



Education  
Scotland  
Foghlam Alba

# Scottish Survey of Literacy and Numeracy (SSLN)

Professional Learning Resource

Number and number processes

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# Introduction

‘A strong focus on literacy and numeracy is essential: all children and young people require these skills to gain access to learning and to succeed in life. Confidence and competence in literacy and numeracy provide the foundations for lifelong learning.’

*Building the Curriculum 3*

This professional learning resource is for all members of the learning community to work on together, in small groups or departments or as individuals. The resource offers a range of rich materials for in-service days and other professional learning. It is designed to meet the needs of individual practitioners, groups within schools, learning communities, and education authority staff with responsibility for numeracy. The resource lends itself well to promoting professional reflection, dialogue and debate about numeracy and how to improve it. It offers a reference point for teachers to evaluate the quality of the delivery of the numeracy aspect of the mathematics curriculum and numeracy across learning as experienced by learners across stages and at transition points. Numeracy, alongside literacy and health and wellbeing, sits at the heart of Curriculum for Excellence, as the knowledge, skills and attributes which equip children and young people for learning, life and work.

This professional learning resource provides guidance and advice to help inform learning and teaching practices in line with the main objectives of the Scottish Survey of Literacy and Numeracy (SSLN). It provides practitioners with more detail on children’s and young people’s strengths and areas for improvement in numeracy as identified within the in-depth analysis of the SSLN numeracy survey data.

SSLN allows exploration of children and young people’s performance across the numeracy organisers. This professional resource aims to share with practitioners, children’s and young people’s performance in:

- Number and number processes

The resource aims to help you to use these findings to:

- reflect on your own practice in developing and promoting numeracy,
- consider how to enhance children’s and young people’s numeracy skills, to support their learning across the curriculum,
- plan how to develop your practice to incorporate some new concepts and ideas,
- share views on numeracy across learning.

The analysis of children’s and young people’s performance within this numeracy organiser provides an opportunity to reflect on and explore planning for effective learning, teaching and assessment.

**Please note that to differentiate whether a question was asked as part of the mental section or as a written booklet question the questions are marked as follows: Written questions are marked with a “W” and mental questions with an “M”**

## P4 - First level

Overall children were more successful with calculations involving addition than those involving subtraction and multiplication. They were less successful in carrying out calculations involving division. Mental calculations were generally carried out less well than written calculations. Children were less successful in completing mental calculations involving subtraction than those involving addition. As reported in the 2011 SSLN Professional Learning Resources, calculations involving fractions were not carried out well with almost one fifth of children offering no response and less than one half answering calculations correctly. Children were able to identify the value of a digit in a 3-digit number. Overall, children were not able to identify a strategy to solve more complex problems.

Children's knowledge and understanding was not as strong in the aspects highlighted in red.

Early level	First level
<p><i>I have explored numbers, understanding that they represent quantities, and I can use them to count, create sequences and describe order.</i></p> <p style="text-align: right;"><i>MNU 0-02a</i></p> <p><i>I use practical materials and can 'count on and back' to help me understand addition and subtraction, recording my ideas and solutions in different ways.</i></p> <p style="text-align: right;"><i>MNU 0-03a</i></p>	<p><i>I have investigated how whole numbers are constructed, can understand the importance of zero within the system and can use my knowledge to explain the link between a digit, its place and its value.</i></p> <p style="text-align: right;"><i>MNU 1-02a</i></p> <p><i>I can use addition, subtraction, multiplication and division when solving problems, making best use of the mental strategies and written skills I have developed.</i></p> <p style="text-align: right;"><i>MNU 1-03a</i></p> <p><i>Having explored fractions by taking part in practical activities, I can show my understanding of:</i></p> <ul style="list-style-type: none"> <li><i>• How a single item can be shared equally</i></li> <li><i>• The notation and vocabulary associated with fractions</i></li> <li><i>• Where simple fractions lie on the number line.</i></li> </ul> <p style="text-align: right;"><i>MNU 1-07a</i></p> <p><i>Through exploring how groups of items can be shared equally, I can find a fraction of an amount by applying my knowledge of division.</i></p> <p style="text-align: right;"><i>MNU 1-07b</i></p>

## Addition and subtraction

Children's success rate was higher in written addition calculations where the calculation was already set out and there was no context. They were generally better at carrying out addition calculations than subtraction calculations, with the success rate being approximately 10% higher.

