Uses a visual representation to communicate their understanding</p> <ol style="list-style-type: none"> Timelines.  Fraction wheel (one fifths)  1/5 or 12 minute segments cut up. 	<p>Did anyone else do this? Did anyone do something similar? What is similar? What is different? Are any advertisements included in this answer? Do we need to use a different strategy to find the answer?</p> <p>Did anyone use the resources? Can you explain how you used it? Did anyone use it differently? Why? Did it help?</p> <p>Which resource do you think is more useful?</p>	<p>Are students engaging in the discussion? Are they listening to each other? Can they see connections in each others' responses?</p>



d. Rotation of hands on clock face.



e. Any sketch of value closely linked to the above i.e. dividing hours into 12 minute intervals.

3. Adds one add break as they only see one complete hour.

$$18:30 + 1\text{hr}51\text{m} + 12\text{m}$$

4. Converts 1 hour 51 mins to 111minutes.

5. Adds $48\text{m} + 48\text{m} = 96\text{m}$

Takes 96m from 111m to get 15 minutes

6. Uses repeated subtraction

$$\begin{array}{r} 111\text{m} \\ -48\text{m} \\ \hline 63\text{m} \\ -48\text{m} \\ \hline 15\text{m} \end{array}$$

7. Subtracts 48m twice from 1 hour 51minutes using column method.

$$\begin{array}{r} \text{H} \quad \text{M} \\ 1 \quad 51 \\ - \quad 48 \\ \hline 1 \quad 03 \\ - \quad 48 \\ \hline 15 \end{array}$$

8. Subtracts 48m twice incorrectly using decimals.

$$1.51 - 0.48 = 1.03$$

$$1.03 - 0.48 = 0.55 \text{ etc.}$$

9. Subtracts 48m twice from 1hr 51m using the DMS function on their calculator.

“Student A” added one 12 minute slot? Is this enough? We’re getting closer to the correct answer? How can we improve it?

Did anyone else use this method? Where did you learn it? Do you like this method? Why?

Do we all like this method?

Do we understand what “Student B” did here?

Are there any similarities between this and any of the other methods anywhere else on the board?

Are we finished now? Do we need to do anything else?

Why can’t we write 48 mins as 0.48? can someone explain that to the class? Does anybody have anything else to add?

Do students have a preferred method? Are they over reliant of a taught method? Do they have the understanding behind the procedure? Are they using the procedure proficiently?

Do students appreciate that we can do things in different ways and end up with the same answer?

Are students able to read questions carefully and understand them? Do literacy and comprehension skills hold them back when dealing with worded questions?

Were students able to access the questions and multiple solutions.

Summing up & Reflection

Teacher will go through the board plan and sum up what they have covered in the class.

Students will be given a follow on homework task.

Teacher will clarify the problem for students.

Exit post its: Students will be asked to reflect on the

Teacher will talk through the class and summarise what they have learned.

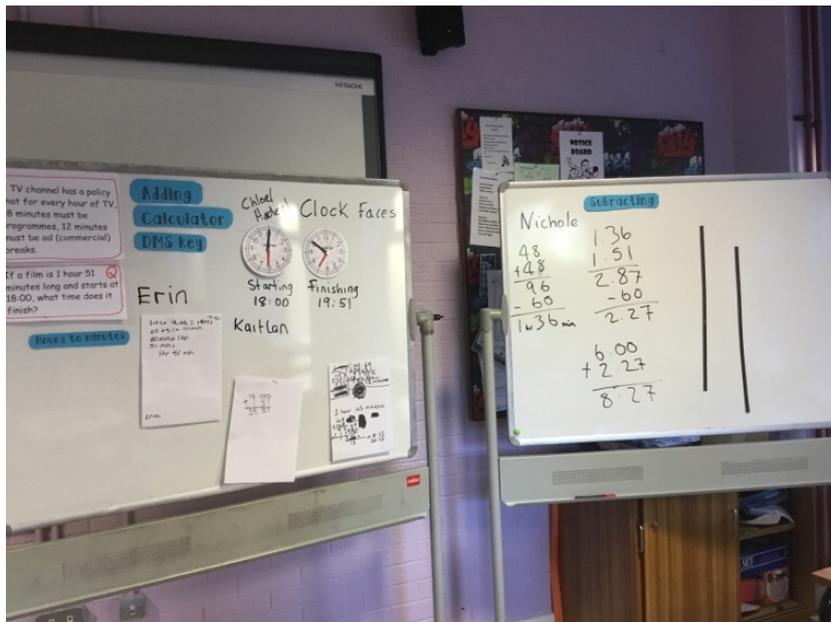
Teacher will read through the homework and ensure that students are clear on their

