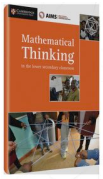
WORKHOP GUIDES FOR TEACHERS TO LEARN TOGETHER
LOWER SECONDARY N1 FRACTIONS DECIMALS & PERCENTAGES
Guide for your own self-help professional development workshop
and resources for inquiry based lessons.

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
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EACH WORKSHOP GUIDE HAS A SIMILAR FORMAT:

PAGE 1 **TITLE PAGE**
Teaching strategy.
Curriculum content and learning outcomes.
Summary of mathematical topic (FACT BOX.)

PAGES 2 & 3 WORKSHOP ACTIVITIES FOR TEACHERS
Two pages for you to work through with your colleagues. These are activities 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 TO 10 **CHANGES IN MY CLASSROOM PRACTICE**
Pages on implementing the teaching strategies with additional resources and activities for use during or after the workshop such as worksheets and templates.

Links between fractions, decimals and percentages

Teaching Strategy: Visual and practical

Curriculum content: Deeper understanding of fractions, decimals, percentages and the links between them

Prior knowledge needed: First ideas about fractions, decimals, percentages, including understanding of equivalent fractions

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

- Know how to represent parts of a whole in a variety of ways
- Understand how pictures can show the relationships between equivalent fractions, decimals and percentages
- Be able to change between fractions, decimals and percentages in a variety of situations
- Appreciate the links between fractions, decimals and percentages
- Have experienced having to justify the links they claim.

Fact box

Parts of a given whole can be labelled in different ways: as fractions, decimals or percentages, and it is useful to be able to change between these representations.
Depending on the situations, one representation might be easier than another.

$\frac{3}{5}$ is one of an **infinite family of equivalent fractions**: $\frac{6}{10}, \frac{9}{15}, \frac{12}{20}$ and so on.

$\frac{3}{5}$ can be thought of as **3 wholes shared equally among 5**, or $\frac{1}{5}$ **3 times over**, so as a decimal.

$\frac{3}{5}$ can be worked out as **3÷5** or 0.6. The first 2 decimal places gives us the %, since the first 2 places tells how many $\frac{1}{100}$ths: in this case, $\frac{3}{5}$ is 60%.

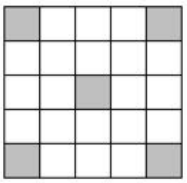
To find $\frac{3}{5}$ of an amount, it's usually easiest to find $\frac{1}{5}$ of it (by dividing by 5) and then multiply that by 3 – but it might be easier to find $\frac{1}{10}$ then multiply by 6, or….

Workshop Activities for Teachers

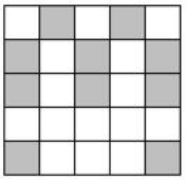
Activity 1: Pictures for fractions, decimals and percentages (FDP)

Paper (squared paper is easiest!) or showboards Pairs 20 minutes

Percentages on a 10 ×10 grid
In pairs draw a 10 ×10 grid and shade 20% of it. Now label in at least 4 different ways: 20%, 0.2 etc.
(*Pause think and try this)*
Can you think of interesting ways to shade 20%?



Percentages on other sizes of grid
Now shade 20% of a 10 × 5 grid, then 20% of a 5 × 5 grid, then 40% of a 5 × 5 grid.
How would you convince learners that what you have is correct?



Shading a grid for someone else to label
One teacher draws a grid and shades part of it, for example, as shown in the picture.
Another teacher then has to label it.
Which grids are hardest, and why?
Which 'parts' are hardest? What would you do for another fraction that does not make an exact decimal or percentage?

Notes to help you do Activity 1

Thinking about 'awkward' fractions such as $\frac{1}{3}$ is important: it's actually $33\frac{1}{3}\%$ so $33\frac{1}{3}$ little squares out of 100. Using 100 squares to begin with helps learners to understand that a percentage is the number out of 100; moving to other size grids helps them then to get a wider understanding of percentages.

Activity 2: Making sentences about FDP

Paper, scissors, photocopy of cards for each pair (page 8) Pairs 30 minutes

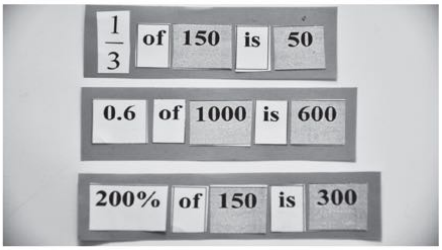
Each pair, cut out the cards on page 8

0.6	$\frac{1}{5}$	$\frac{1}{3}$	200%	$\frac{1}{2}$	$\frac{1}{4}$	of	36	600	10	200	150	50
$\frac{2}{3}$	100%	25%	0.75	$\frac{1}{10}$	30%	is	100	80	500	1000	300	2000

Arrange the cards to make as many true sentences as you can,
e.g. 0.6 of 500 is 300.
Can you use all the cards?