Overall, problem solving strategies such as working backwards were not well developed.

### Areas of strength

Children demonstrated that they could:

- add numbers involving multiples of ten and single digits
- add two-digit numbers including bridging across tens
- subtract a single digit number from a two-digit number with no bridging
- mentally subtract a two-digit multiple of ten from a two-digit number

Almost all children could answer questions similar to these correctly

adding numbers involving multiples of ten and single digits

Work out

$$10 + 10 + 8$$

Answer \_\_\_\_\_

W

When asked to add two digit numbers mentally most children could accurately answer questions where the larger number comes first.

Work out

$$18 + 13 =$$

M

When undertaking addition calculations set in context, children performed better in questions with only two whole numbers.

School pupils are waiting to get the bus to school  
There are 18 pupils at one stop.  
There are 13 pupils at another stop.

How many pupils are waiting for the school bus?

Answer \_\_\_\_\_

W

Three quarters of children were able to carry out calculations similar to this.

There were 342 pupils in a school. A further 8 started at the beginning of term.  
How many pupils were in the school now?

\_\_\_\_\_

W

Children were able to carry out simple, written calculations involving the subtraction of a single digit number from a two digit number better than those involving three digit numbers. Where subtraction calculations had been set in context, children were more successful with questions involving the subtraction of a single digit number.

**Most children** answered correctly questions similar to the questions below.

- Subtract a single digit number from a two digit number with no bridging.

Mr Brown the baker has 87 cakes. He gives 5 to his daughter.

How many cakes does Mr Brown now have?

Answer: \_\_\_\_\_ cakes

W

Fill in the missing number

$$18 - \square = 11$$

W

**Most children** were successful at carrying out mental subtraction calculations involving a single digit number. They found mental subtractions most challenging when bridging across tens.

$$89 - 30$$

M

Children were more successful with subtraction calculations involving money where the calculations involved coins less than 10p. **Almost all children** could correctly answer a question similar to the one below.

Bobby has 10p. He gives 2p to Dan and 5p to Ann.

How much money has he left?

Answer: \_\_\_\_\_p

W

## Areas for improvement

Children were less successful in carrying out calculations involving the addition of two digit numbers mentally and/or in context than in questions which were written and with no context.

Based on the responses, children's understanding of how to deal with questions involving the following aspects were not well developed.

- adding or subtracting two digit numbers mentally and in context
- money calculations involving both pounds and pence

**Less than 50%** of the children could carry out mentally a subtraction calculation involving two digit numbers bridging across tens in questions similar to the one below.

- adding or subtracting two digit numbers mentally and in context

There are 34 pupils on a school bus. 18 pupils get off. How many are still on the bus?

\_\_\_\_\_

M

Children performed less well in money calculations involving a combination of pounds and pence. **Two thirds** did not answer correctly questions similar to the one below.

- calculations involving money both pounds and pence

Darren has these coins . He wants to buy a comic costing £1.10



Almost one tenth of children offered no response to a question similar to this one.

How much more money does he need?

Answer: \_\_\_\_\_p

W

## Reflective questions

Across our learning community are we consistent in our approaches to

- developing children's mental calculation skills on a daily basis
- planning for progression in mental agility?
- planning discrete learning opportunities to develop children's calculation skills?
- planning regular opportunities to reinforce and revisit children's mental and written calculation skills?
- teaching addition and subtraction simultaneously as inverse operations?
- asking higher order questions which help children demonstrate understanding of the relationship between addition and subtraction?