Written feedback on Post Its.

class. What they learned, how they learned it and did they enjoy it?	expectations. Teacher will explain Exit Post Its activity.	
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10. Board Plan

Board 1			Board 2														
<p>A TV channel has a policy that for every hour of TV, 48 minutes must be programmes and 12 minutes must be ad (commercial) breaks.</p> <p>If a film is 1 hour 51 minutes long and starts at 18:00 what time does it finish?</p>	<p>Finds the finish time of the film without including any advertisements</p> <p>1. Column Method</p> <p>2. Incorrectly using Decimals</p> <p>3. Calculator—DMS Key</p>	<p>Visual Representation</p>	<p>Adds one add break as there is one whole hour of film but doesn't consider that the film will now take at least 2 hours</p> <p>Converts 1 hour 51 mins to 111minutes.</p> <p>Adds $48m + 48m = 96m$</p> <p>Takes 96m from 111m to get 15 minutes</p>	<p>Uses repeated subtraction</p> $\begin{array}{r} 111m \\ -48m \\ \hline 63m \\ -48m \\ \hline 15m \end{array}$ <p>Subtracts 48m twice from 1 hour 51minutes using column method.</p> <table border="0"> <tr><td>H</td><td>M</td></tr> <tr><td>1</td><td>51</td></tr> <tr><td>-</td><td>48</td></tr> <tr><td>1</td><td>03</td></tr> <tr><td>-</td><td>48</td></tr> <tr><td></td><td>15</td></tr> </table> <p>Subtracts 48m twice incorrectly using decimals.</p> <p>$1.51 - 0.48 = 1.03$ $1.03 - 0.48 = 0.55$ etc.</p>	H	M	1	51	-	48	1	03	-	48		15	<p>Subtracts 48m twice from 1hr 51m using the DMS function on their calculator.</p> <p>Gets the answer 20:15 using one or more of the methods mentioned previously. (If someone gets the answer 8:15 this will be addressed here.)</p>
H	M																
1	51																
-	48																
1	03																
-	48																
	15																



11. Evaluation

a. Did students understand the question?

During the introduction of the problem we believed that students did understand the problem. The teacher had to deal with a behavioural issue at the start of the class so the initial discussion was interrupted. The teacher lead a discussion at the start of the class so that students could share their prior learning and understanding. We believed that students understood that the advertisements would make the duration of the film screening longer. However, despite this initial understanding some of the students still worked out the end time of the film without consideration for the advertisements. The students were prompted to develop their answers further but could not grasp what they had to do.

b. Did the materials given work well with the lesson?

The materials worked very well with the lesson. The clock faces with moveable hands and the printable clock faces were well used particularly by the weaker students in the class. Other resources such as the fraction segments and the timeline were not as well used. However, if the students were somehow encouraged to approach this problem using a sequencing approach perhaps these resources would have been of greater use.

c. Did the timing of the lesson work out?

Given the needs of the students in this class we wondered if there is scope within the lesson study model to partition the times more in order to scaffold the problem better. For example, having simply added the two times together without including advertisements, one student sat waiting for a large amount of time waiting for Ceardaíocht to begin. Had the class been given the opportunity to share their progress earlier in the lesson this student may have been encouraged to assess her own response and improve upon it.

