

Participant pack

Module 12b: Developing functional mathematics with vocational learners

Number concepts and skills

Handouts

- HO 1: Aims and outcomes
- HO 2: Personal reflection sheet
- HO 3: What's involved in number
- HO 4: Calculations
- HO 5: Sample errors with notes
- HO 6: Tips for developing concepts and helping learners progress
- HO 7: Useful websites

PowerPoint slide notes

HO 1: Aims and outcomes

Aims

To enable a conceptual understanding of number to be developed with learners in vocational contexts

Outcomes

By the end of the session participants will have:

- identified some techniques and strategies used in calculating and how these can build towards a conceptual understanding of number;
- experienced a range of maths learning activities and have adapted one (or more) to suit relevant vocational contexts;
- reviewed techniques that expose common learner errors and misconceptions in number and identified how to use these to progress learning and understanding; and
- identified challenges to learners presented by functional mathematics accreditation and explored how these may be overcome.

HO 2: Personal reflection sheet

Module 12b: Number concepts and skills

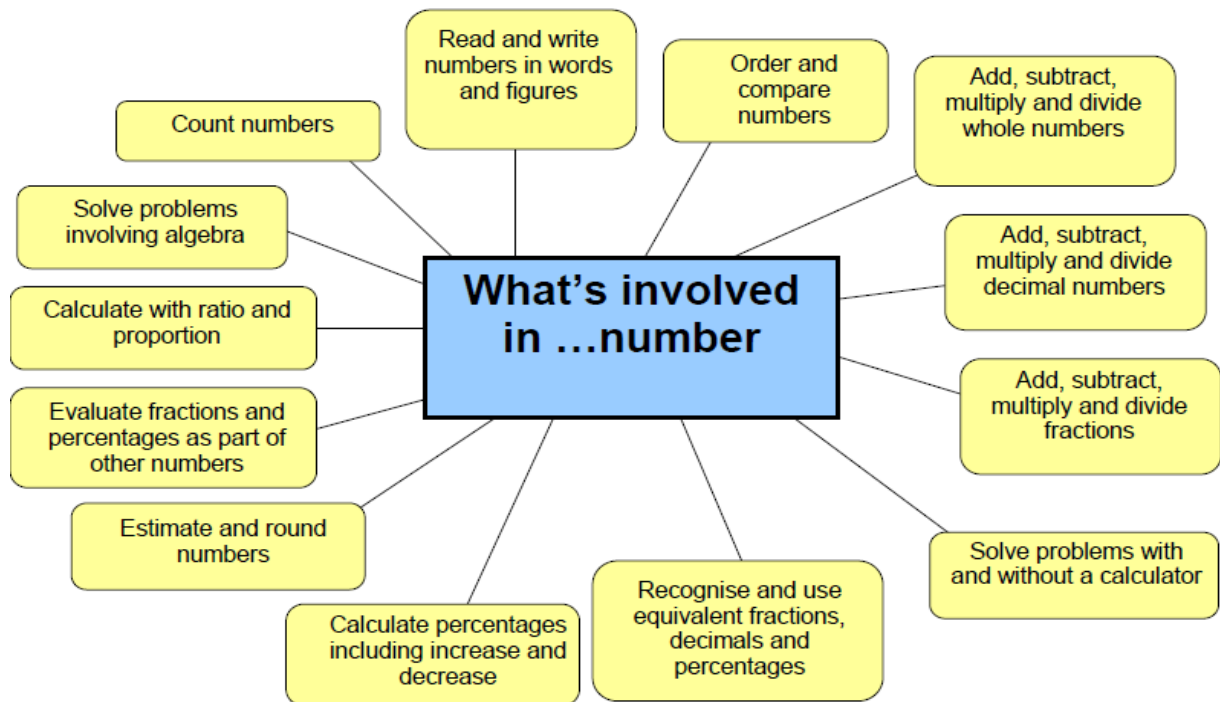
As you go through the different topics and activities during the session, make notes below regarding topics you feel confident about and those that you need to consolidate further.

Topic / activity	Reflections
Equivalence card match	
Introductions	
Vocational contexts and functional maths	
Identifying existing skills in calculating	
Place value and a feel for number	
Sometimes, Always, Never True	
Ordering and equivalence	
Interpreting answers	

Exploration of common errors	
Proportional reasoning	
Next steps	

HO 3: What's involved in number

<http://repository.excellencegateway.org.uk/fedora/objects/import-pdf:14067/datastreams/PDF/content>



Identify the situations in which these number skills are required in your vocational area.