### **Learning and Teaching (L & T) resources:**

**(L&T) resources** – Games to support addition

[http://www.teachingideas.co.uk/maths/contents\\_addition.htm](http://www.teachingideas.co.uk/maths/contents_addition.htm)



**(L&T) NRich maths** Adding different numbers together to make a bigger numbers <http://nrich.maths.org/7819>

**(L&T) NRich maths.** Solving addition problems to balance a V shape <http://nrich.maths.org/6274>

**(L&T) NRich maths.** Using subtraction in a practical way to solve problems <http://nrich.maths.org/6227>

**(L&T) NRich maths** Using addition and subtraction or change to equal a number. <http://nrich.maths.org/5651>

### **Career-Long Professional Learning (CLPL) resources:**

**(CLPL) Great maths Teaching Ideas.** Looking at successful ways to teach addition and subtraction together <http://www.greatmathsteachingideas.com/number-resources/additionofintegers/>

## Multiplication and division

Overall children did better in multiplication questions than division questions. The proportion of children offering no response to multiplication questions was variable with a higher response rate to questions set in context. For questions involving fraction calculations, either written or mental, the no response rate was approximately 20%. Around half of children could multiply a two digit number by a single digit number, with the success rate being higher when the question was set within the 2 or 5 times table. Generally mental division calculations were performed less successfully than written ones. In mental calculations involving division there was little difference between children's performance in questions set in context versus atomistic questions. Less than half could apply their knowledge of division to find a fraction of an amount.

### Areas of strength

Children demonstrated that they could:

- mentally multiply by 5
- divide two digit numbers by either 2 or 5 where the answer is a whole number

Children performed best in mental calculations when the question involved multiplying by a single digit, or where thinking was supported by visual prompts.

**Most children** answered correctly questions similar to the one below.

- mentally multiply by 5

9 teams take part in a tournament. There are 5 players in each team. How many players take part?  
Can you tell me your answer now?

M

**Most children** could answer a division calculation similar to the one below

- divide two digit numbers by either 2 or 5 where the answer is a whole number

Work out

$$16 \div 2 =$$

Answer: \_\_\_\_\_

W

**Most children** could answer a question involving money set in context where the division was by either 2 or 5

How many 5p sweets can I buy for 45p?

\_\_\_\_\_

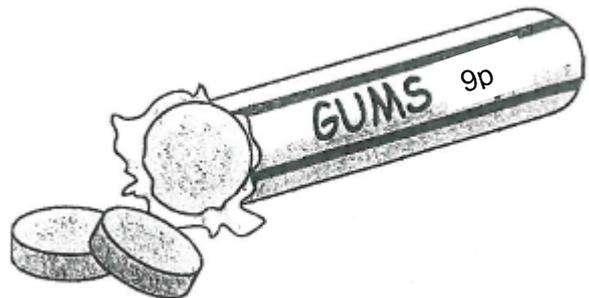
W

**Most children** could carry out calculations similar to the one in the question below.

You buy 4 packets

How much do you pay?

Answer: \_\_\_\_\_ p



W

## Areas for improvement

Based on the responses, children's understanding of how to deal with questions involving the following aspects was not well developed:

- carrying out multiplication and division calculations outwith the 2 and 5 times tables
- knowledge and understanding multiplication and division and the links to the times tables
- calculating a fraction of an amount.

**Less than two thirds of children** could carry out straight forward multiplication calculations accurately. A common error in carrying out multiplication calculations mentally was to add rather than multiply. Children performed least well when dividing by numbers other than 2 or 5.

**Less than half of children** could answer a question similar to this one.

- Carrying out multiplication and division calculations outwith the 2 and 5 times tables

$$\begin{array}{r} 14 \\ \times 6 \\ \hline \end{array}$$

W

When undertaking mental calculations in questions other than the 5 times table, less than 50% of children could answer questions similar to the one below

- carrying out multiplication and division calculations outwith the 2 and 5 times

Crayons come in packets of 9.  
Scot has 8 packets.  
How many does he have altogether?

\_\_\_\_\_

W

Regardless of whether a mental calculation had a visual prompt less than a half of children could answer division calculations similar to the ones below.

- knowledge and understanding multiplication and division and the links to the times tables

Work out

$$48 \div 6 =$$

Answer: \_\_\_\_\_

Around a third of children did not respond to a question similar to this

W

Only around a half of children could answer a question similar to the one below.

$$56 \div 8 =$$

Answer: \_\_\_\_\_

M

Questions similar to the one below, which involve reasoning, were answered correctly **by less than half** of children.