You might like to make the second set bigger than the first.
What would be good numbers to use?

If you have time, make a set of cards for another pair to try.



Sentences made with the cards.

Activity 3 Trying the classroom activities

Paper or showboards, scissors, sticky tape, prestick or blutack Pairs or whole group 30 min

Now try all the Classroom activities that you haven't tried yet. Discuss what your learners would gain from each activity and choose the ones you will try with your learners taking into account class size and resources available. Which activity will you use first?

It is useful to spend 10 minutes at the start of a lesson on one of these activities if you know that the learners will need to use fractions, decimals or percentages in the main part of the lesson.

Activity 4: Fraction, Decimal, Percentage Bingo

Paper or showboards Pairs or threes then whole group 40 minutes

Share the work around the whole group of making a list of 25 fraction, decimal and percentage questions with answers 1, 2, 3, …, 25. For example:

1 = 5% of 20;

2 = $\frac{1}{4}$ of 8;

3 = 0.25 of 12;

4 = the number of eighths equivalent to $\frac{1}{2}$; …

Each teacher draws a 5 × 5 grid, and places the numbers 1 to 25 on it somewhere. The grids are likely all to be different. Here is an example of one grid:

25	7	9	3	15
16	12	24	2	11
8	18	1	19	6
5	20	23	10	13
17	21	4	14	22

One teacher now calls out the 25 questions ('clues') in random order and the others in the group draw a line through the answer; the winner is the first to mark 5 in a straight line in any direction. (In a class, you might go on until 3 learners have a line of 5).

THINK: How might you make this activity harder? Or easier?
If you like the activity, how could it be adapted for other curriculum content?

If you do not have time for this activity during the workshop then it can be used as a follow-up activity and it can be readily adapted to other curriculum areas.

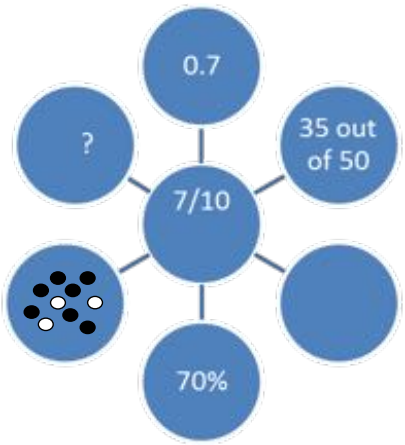
Classroom Activities for Learners

Activity 1: Different representations of fractions, decimals and percentages.

Showboards or paper | Pairs or threes | 15 minutes

Draw a circle and puts a fraction in the middle, e.g. $\frac{7}{10}$

Draw about 6 other circles on lines out from the first. Ask each group to draw a copy of the circles diagram and fill each empty circle with either a picture of the fraction, or some words, or another fraction or decimal or percentage, that means the same as $\frac{7}{10}$.



Ask for suggestions on showboards and make each group justify its answers. Keep asking 'does any group have something different?' Ask as many different learners as possible.

Repeats with a different fraction (harder or easier, depending on response to first fraction).

Activity 2 Pictures for fractions, decimals and percentages

Show-me boards or squared paper | Individuals or pairs | 20 minutes

Shading a 10 × 10 grid

Ask the learners to draw a 10 × 10 grid, shade *any* 30 little squares and label it 30% or 0.3 or $\frac{3}{10}$ or any other equivalent fraction. Explain that these are different names for the same part of a whole, and whichever is easiest can usually be used.

Encourage the learners to find a pattern of shading that is different to those around them.

Ask the learners to draw 3 more 10 × 10 grids and shade different percentages e.g. 25%, 17%, 10%.

Shading a 10 × 5 grid or a 5 × 5 grid

As learners get more confident ask them to shade different fractions of the grid e.g. 0.1 of a 10 × 5 grid or $\frac{1}{5}$ of a 5 × 5 grid. Choose teacher learners to come to the front of the class to explain how they know that what they have shaded is correct and how they know that their labels are correct.

Learners are making connections between different labels for a part (FD or P) and pictures of those parts.

Activity 3: Making dominoes

Scissors, showboards, paper. Whole class or groups of 3 40 minutes
Blu tack, prestick or sticky tape.
Set 6 large paper dominoes (see page 8)

Make a set of 6 large paper dominoes that can easily be seen by the whole class.

0.5	$\frac{2}{5}$

Fix this domino on left of the board and all the other dominos on the right.

0.5	2/5	3%	25%
0.25	1/3	33⅓%	3/8
40%	3/100	0.375	?

Ask the learners to look for a domino to match $\frac{2}{5}$ and to draw that domino on their showboard.

Ask a learner to come to the board to place the matching domino as shown below and then to find the next domino. Repeat this until, when the last domino is placed, you ask the learners to suggest a fraction or percentage to replace the question mark that has the same value as 0.5 on the first domino. The six dominoes can be placed in a loop.