List your examples below:

HO 4: Calculations

Calculations

1. $19 + 59$
2. $203 - 78$
3. $£10 - £5.99$
4. $60\% \text{ of } £120$
5. 10×3.1
6. 0.75×0.2
7. $\frac{5}{8} \text{ of } £240$
8. $918 \div 17$
9. $63 \div 3$
10. 21.5×4

HO 5: Sample errors with notes

This activity is adapted from an activity in 'Helping learners progress with their maths', a CPD developed by the LSIS Skills for Life Support Programme in 2010. The session is still available on the Excellence Gateway:

<http://www.excellencegateway.org.uk/page.aspx?o=295474>

Note

The reasons and strategies suggested here are not the only possibilities – there could be other alternatives. Also, sometimes particular strategies will not work – it depends on the learner and on the context. There is no one 'cure-all' approach!

Question 1

There are 64 bottles to a crate. How many bottles are there in 17 crates?

Student answer

$$\begin{array}{r} 64 \\ \times 17 \\ \hline 68 \\ \underline{64} \\ 132 \end{array}$$

The learner has multiplied the 4 in 64 by 17. This method would have worked if they had then multiplied the 60 in 64 by 17 and added the two answers together. However, they have become muddled and multiplied 64 by 1 instead. They have also forgotten to take into account that the '1' in 17 is in fact 10, so there should have been a blank space or a zero after the answer '64' to show that it is in fact 640. This learner is having problems remembering the standard written algorithm for long multiplication. Some learners with dyslexia might find it hard to recall which order to multiply the digits in, or to remember where they are up to.

Some strategies for Question 1

Encourage the learner to find ways to check the answer, and to see if it seems 'sensible' (e.g. by visualising the crates and bottles, or by thinking that the answer must be bigger than 600 because 64 is bigger than 60 and 17 is bigger than 10).

Provide an alternative way to multiply, e.g.

$$\begin{array}{r} 64 \\ \times 17 \\ \hline 28 \quad (4 \times 7) \\ 420 \quad (60 \times 7) \\ 640 \quad (64 \times 10) \\ \hline 1088 \end{array}$$

The method above breaks down the algorithm into shorter steps, but the learner still needs to remember which digit they are multiplying by and which ones are left. A

way round this is to use the grid method below (another suggestion is the lattice method):

X	60	4	
10	600	40	
7	420	28	
totals	1020	68	1088

Question 2

£12.44 + 46p

Student answer = £12.9p

The learner has used a calculator and the result is shown as 12.9. The learner has also misunderstood how to write sums of money and does not realise that the 'p' is not required yet.

Some strategies for Question 2

Any or all of these and more:

- Ask the learner to read out the answer and ask how they know if it is 9 or 90p.
- Ask the learner to add 44p and 46p using real coins and to write the answer down. Compare with the calculator results and discuss.
- Look at advertisements or catalogues to see how sums of money are recorded.
- Compare with the way that measurements are written down
- Discuss what each 'column' stands for when writing down sums of money.
- Play money 'bingo' with different sums of money written in figures on grids. The teacher reads out a list of sums of money and the learners cross them off as they hear them. The first to cross out the whole grid wins.

Question 3

What is 624 divided by 6?

Student answer
$$\begin{array}{r} 14 \\ 6 \overline{)624} \end{array}$$

Instead of thinking '6 into 2 won't go, so put a zero and carry over the 2', the learner has calculated 24 divided by 6 and written the answer at the top.

Some strategies for Question 3

Encourage checking strategies and seeing if the answer is 'sensible'. Once the learner has discovered that the answer is wrong, see if they can correct it themselves, or with peer support. Offer alternative ways of calculating division, e.g. 'chunking' (type 'division by chunking' into an internet search engine for some explanations of this, including a video on YouTube), which uses repeated subtraction.

In fact the standard written algorithm uses a similar method to chunking.

$\begin{array}{r} 377 \\ 3 \overline{)112321} \end{array}$	<p>Step 4: This adds up to 377</p> <p>Step 3: 3 into 21 goes 7 times</p> <p>Step 2: 3 into 230 goes 70 times, remainder 20 (which is added to the 1)</p> <p>Step 1: 3 into 1100 goes 300 times, remainder 200 (which is added to the 31)</p>
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This is not to suggest you would explain this to every learner, but it is helpful to understand it as a teacher.

Question 4

What is 50% of £400?

Student answer:

$$\frac{50}{400} \times 100 = \frac{50}{4} = £12.50$$

The learner has mis-remembered the algorithm for finding percentage quantities and has put the 100 on the top instead of the bottom. They are relying on rote learning of procedures rather than understanding what is really happening.