- knowledge and understanding multiplication and division and the links to the times tables

Draw a circle around the numbers which divide evenly by 7

49    62    56    21    37    28

Which of the numbers circled divide evenly by 2

Answer: \_\_\_\_\_

W

Children also lacked success in carrying out calculations involving fractions.

- calculating a fraction of an amount

**Less than a half** were able to make a connection between calculations involving fractions and division, with **less than a third** able to answer a question like the one below.

Common errors included subtracting the denominator or stating the denominator as the answer.

Dan has 70 toy cars.  
1/10 of them are red.

How many are red?

Around a tenth of children offered no response to questions similar to ones like this.

W

### Reflective questions

Across our learning community are we consistent in our approaches to:

- planning an appropriate mixture in the nature and frequency of questions to ensure appropriate challenge and development of children's knowledge and understanding of the times tables?
- linking multiplication and division?
- linking multiplication and division to working with fractions?

### Learning and Teaching (L&T) and resources:

**(L&T)** This shows repeated addition and therefore the concept of multiplication. It could also be used to challenge children to work systematically to find all possible solutions.

<http://nrich.maths.org/4734/note>

**(L&T)** The idea of inverse operations is core mathematical concept and this activity offers opportunities to explore them in a meaningful way.

<http://nrich.maths.org/8292/note>

**(L&T)** This enables discussion to take place about halving and doubling.

<http://nrich.maths.org/8117/note>



## Career-Long Professional Learning (CLPL) resources:

**(CLPL) Difficulties with division** . An explanation for teachers

<http://nrich.maths.org/5450>

**(CLPL) Basic guidance on the teaching of division and multiplication-** A simple guide for teachers

[https://www.learntogether.org.uk/Resources/Documents/Teaching%20Guidance%20Multi%20and%20Div\[1\].pdf](https://www.learntogether.org.uk/Resources/Documents/Teaching%20Guidance%20Multi%20and%20Div[1].pdf)

### Place value

Most children understand the link between a digit, its place and its value up to three- digits. Around half could extend this to four -digit numbers. When working with numbers in the thousands, approximately half of children could answer the questions correctly. Most children could identify numbers on a partially marked number line.

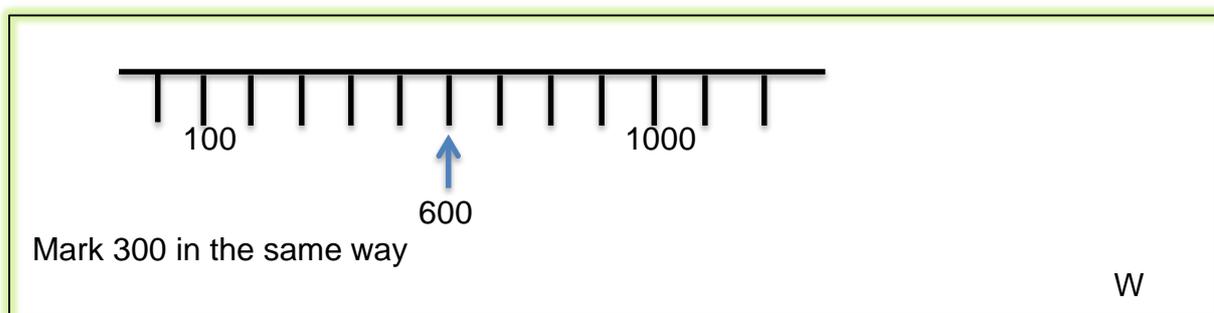
#### Areas of strength

Children demonstrated that they could:

- identify numbers on a number line with graduations in units and hundreds
- identify the highest and lowest numbers from a group of three digit numbers
- identify the place value of a digit in a four-digit number.

**Almost all children** could identify a value on a number line in question similar to this one.

- identify numbers on a number line with graduations in units and hundreds



**Most children** could answer questions similar to the one below

- identify the highest and lowest numbers

The local shop's price of an apple is more than the supermarket price.  
How much more?

