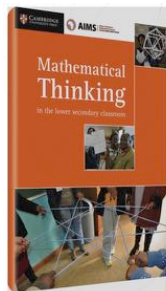


MANAGE YOUR OWN PROFESSIONAL DEVELOPMENT WORKSHOP

These guides are designed to support teachers in developing a deep understanding of the mathematics they teach and in developing more effective ways of teaching.

You can use these guides on your own or as one of a group of teachers who meet together to talk about your mathematics lessons as part of your professional development. Maybe one of you will take the lead in organizing time, date and venue but once you are doing the activities together you will all participate on equal terms in the discussion and reflection.



Mathematical Thinking in the lower secondary classroom

Edited by Christine Hopkins, Ingrid Mostert and Julia Anghileri

978-1-316-50362-1

These Lower Secondary Workshop Guides are chapters in the AIMSSEC Mathematical Thinking Book.

Buy the book online from [Amazon](http://www.amazon.com) or from

<http://www.cambridge.org/za/education> Search for AIMSSEC or for ISBN 9781316503621. To order the book in South Africa go directly to

<http://www.cup.co.za>

For reviews and curriculum map see

<https://aiminghigh.aimssec.ac.za/mathematical-thinking/>

The AIMSSEC App can be downloaded from the internet onto any android smart phone, laptop or tablet in 3 or 4 minutes and it is free.

Go to Google Play and search for **aimssec** and follow instructions. **Please register on the AIMSSEC App so that**, when you are connected to the internet, you can add comments, ask questions and join in professional discussions on the AIMING HIGH Teacher Network website.

After downloading the AIMSSEC App, everything will be available on your own phone or other device so that you will be able to use all the AIMING HIGH resources, lesson activities and professional development workshop guides offline, that is WITHOUT USING THE INTERNET.

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EACH WORKSHOP GUIDE HAS A SIMILAR FORMAT:

PAGE 1 **TITLE PAGE**

- Teaching strategy focus. *Each guide focuses on and exemplifies a widely used teaching methodology.*
- Curriculum content and learning outcomes.
- Summary of mathematical topic (FACT BOX.)
- Resources needed

PAGES 2 & 3 **WORKSHOP ACTIVITIES FOR TEACHERS**

Two pages for you to work through with your colleagues. These activities are to be shared and discussed. For each activity there is a list of resources needed , how to organise the activity (e.g. individual, pairs, whole class) , how long the activity will take , when to pause, think and try the activity , and when to record your work .

PAGES 4 & 5 **CLASSROOM ACTIVITIES FOR LEARNERS**

Two pages to help you plan your lesson. You are advised how long to allow for the activity, the resources you might need and the key questions to ask.

PAGES 6 - 10 **CHANGES IN MY CLASSROOM PRACTICE**

Pages on using the teaching strategies with additional resources and activities for use during or after the workshop such as worksheets and templates. For follow-up activities you will find lots more lesson activities on the AIMING HIGH Teacher Network <https://aiminghigh.aimssec.ac.za/category/lesson-activities/>



Time

Visual and practical, discussion

By Cherri Moseley

Cherri Moseley taught in primary schools in the UK for 15 years, working with children aged from 3 to 11. She has always been particularly interested in mathematics and how children develop their understanding of the subject. Cherri has visited schools in South Africa, Hungary and Portugal to explore teaching methods and approaches. Cherri now works as an independent primary mathematics consultant and author, delivering CPD in schools, clusters and at conferences both independently and for a range of other organisations. She has written a wide variety of mathematics resources for teachers and advises publishers on new resources.



Time

Teaching strategy: Visual and practical, discussion

Curriculum content: Reading time and time instruments, calculations and problem solving in contexts involving time.

Prior knowledge needed: Read, tell and write time in 12-hour format on both analogue and digital instruments.

Intended Learning Outcomes At the end of this activity teachers and learners will:

- ✓ Know how 12 hour formats relate to 24 hour formats on both analogue and digital clocks
- ✓ Understand how to calculate time intervals in hours and minutes
- ✓ Be able to read, tell and write time in 24-hour formats on both analogue and digital instruments
- ✓ Appreciate that a counting on strategy can be used when working with measures
- ✓ Have experienced making resources to support learning.

Fact box

There are **24 hours** in a **day**

There are **60 minutes** in an **hour**

There are two periods of 12 hours in a day

The first period is a.m.

It begins at **12 o'clock midnight, 12 a.m.**
00.00 digital time.

a.m. stands for **ante meridiem, before midday**

The second period is p.m.

It begins at **12 o'clock midday, 12 p.m.**
12.00 digital time.

p.m. stands for **post meridiem, after midday**

Resources needed: Scissors, scrap paper and card, plate or paper plate, split pins, ruler. Digital clock or watch, analogue clock.