Some strategies for Question 4

This is about enabling the learner to discover the connections between fractions and percentages, and also connecting their intuitive understanding with formal procedures. Ways to proceed depend on the learner's starting point, e.g. do they understand that 50% is the same as $\frac{1}{2}$ or $\frac{50}{100}$? Offer the learner some contextualised examples where 50% is used, for example in a sale, and ask them to work out the discount mentally. Then ask them what method they used. If their

method works, go back to the original example and ask them to apply the same method. Other strategies might include using a visual representation, e.g. a diagram or a set of objects (e.g. 4 lots of 100 square grids).

Question 5

Find the change from £5 for an item costing £3.97

Student answer : **£2.97**

The learner has calculated this using the standard written algorithm, but instead of $0-7$, has calculated $7-0$ and got 7, and similarly for the rest of the calculation.

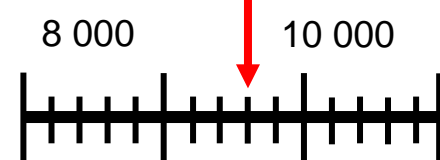
Using the standard written algorithm to work out 'change' is artificial, because people do not get out a pen and paper and work it out this way when shopping – it is usually calculated mentally or electronically.

Some strategies for Question 5

Use real money, counting on, calculators, a number line, etc. Once the learner has a secure method, you could ask them to go back to the original calculation to discuss what they did wrong.

Question 6

What is the reading on the scale?



Student answer: 8 800

The learner has looked at the 8000 and not the 10000 and has made the assumption that each division on the scale is worth 100. The learner has not understood that different scales have different scales!

Some strategies for Question 6

The learner could be asked to look at a number of 'scales', e.g. on measuring tapes, weighing scales, clocks, etc and asked to work out what each division represents on each type of scale. Once they have a method for this, they could revisit the original example.

Question 7

An aircraft takes 1hr 34 mins to fly 634 miles. How long will it take to complete 1100 miles at the same speed?

Student answer : $634 \div 1.34 = 473.13$
 $1100 \div 473.13 = 2.32$ hrs

The reasoning is sound in this answer; it is the handling of time that is at fault. The learner has written the time taken as a decimal without considering that there are 60 minutes in an hour not 100. The final answer has been left as a decimal so it is not easy to see if the learner thinks this is 2 hrs 32 mins.

Some strategies for Question 7

Incorrect conversion of time to decimals is a very common error. Explore the learner's understanding of the decimal system and place value. Discuss the representation of quarter hours and half hours as decimals and how this relates to equivalences the learner may already be happy with, e.g. How would they represent $2\frac{1}{2}$ hrs as a decimal? Engage in plenty of equivalence activities with other measures so that time can be seen as a special case. (Consider the starter activity for this module and module 12c). Give practice with real life examples, e.g. bills, wage slips, time sheets where time is given in a decimal format.

Question 8

The label on a bottle of cleaning fluid states 'dilute 1 part cleaning fluid to 6 parts water'.

How much water must be added to 300 ml of cleaning fluid?

Student answer: 50 ml

The learner has divided instead of multiplied. Ratio questions have several pieces of information which some learners (e.g. dyslexic learners) find problematic to hold in their heads all at once.

Some strategies for Question 8

Try the question 'for real' using measuring jugs, water and a coloured liquid such as fruit squash! Ask the learner to write down all the important information in the

question and then to think about how to set it out in a systematic way (e.g. in a table), and see if this helps.

Question 9

A department store is open 7 days a week, with late night opening on Thursdays. Two thirds of the employees travel to work by public transport or by walking. The rest travel by car. There are 171 employees altogether. How many travel to work by car? Show how you got your answer.

Write down two more factors that you might need to take into account when allocating parking spaces.

Student answer: 114

Some people might get dropped off

This is not untypical of a 'functional skills' style of question. The learner has to select the information necessary for answering the question and discard any irrelevant information (although this may be needed later). 'Working out' is asked for and a question relating to the context is included. This learner has worked out $\frac{2}{3}$ instead of $\frac{1}{3}$, and has not shown their method. However, the problem appears to be decoding the question rather than anything to do with finding fractions of quantities.

The answer to the last part is an acceptable one, and shows that they have considered the context as a whole. Other acceptable answers could be that given the long opening hours and the store opening 7 days a week, staff probably work shifts and therefore would not all be there at the same time, or that people might car-share, or that those with a disability would need car parking spaces close to the building.

Strategies for Question 9

Ask the learner to read the question again (they could highlight or write out the relevant information) and estimate the answer. A sketch of a pie chart representing the total number of employees might help.