Fruit	Local Shop	Supermarket
orange	20p	16p
banana	25p	20p
apple	26p	19p
pear	15p	19p
grapes	9p	15p

Answer: item: \_\_\_\_\_ price: \_\_\_\_\_

W

**Almost three quarters of children** could answer questions similar to this one.

Use the digits 1,3 and 4 to make four different numbers  
The numbers must be more than 20 and less than 50

Answer: \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_

W

**Almost all children** were able to order numbers from largest to smallest to answer questions similar to the one below.

- identify the highest and lowest numbers from a group of three digit numbers

Andrew lives 412 metres away from the school.  
Eva lives 224 metres away.  
Ken lives 541 metres away.  
Dan lives 356 metres away.

Who lives closest to the school?

Answer: \_\_\_\_\_

W

**Most children** could correctly identify the place value of any digit in a four digit number as requested in a question like this.

- identify the place value of a digit in a four-digit number

In the number 9805, write down the hundreds digit.

Answer: \_\_\_\_\_

W

### Areas for improvement

Based on the responses children's understanding of how to deal with questions involving the following aspects were not well developed.

- the place of zero within the number system
- conversion from written to numerical form
- applying reasoning skills

Children's lack of understanding of the place of zero is impacting negatively on their ability to work with numbers with a zero digit. **Less than 50% of children** carried out correctly a subtraction in a question similar to the one below.

- the place of zero within the number system

$$\begin{array}{r} 102 \\ - 12 \\ \hline \end{array}$$

W

When asked to express the numerical value of a four digit number written in words **less than half** of learners are able to do so.

- conversion from written to numerical form

What is the value of 5 **thousands** and 6 **tens**?

Answer: \_\_\_\_\_

W

**The majority** were able to reason out how to place four digits in order to create either a number with the greatest or lowest possible value, such as in a question like this.

- applying reasoning skills

Write the smallest possible whole number using the digits only once

8 5 7 1

Answer: \_\_\_\_\_

W

### **Reflective questions**

Across our learning community are we consistent in our approaches to:

- planning learning and teaching that focus on developing the concept of place value?
- using appropriate contexts for learning to consolidate children's understanding of the place of zero?

### **Learning and Teaching (L&T) resources**

**(L&T) Developing children's number sense and their understanding of place value.**

<http://nrich.maths.org/10712>



### **Career-Long Professional Learning (CLPL) resources:**

**(CLPL) SchoolMath-Ideas for teaching place value**

[http://www.homeschoolmath.net/teaching/pv/tens\\_ones\\_place\\_value.php](http://www.homeschoolmath.net/teaching/pv/tens_ones_place_value.php)

## P7 - Second Level

Overall, children had an appropriate knowledge and understanding of some of the core concepts within the first level. However, children did not have a firm grasp of first level concepts such as place value and knowledge of multiplication facts and related division facts. This is having a detrimental impact on their understanding of key concepts within second level.

By P7, children’s performance was strongest in calculations involving addition and weakest in those involving division. Their mental calculation skills were not as strong across the four operations as their skills in written calculations.

Previous SSLN survey findings (2011) highlighted the need to strengthen children’s skills in multiplication and division within first level. The analysis of the SSLN survey 2013 indicated a continuing need to strengthen these skills at first level and to ensure they are routinely progressed and developed by P7. Comparisons between the 2011 and 2013 survey indicates that children’s performance at P7 is not improving mainly due to a lack of knowledge and understanding of core concepts within the earlier levels.

Similarly to the SSLN 2013 P4 survey findings, P7 children performed better in questions which were straightforward and set in familiar contexts

Children’s knowledge and understanding was not as strong in the aspects highlighted in red in the table below.