Workshop Activities for Teachers


Activity 1: Make a clock

 *Scissors, scrap card and plate or paper plate, split pins*  *Pairs*  *20 minutes*

In pairs, draw around a small plate or use a paper plate to make a circle about 18cm in diameter. Write the number 12 at the top and the number 6 at the bottom. Carefully space the other numbers evenly around the clock.


Cut out 2 pointers. The minute hand should be long enough to reach the numbers around the edge of the clock. The hour hand should be 1 cm shorter than the minute hand.

Use the end of the scissors to make a small hole through the ends of the pointers and the centre of the clock face. Push the split pin through the hole, opening out the ends to keep the hands in place.

Stop and try this now 

Show your partner a time on your analogue clock. Ask your partner to read the time in as many different ways as they can, for example 13 minutes past 6 a.m., 13 minutes past 6 p.m., 06:13 a.m., 06:13 p.m., 18.13.

Discuss what it means when the minute hand points *between* two numbers.

Discuss where the hour hand will be at half past an hour and a quarter past (or a quarter to) an hour. 



Notes to help you do Activity 1

This activity emphasises the key features of an analogue clock. By getting the learners to number their own clocks it will help them to remember where the numbers go. The long hand is the minute hand. It takes 5 minutes to move from one number to the next. The short hand is the hour hand. It takes one hour to move from one number to the next. Both hands travel in a **clockwise** direction around the clock.

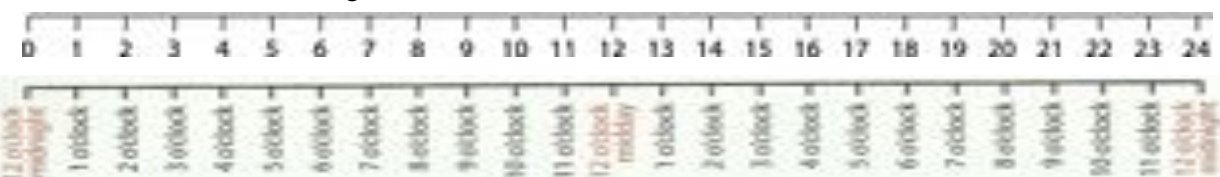
Activity 2: Day line

 *Scissors, rulers, scrap paper or card*  *Pairs*  *20 minutes*

In pairs, make a day line. Use a long strip of paper about 2 cm wide to make a 0 to 24 number line. Your strip needs to be 48cm long, so you may need to join pieces together.

Draw a long line about half a centimetre below the top long edge of the strip. Label the left hand end 0, writing 12 o'clock midnight below it.

Measure 2cm along the line and mark 1, writing 1 o'clock below it. Measure a further 2 cm along the line and mark 2 o'clock. Continue to 12, marking this 12 o'clock midday. Continue marking 2cm along the line, numbering to 24 but labelling 13 as 1 o'clock, 14 as 2 o'clock and so on until 24, which should be labelled 12 o'clock midnight.




Times from midnight to 1 minute before midday are labelled as a.m. on a 12 hour clock.

Times from midday to one minute before midnight are labelled as p.m. on a 12 hour clock.

Set your analogue clock to a time. This time could be a.m. or p.m. Mark both on your **day line**.

Write each time both ways. For example, quarter past 10 would be 10:15 and 22:15.

Discuss with colleagues how the time is written differently in 12 hour format and in 24 hour format. 


Notes to help you do Activity 2

It is important that teachers make their first day line themselves. This helps to reinforce what it is and how the parts are linked. However, the day line is unlikely to be very strong and may soon be damaged. A photocopyable version can be found at the end of this chapter.

Activity 3: Calculating time intervals

 *Clock, scrap paper, ruler*

 *Pairs*

 *20 minutes*

If the train leaves at 25 past 3 in the afternoon and arrives at 25 to 6 the same afternoon, how long does the journey take?

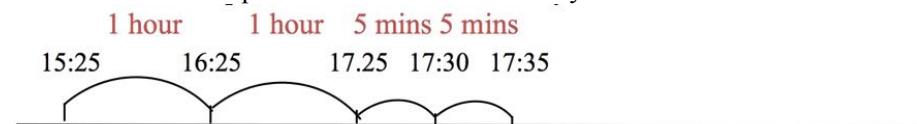
Count on using the clock. Move the hands from 25 past 3 to 25 past 4 (1 hour) to 25 past 5 (**2 hours**).

Now move the minute hand on in 5 minute jumps from 25 past 5 to half past 5 (5 minutes), then to 25 to 6 (**10 minutes**). The journey time is **2 hours 10 minutes**. 

Now use a number line to calculate time intervals.