Explain that credit is given for showing methods, and ask the learner to explain their method for this question, and how they might write it down. You might also want to give them positive feedback about the answer to the last part, and to discuss what other factors might be relevant.

HO 6: Tips for developing concepts and helping learners progress

- Talk maths.
- Make connections between mathematical ideas and concepts.
- Find a range of interesting, relevant contexts for number work.
- Ask learners to identify naturally-occurring mathematical problems and scenarios in their vocational and life contexts.
- Expose and discuss common misconceptions.
- Start where the learner is by building on what they already know.
- Use challenging, collaborative tasks to get learners talking, reasoning and justifying.
- Encourage learners to adopt a Plan / Do / Review approach to problem solving.
- Encourage reasoning rather focusing on 'right' answers.
- Make it clear that it's OK to make mistakes.
- Remind learners to estimate answers before starting a calculation.
- Make connections between what learners already know and what is new.
- Encourage learners to think forwards and backwards by giving an answer and asking them to write the question.
- Encourage a range of checking processes – reverse operations, alternative methods, use a calculator, common sense or experience.
- Encourage learners to substitute simpler numbers as a way of seeing how to approach a problem.

HO 7: Useful websites

Adult numeracy core curriculum

<http://www.excellencegateway.org.uk/node/1514>

New interactive online version. As well as the numeracy curriculum, there are sections on embedding, family learning and employability, links to resources and other curricula, ideas, suggestions and activities, personal space, contributions from other tutors and more.

BBC Skillswise

<http://www.bbc.co.uk/skillswise/maths>

Online and paper-based resources for adult numeracy learners.

Braingames

<http://www.braingames.org.uk/>

Online interactive learning materials in a games format, including English and maths.

Being Functional resources

<http://tlp.excellencegateway.org.uk/tlp/fs/fs-resources/about.php>

A range of functional skills resources, including CPD activities.

Excellence Gateway - nationally developed Skills for Life materials

<http://rwp.excellencegateway.org.uk>

Resources developed over the period 2001 to 2010 to support the national Skills for Life Strategy and other Skills for Life developments.

Embedded learning materials

<http://rwp.excellencegateway.org.uk/Embedded%20Learning/>

An extensive range of materials to support embedded learning (including numeracy) in over 25 vocational, community, employability and health settings.

Functional skills on the Excellence Gateway

<http://www.excellencegateway.org.uk/node/21154>

See this menu page to access the range of functional skills resources on the Excellence Gateway, including the new functional skills starter kit:

<http://www.excellencegateway.org.uk/node/20280>

Improving Learning in Mathematics

<http://tlp.excellencegateway.org.uk/teachingandlearning/downloads/default.aspx#/math>

Resources for improving teaching in mathematics, including a selection of downloadable materials. Aimed primarily at Level 2 and 3 learners.

Learning Mathematics in Context

<http://tlp.excellencegateway.org.uk/tlp/xcurricula/lmic/>

Ideas and resources to help you explore teaching and learning mathematics within vocational and other subject areas.

Mathematical Moments

<http://tlp.excellencegateway.org.uk/tlp/stem/stem-mm.html>

Each Mathematical Moment invites you to focus on a particular mathematical topic, offers you suggestions for activities you could carry out with your learners, prompts you to anticipate, and then reflects on learners' responses, and finally offers you some follow-up ideas. The topics are addressed at levels ranging from Entry to Level 3.

Move On

<http://www.move-on.org.uk/>

English and Maths resources for teachers, learners and providers, encompassing promotion, engagement and delivery. Check out Stop 4 of the Teacher Route.

National Centre for Excellence in the Teaching of Mathematics

<https://www.ncetm.org.uk/>

Resources and tools for teachers of maths and numeracy across all sectors (primary, secondary and FE). Check out the following pages. Note that you need to register before accessing these materials.

Numeracy Challenge <https://www.ncetm.org.uk/resources/13790>

Maths at Work <https://www.ncetm.org.uk/resources/11329>

FE Magazine <https://www.ncetm.org.uk/resources/14609>

Mathemapeda <https://www.ncetm.org.uk/mathemapeda/>

Thinking Through Maths (online CPD module)

<https://www.ncetm.org.uk/reflective-learning/ttm>

Northern College

<http://www.northern.ac.uk/content/?id=133>

Active resources for teaching functional mathematics (Entry 3 and Level 1).

Nrich

<http://nrich.maths.org/public/index.php>

Free mathematics enrichment materials (problems, articles and games) for teachers and learners. Aimed at ages 5 to 19 years, but much is suitable for adults.