First level	Second Level	Third level
<p><i>I have investigated how whole numbers are constructed, can understand the importance of zero within the system and can use my knowledge to explain the link between a digit, its place and its value.</i> <b>MNU 1-02a</b></p> <p><i>I can use addition, subtraction, multiplication and division when solving problems, making best use of the mental strategies and written skills I have developed.</i> <b>MNU 1-03a</b></p> <p><i>Having explored fractions by taking part in practical activities, I can show my understanding of:</i></p>	<p><i>I have extended the range of whole numbers I can work with and having explored how <b>decimal fractions are constructed, can explain the link between a digit, its place and its value.</b></i> <b>MNU 2-02a</b></p> <p><i>Having determined which calculations are needed, I can solve problems involving whole numbers using a range of methods, sharing my approaches and solutions with others.</i> <b>MNU 2-03a</b></p> <p><i>I have explored the contexts in which problems involving <b>decimal fractions</b> occur and can <b>solve related problems using a variety of methods.</b></i> <b>MNU 2-03b</b></p>	<p><i>I can use a variety of methods to solve number problems in familiar contexts, clearly communicating my processes and solutions.</i> <b>MNU 3-03a</b></p> <p><i>I can continue to recall number facts quickly and use them accurately when making calculations.</i> <b>MNU 3-03b</b></p> <p><i>I can use my understanding of numbers less than zero to solve simple problems in context.</i> <b>MNU 3-04a</b></p>

<ul style="list-style-type: none"> <li>• How a single item can be shared equally</li> <li>• The notation and vocabulary associated with fractions</li> <li>• Where simple fractions lie on the number line.</li> </ul> <p style="text-align: right;"><i>MNU 1-07a</i></p> <p>Through exploring how groups of items can be shared equally, I can find a fraction of an amount by applying my knowledge of division.</p> <p style="text-align: right;"><i>MNU 1-07b</i></p>	<p><i>I can show my understanding of how the number line extends to include numbers less than zero and have investigated how these numbers occur and are used.</i></p> <p style="text-align: right;"><i>MNU 2-04a</i></p>	
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## Addition and subtraction

By P7, children were able to answer short response questions involving addition and subtraction. Most were able to carry out addition and subtraction calculations set within familiar contexts involving money, data analysis and measure. However, children's lack of knowledge and understanding of key learning within first level is having a detrimental impact on their progression and understanding at second level. For example, there is a need to strengthen their knowledge and understanding of the importance of zero and the link between a digit, its place and value ( MNU1-01a) in order to carry out calculations involving decimal fractions.

### Areas of strength

- carry out straightforward addition and subtraction calculations including those involving money
- extract and use information from simple diagrams, tables and graphs
- carry out addition and subtraction calculations set within familiar contexts

**Most children** were able to carry out calculations within straightforward questions as illustrated below.

- carry out straightforward addition and subtraction calculations, including those involving money

$$\begin{array}{r} 6747 \\ + 2966 \\ \hline \end{array}$$

W

$$\begin{array}{r} 1881 \\ - 1875 \\ \hline \end{array}$$

W

In questions involving money in familiar contexts, as illustrated below, **most children** were able to carry out the calculations correctly.

The cost of items in a clothes shop are:

Hat £4.50

Shirt £12.25

Shorts £7.60

What does it cost to buy all three items?

W

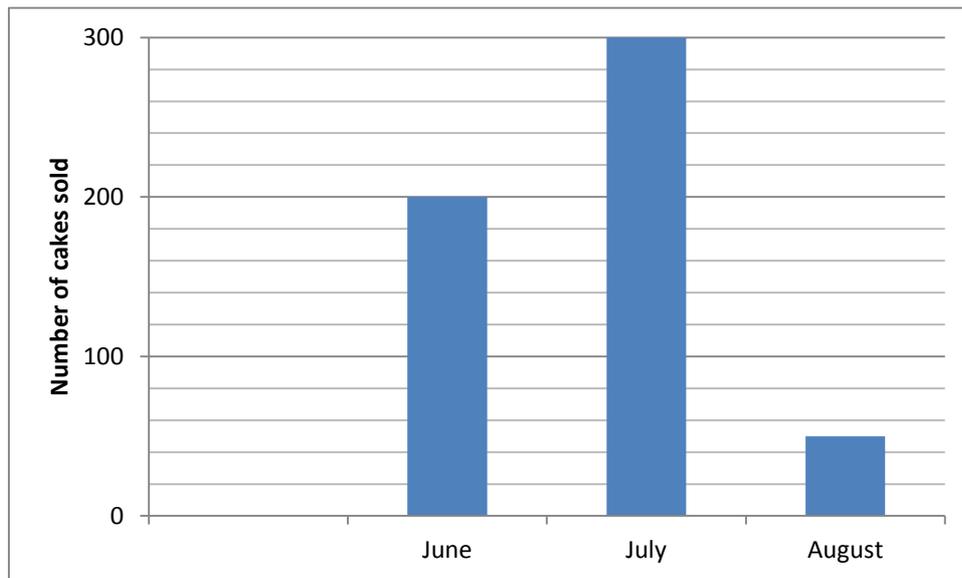
Rosie went shopping. She took £4.55 and returned with £2.15.  
How much did she spend?