0.5	$\frac{2}{5}$	40%	$\frac{3}{100}$

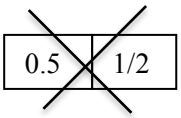
Shuffle and repeat
Shuffle the dominoes. Choose any domino to start and see how quickly the class can form the loop.

Making your own set of dominoes
Organise the class into groups of three and tell them that they are going to make their own sets of dominoes using fraction, decimals and percentages that they choose themselves.

- The set should have at least 10 dominoes.
- The dominoes MUST link up, with the last one linking back to the first one so that they form a loop and you can start with any domino in the set.

Help the learners to find equivalent representations to include on their dominoes

Teaching ideas



- Make sure that learners do **not** put equivalent fractions on the same domino e.g. This will make the activity impossible as different values are needed for matching other dominos.
- Learners can be helped by putting suggestions for each domino on the board.
- If all the individuals use their own fractions, decimals and percentages then several sets can be combined to make a bigger set of dominos to use in further classes or for playing in leisure time.
- As you circulate ask the learners to explain how they work out their matching fractions, decimals and percentages.

Changes in my classroom practice

Implementing the teaching strategy

By giving learners lots of different opportunities to make links between fractions, decimals and percentages, including different pictures of them, their understanding of those links is made stronger so that learners can choose which is easiest to use in a given problem.

Pictures are important tools: use them with learners of all ages, and let younger learners see the pictures that older learners use, so they know that it is a good mathematical way of thinking. Ask for representation that no one else has. This shows that you value creative thinking.

Talking about ideas, *listening* to other learners' ideas, and *justifying* different representations, deepens understanding. Keep asking learners to *explain* how they know something is true.

Ask for a representation that no-one else has: show you value unusual and creativ thinking.

Think: Which fractions turn into exact decimals? Why? Challenge your learners to find out!

Teachers listen and discuss

Key Questions to develop understanding

Pictures for fractions, decimals and percentages

- So which fractions or percentages are easy to show on a 10 ×10 (or 10 × 5, or 5 × 5) grid?
- Why? What would be hard parts to show?
- How would you answer the same question using a 6 × 5 grid?

Fractions, Decimals, Percentages: Different representations

- Who has a different sort of way of showing $\frac{7}{10}$?
- Why is that equivalent?
- Does anyone have an especially interesting way of showing $\frac{7}{10}$? Convince us that it is equivalent.
- What fraction could we try that would make this activity really hard? Why?
- If we know the decimal equivalent for ½ can we use this to find the decimal equivalent for ¼ or for ⅛?

Helping learners remember

Often learners seem to understand a topic at the time of teaching but if the ideas are not used again for several weeks they will have forgotten much of what they learnt. This is the way our minds work: ideas that are refreshed and used regularly are easiest to remember. Many of these activities can be used for 5 - 10 minutes as lesson starters. Visual reminders such as having posters up in your classroom and talking about them for a few minutes at the beginning or end of a lesson can help learners to recall important ideas. Auditory reminders such as a few minutes of mental maths will also help the memory.

Making posters for your classroom

Triples Equivalent fractions, decimals and percentages can be displayed on a poster in the classroom.

Start with some easy triples e.g. ½ 0.5 50% that will be familiar with the learners.

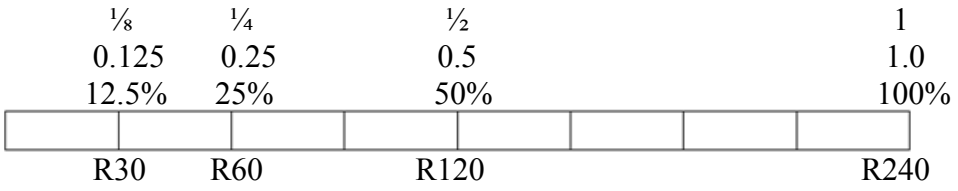
Over several lessons add more complex triples e.g. ⅔, $0.\overline{66}$, $66.\dot{6}$ %

Or ⅛, 0.125, 12½%

Include fractions larger than 1, for example, 2½, 2.5, 250%

Number lines Use images showing a number line with fractions decimals and percentages all shown.

For example, make a fraction and percentage bar related to a real context like money:



Mental mathematics

In this workshop guide you will find activities that can be used again and again to consolidate learning of FDP. Once the learners know the activities you can use them quickly at the start of a lesson or when there are a few minutes to spare. The learners will let you know which ones they like best.

0.6	$\frac{1}{5}$	$\frac{1}{3}$	200%	$\frac{1}{2}$	$\frac{1}{4}$	of
$\frac{2}{3}$	100%	25%	0.75	$\frac{1}{10}$	30%	is

of	of	of	of	of	of
is	is	is	is	is	is

36	600	10	200	150	50
100	80	500	1000	300	2000

DOMINOES

0.5	**2/5**	**3%**	**25%**
0.25	**1/3**	**33⅓%**	**3/8**
40%	**3/100**	**0.375**	**?**

Photocopy and cut out