OCR support materials for Functional Skills Maths:

Level 1: <http://www.ocr.org.uk/qualifications/type/fs%5F2010/maths/l1/documents/>

Level 2: <http://www.ocr.org.uk/qualifications/type/fs%5F2010/maths/l2/documents/>

Tasks to use as teaching resources or practice assignments.

Office of Fair Trading Skilled to Go

<http://www.oft.gov.uk/about-the-oft/partnership-working/partnership-working-info/consumer-education/resources/sthome>

A teacher's toolkit of games and resources for consumer education, with literacy and numeracy embedded.

Resources to support the pilot of functional skills

<http://www.excellencegateway.org.uk/page.aspx?o=201311>

Teaching and learning functional mathematics

Skills workshop

<http://www.skillsworkshop.org/>

Free downloadable Skills for Life and functional skills resources from this private website.

Subtangent

<http://www.subtangent.com>




Interactive maths games and resources that can be used on line or downloaded.

Tarsia Formulator

http://www.mmlsoft.com/index.php?option=com_content&task=view&id=4&Itemid=5

Free downloadable software to help create your own mathematical jigsaws and domino activities.


PowerPoint slide notes



Support for English, maths and ESOL

Developing functional mathematics with vocational learners

Module 12b: Number concepts and skills




Starter: Card match

You have a representation of a number on your card.

You need to find 3 other participants who have the same number represented in a different way.

Once you are a group of four find a table to sit at consider these two questions:

- What are the barriers to making progress in mathematics?
- How can these barriers be overcome?



Aim

To enable a conceptual understanding of number to be developed with learners in vocational contexts

Learning outcomes



By the end of the session participants will have:

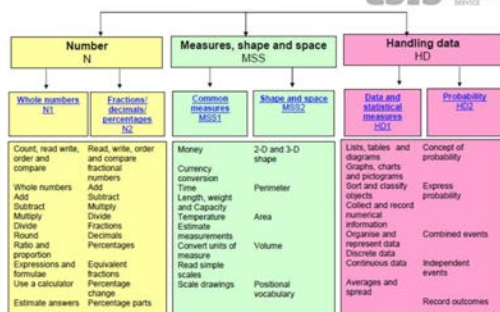
- Identified some techniques and strategies used in calculating and how these can build towards a conceptual understanding of number
- Experienced a range of maths learning activities and have adapted one (or more) to suit relevant vocational contexts
- Reviewed techniques that expose common learner errors and misconceptions in number and identified how to use these to progress learning and understanding
- Identified challenges to learners presented by functional mathematics accreditation and explored how these may be overcome

Introductions

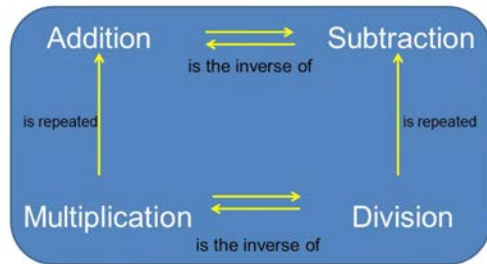


- Say what you have learnt about one of your group during the starter activity
- What vocational work and teaching experiences are represented in the whole group?
- With reference to the aims and outcomes what do you expect to gain from the day?

Adult numeracy core curriculum



Connecting the four rules



Common errors and misconceptions



A storeman fills crates with bottles. Each crate holds 64 bottles. He receives an order for 17 crates. How many bottles will he need to complete the order?

$$\begin{array}{r} 64 \\ \times 17 \\ \hline 68 \\ 64 \\ \hline 132 \end{array}$$

Answer: 132 bottles

Misconceptions and errors



Some possible reasons:

- misunderstanding the problem
- misreading information
- missing an essential step
- not grasping the concept
- lack of knowledge or understanding of a mathematical technique
- forgetting mathematical techniques at the time of the assessment
- not thinking about the problem holistically

Misconceptions and errors instructions



- Work in groups of 2 or 3. Study the sheet.
- Write down what has happened and why you think it might have happened (e.g. failure to approximate, a misconception, misremembered rule, incorrect generalisation).
- Write down a strategy that could be used to support the learner to progress in this area.
- Move to the next table, repeat the process and add comments to those already made.

Reflection



During this session you have:

- Identified some techniques and strategies used in calculating and how these can build towards a conceptual understanding of number
- Experienced a range of maths learning activities and have adapted one (or more) to suit relevant vocational contexts
- Reviewed techniques that expose common learner errors and misconceptions in number and identified how to use these to progress learning and understanding
- Identified challenges to learners presented by functional mathematics accreditation and explored how these may be overcome