W

**Most children** were able to extract and use information to calculate the answers to straightforward questions as illustrated below.

- extract and use information from simple diagrams, tables and graphs

A baker sells cupcakes during the summer months.  
He completes this graph to show his sales.



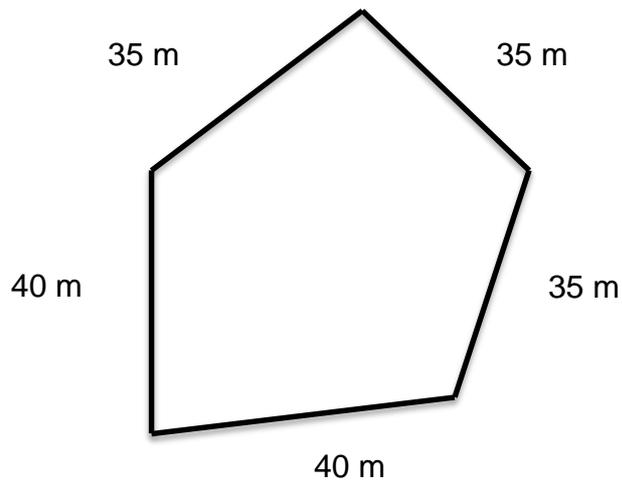
How many cupcakes were sold altogether?

W

**Most children** were able to answer questions involving measurement where all the lengths were given and the same unit of measure used throughout, as illustrated below.

- carry out addition and subtraction calculations set within familiar contexts

This is a sketch of the map of the play park.



What is the perimeter of the play park?

W

**Almost three quarters of children** correctly carried out simple two-step questions set within familiar contexts.

There are 90 people invited to a party.

- 32 are men
- 29 are women
- The rest are children

How many children are invited?

W

## Areas for improvement

Based on their responses, children's understanding of how to deal with questions involving the following aspects was not well developed:

- straightforward addition and subtraction calculations involving decimal fractions
- forming a decimal fraction to complete a calculation, both within and outwith a context
- balancing a calculation to carry out the required operation
- strategies to work out more complex questions

Children's lack of knowledge, skills and understanding within the following experience and outcome is impacting negatively on their ability to carry out addition and subtraction calculations accurately.

*I have extended the range of whole numbers I can work with and having explored how decimal fractions are constructed, can explain the link **between a digit, its place and its value.***

**MNU 2-02a**

The following questions illustrate the need to improve children's skills in carrying out calculations involving decimal fractions.

**Less than a half** of children carried out questions such as the one below accurately.

- straightforward addition and subtraction calculations involving decimal fractions

Write the missing total

$$\begin{array}{r} \text{£ } 45.49 \\ \text{£ } 6.39 \\ \text{£ } 6.39 \\ + \text{£ } 18.89 \\ \hline \end{array}$$

6% did not attempt a question similar to this.

W

**Only around a third** answered questions similar to the one below accurately.

Erin bought a CD player for £54.49, two CDs costing £5.39 each and a third costing £11.99.

How much did Erin spend?

W

- Forming a decimal fraction to complete a calculation, both within and outwith a context

$$\begin{array}{r} 12.67 \\ 7.48 \\ + 6.4 \\ \hline \\ \hline \end{array}$$

Almost a tenth did not attempt a question similar to this.

W

**Less than a half** answered questions similar to the one below accurately.

Calculate

$$12.56 + 7.47 + 6.5$$

A tenth did not attempt a question similar to this.