<u>Current timings</u>	<u>Proposed Future timings</u>
5 minute introduction	5 minute introduction
10 minutes of Independent Work	5 minutes of Independent Work
20 Minutes of Ceardaíocht	10 Minutes of Ceardaíocht
5 minute Summary	5 minutes of Independent Work
	10 Minutes of Ceardaíocht
	5minute Summary

There is a danger however that weaker students will follow the lead of a stronger student and we could potentially lose out on the multiple responses possible from the problem.

d. Did the students come up with the anticipated answers?

The majority of the class did not include advertisements in their calculations and simply added 1 hour and 55 minutes to the starting time. They did this in a number of ways as outlined in step 1 and 2 of the 'Students Individual Work' section above. Although these students did not deal with the problem in the depth that we had hope we can still be confident that they achieved the following lesson goals as set out previously:

- Students will be able to carry out operations of time.
- Students will convert between minutes and hours.
- Students will be able to use their calculator as a tool for time operations.
- Students will be able to work between digital and analog time.
- Students will be able to use correct notation for digital time and analog time.
- Students will be able to use the appropriate language of time, proportion etc. to communicate their approach with confidence.

One student in particular did progress beyond this point. She understood that the film would take longer to screen and attempted a number of different calculations but failed to reach the final answer. She demonstrated a good level of proficiency when adding and subtracting time as well as converting between minutes and hours. There could be a number of reasons why she was unable to reach the correct answer for example:

- Inability to sequence events.
- Getting 'bogged down' in calculations, losing her train of thought and misunderstanding the next logical step.
- Being in a rush to finish the problem and not being able to evaluate her own work.

This student was eager to demonstrate her work to the class and was able to communicate her ideas well.

- e. Is there anything about the lesson that could be improved on?
As mentioned before these students may have benefited from different timings. Also, there may be scope to scaffold the lesson better for students so that they can sequence the events better and visualize a timeline. This will have to be done carefully in such a way as to steer students to one method only when so many others are possible.

12. Reflection

- a) What we had hoped to observe during the lesson:
We had hoped that students would be better able to solve problems with time. We wanted students to be able to vocalise what they did and did not understand when it comes to calculating with time. We wanted students to become aware of the many ways we can do calculations with time including taught methods i.e. column method, visual methods based on understanding and tools such as calculators. We wanted students to encounter a problem with which they would have some interest i.e. films and media, and therefore would want to engage with.
- b) What we observed during the lesson:
We observed the students using a wide variety of methods and resources. Whilst all students completed some calculations with time not all were able to engage with the problem in the depth we had hoped. It was difficult for the teacher to clarify the problem at the start of the class as a behavioural issue had to be dealt with which distracted the attention of the other students. During the independent work the teacher did try to explain this to students but the weaker students did not seem to grasp what was meant. All students were able to participate in the ceardaocht and demonstrate their knowledge of time. The problem-solving skills of the students need to be developed further. The question was posed using simple language and kept concise to support students with learning needs. Students learned from each other and showed respect to their peers by listening to their contributions.
- c) major points raised during the post-lesson discussion, and the team's own opinions;
The ability of the students was a major talking point after the lesson. Some students simply could not progress beyond the more basic aspects of the question. Students had proficient calculation skills but could not access parts of the question due to poor problem-solving skills. There is a need to scaffold the problem but it will be difficult to do so without limiting the number of approaches we could potentially see. The teacher did well to keep to the timings as set out in the proposal particularly taking into consideration the disruptions at the start of the lesson however there may be a need to include shorter intervals for students with SEN and other needs.
- d) ideas for future study.
A follow up lesson could include how the advertisements may be screened during an hour of programming, i.e. should we have one 12-minute slot of adds or perhaps four 3-minute slots. As mentioned before students struggled with how to sequence the problem so a follow-on question such as that may help develop those skills.