You can use analogue time or convert the times to digital time, 15:25 and 17:35 to make it easier to label a number line.

Draw and label the part of the number line that you need.



The journey time is **2 hours 10 minutes**.




Discussion

Do you prefer the clock or the number line approach? Why?

Is one better than the other for developing initial understanding?

Classroom Activities for Learners

Activity 1: Make a clock

 *Scissors, scrap card and plate or paper plate, split pin*  *Individual*  *e.g. 20 minutes*

Ask learners to draw around a small plate or use a paper plate to make a circle about 18cm in diameter. Show learners how to fold the circle in half and label the top of the fold 12 and the bottom of the fold 6. Fold a second time at right angles to the first fold. With 12 at the top, label the right hand end of the fold 3 and the left hand end 9. Ask learners to space the remaining numbers evenly between the marked numbers.

Show learners how to cut out 2 pointers, a longer minute hand long enough to reach the numbers around the edge of the clock and an hour hand about 1 cm shorter than the minute hand.

Show learners how to use the end of the scissors to make a small hole through the ends of the pointers and the centre of the clock face. Push the split pin through the hole, opening out the ends to keep the hands in place.

Challenge learners to display given times. Say the time in different ways, using a range of time words including o'clock, to, past, a.m. and p.m.



Ideas for Teaching Activity 1

- Challenge learners to write the multiplication table for 5 as they move the minute hand around the clock face. Ask learners to create a double counting chart to link how to read the hands of the clock.

hours	1	2	3	4	5	6	7	8	9	10	11	12
minutes	5	10	15	20	25	30	35	40	45	50	55	60

- Choose a time such as 20 past 1. Count on in hours with learners moving the clock hands appropriately. Either say the times together, 20 past 2, 20 past 3, 20 past 4 and so on or say 'an hour later' and expect learners to call back the time. Choose a start time such as 25 to 12. Count back in hours in the same way.
- Call out a time and ask learners to display and say the time 5 minutes earlier or later. Extend to 10, 15 and 20 minutes earlier or later. As learners grow in confidence, chose times and time periods which will cross the boundary from one hour to the next.
- Make sure that the learners understand how the hour hand moves slowly from one number to the next as the minute hand moves around the clock. Both movements take 1 hour. At quarter past, the hour hand should be a quarter of the way from one number to the next. At half past, the hour hand should be half way between the two numbers and at quarter to, the hour hand should be three-quarters of the way towards the next number. Explain that hundreds of years ago, clocks only had an hour hand. Ask learners to remove the minute hand from their clock and work in pairs to find how to use their one-handed clock to show quarter past, half past and quarter to each hour. If necessary, remind learners of their work on the position of the hour hand. Share ideas and agree that careful positioning of the hour hand can show the time to at least the quarter hours. Larger clocks with more space between each number could be read to five minutes.

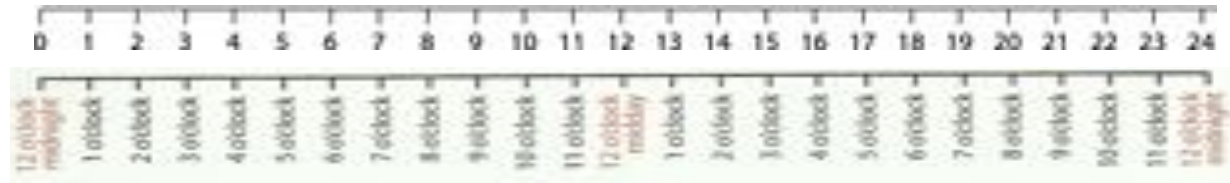


Activity 2: 24 hours in a day

Scissors, rulers, scrap paper or card Pairs

45 minutes

Give learners a strip of paper 48cm long and show them how to turn it into a day line.



Times from midnight up to midday are labelled as a.m. Call out some a.m. times. One learner in each pair shows the time on the analogue clock, the other marks the time on the day line. Pairs check they agree before sharing their answer. Repeat several times with learners swapping roles.

Times from midday to just before midnight are labelled as p.m. Call out some p.m. times. One learner in each pair shows the time on the analogue clock, the other marks the time on the day line. Ask learners to call back the digital 24 hour time. Repeat several times with learners swapping roles. Pairs check they agree before sharing their answer.

Some learners may find it helpful to shade the first half of the number line or hour line (to 12) in one colour and label it a.m., then colour the second half of the number line or hour line (12 to 24) in a contrasting colour and label it p.m.

Use the day line for support when asking similar questions during Mental Mathematics sessions.

Activity 3: Calculating time intervals

Clock, ruler, scrap paper

Pairs

45 minutes

Show learners how to count on using a clock to calculate time intervals.

If the train leaves at 25 past 3 in the afternoon and arrives at 25 to 6 the same afternoon, how long does the journey take?

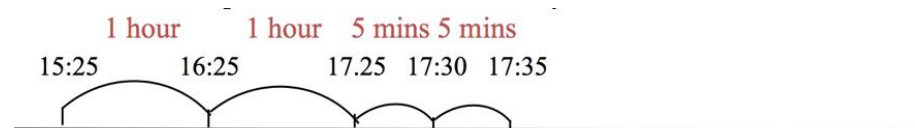
Count on using the clock. Move the hands from 25 past 3 to 25 past 4 (1 hour) to 25 past 5 (2 hours).

Now move the minute hand on in 5 minute jumps from 25 past 5 to half past 5 (5 minutes), then to 25 to 6 (10 minutes). The journey time is 2 hours 10 minutes.

Explain to the learners that they will not always have a clock to use, but they can always draw a number line. Show learners how to use a number line to calculate time intervals.

Convert the times to digital time, 15:25 and 17:35 to make it easier to label a number line. Some learners may need to use their day lines to help them to do this.

Draw and label the part of the number line that you need.



The journey time is 2 hours 10 minutes.

Changes in my classroom practice

Using the Teaching Strategy

All these activities use visual and practical resources to help develop understanding. Controlling the hands on a model clock allows learners to experiment with what they know about time without having to wait for the actual time periods to pass. Linking the standard number line to the two periods of 12 hours in a day (a.m. and p.m.) helps learners to see how to label the hours when using 24 hour time. The number line also helps learners to see that numbers work in the same way, regardless of what they are being used for. 1 hour later than 10 o'clock is 11 o'clock because 11 is one more than 10. The 60 smaller parts between each hour can be treated in the same way as any other standard units, though care must be taken to ensure that learners remember there are 60 smaller parts, not 10, 100 or 1000.

When teachers and learners make something to support their understanding, they often talk about the mathematics involved. This could be as simple as naming the numbers needed between 12 and 3 or describing the space between two numbers on the clock face in terms of fractions. Learners often try out their thinking on each other, using the response they get to confirm or grow their understanding. The same is true for teachers. Discussion helps everyone to think about what they are doing, express their understanding and develop it further.

Change the context of the problems from journeys to the length of a television programme, sporting event or something else. Learners will soon be able to calculate time intervals without support in Mental Mathematics.

Key Questions

Make a clock

- What is it on an analogue clock that tells you the time?
- Where are the hour hand and the minute hand at a given time?
- How are analogue and digital clocks different?
- How many different ways can you say the same time?

24 hours in a day

- What is meant by a.m.?
- What is meant by p.m.?
- When does a day start and end?

Calculating time intervals

- How many minutes are there in an hour?
- What do you need to know to work out how long a journey or some other event takes?

Errors and Misconception

Learners count on to find the difference between times just as they could between other measures such as lengths or weights. They need to remember how many minutes in an hour (60) when working with time.

3 hours 45 minutes cannot be written as a decimal because there are 60 minutes in an hour, not 100.

In other situations, the second unit is often 100 (centimetres in a metre) or 1000 (grams in a kilogram) parts of the first unit and can be written as a decimal. For example, 3 metres 45 centimetres = 3.45 metres and 5 kilograms 250 grams = 5.25 kg.

Follow up activities

The AIMING HIGH Teacher Network has some activities on Time that you might like to try.

The 30 minute lesson **Estimating Time** has several activities that involve learners in estimating how long a minute lasts: <https://aiminghigh.aimssec.ac.za/30-minute-lesson-estimating-time/>

Then there are three lessons that follow on very well from the activities in this workshop guide:

Time 1 <https://aiminghigh.aimssec.ac.za/grades-4-and-5-times-1/>

Time 2 <https://aiminghigh.aimssec.ac.za/grades-5-and-6-time-2/>

Time 3 <https://aiminghigh.aimssec.ac.za/grades-5-to-7-times-3/>

There are also some interesting follow up activities on the NRICH website.

5 on the clock <http://nrich.maths.org/1981/note> asks: over a whole day, how many times does a 5 appear on a digital clock showing 24-hour time? Is it the same number for a 12-hour clock over a whole day? This activity helps learners to think carefully and systematically about how the numbers show the time on a clock.

Two Clocks focuses on clocks with just one hand <http://nrich.maths.org/4806>.

Times <http://nrich.maths.org/49> explores symmetry in digital 24 hour times while

Reading from behind <http://nrich.maths.org/7175> asks learners to find the time between 3 o'clock and 10 o'clock when a digital clock looks the same from both the front and back.

Try the problem for yourself first so you can see what it is about. It is only by engaging with the activity yourself that you can see the mathematics within the problem and how working with the problem will develop learner's understanding.