W

**Less than a fifth** answered questions similar to the one below accurately.

Find the difference between 37.69 and 8.709

A third did not attempt a question similar to this.

W

**Only a quarter** of children were able to answer questions similar to the one below accurately.

In summer the depth of a pond was 49.25 cm. By winter, the pond had risen to a depth of 97.5 cm.

How much deeper was the pond in winter?

W

**Less than a third** of children carried out calculations accurately in questions similar to the one below.

A jeweller cuts 0.375 metres from a 4.1 metre length of a silver chain.

What length is he left with?

Almost a fifth did not attempt a question similar to this.

W

**Less than a fifth** of children were able to identify a strategy to solve questions similar to the ones below. A common error in attempting to find the missing symbols was starting with the thousands.

- Balancing the calculation to carry out the required operation

What do the symbols \* and ■ represent in this subtraction?

$$\begin{array}{r} 6 * 1 3 \\ - 4 1 3 \blacksquare \\ \hline 2 2 8 1 \end{array}$$

A tenth did not attempt a question similar to this.

W

Children were also less successful in carrying out tasks involving a number of steps and the identification and use of problem solving strategies.

- strategies to work out more complex questions

**Less than a fifth** of children solved questions similar to the one illustrated below.

Erica the bus driver sets off with a number of passengers.

- At the first stop she leaves 26 people and collects 14.
- At the second stop she leaves 15 and collects 30.
- She now has 50 passengers on board.

How many passengers did she start off with?

W

### Reflective questions

Across our learning community are we consistent in our approaches to:

- developing children's mental calculation skills on a daily basis?
- planning for progression within mental agility?
- planning regular opportunities to reinforce and revisit children's mental and written addition and subtraction skills?
- teaching addition and subtraction simultaneously as inverse operations?
- helping children make links between inverse operations?

### Learning and Teaching (L & T) resources:

**(L & T)** Interactive whiteboard lesson on how to use partitioning to help with addition.

<http://www.mymaths.co.uk/samples/sampleLessonAdding2digitNumbers.swf>



**(L & T)** Interactive session to help learning with mental agility and standard written forms in addition and subtraction

[http://www.bbc.co.uk/bitesize/ks2/maths/number/addition\\_subtraction/read/2/](http://www.bbc.co.uk/bitesize/ks2/maths/number/addition_subtraction/read/2/)

### Career Long Professional Learning ( CLPL) resources

**( CLPL)** Article by Catherine Twomey Fosnot (2007) on developing number sense to improve addition.

<http://www.contextsforlearning.com/samples/K3OverviewPreface.pdf>

## Multiplication and division

Children performed multiplication calculations less successfully than those involving addition. Calculations involving multiplication were more accurately carried out than those involving division.

### Areas of strength

- 2-digit whole numbers multiplied or divided by a single-digit number
- multiplication by 10
- unitary fractions of an amount

**Most children** answered accurately questions similar to these set out below.

- 2 digit whole numbers multiplied or divided by a single digit number
- multiplication by 10

$$463 \times 10$$

W

$$\text{Calculate } 48 \div 6$$

W

**Most children** answered questions correctly which included extraction of information leading to straight forward calculation accurately.

90 children practise for Sport's Day.  
They are put into 6 equal groups.

How many children are in each group?

W

Jill is having a party. She has invited 26 guests. She wants her guests to sit at tables. Each table can seat 4 people. How many tables will she need so that each of her guests has a seat?

W

**The majority** of children responding could accurately carry out straightforward division calculations involving money as illustrated below.

John saved £91 in 7 months. He saved the same amount each month.

How much did he save each month?

W

**Around two thirds** of children were able to calculate unitary fractions of an amount in questions similar to the one below.

- Unitary fractions of an amount

What is  $\frac{1}{3}$  of 63?

W

### Areas for improvement

Based on their responses, children's understanding of how to deal with questions involving the following aspects was not well developed:

Children were less successful in carrying out multiplication and division calculations which required knowledge and understanding of

- multiplication tables and related division facts
- decimal notation and decimal fractions
- multi step questions and more than one method to reach an answer
- non-unitary fractions linked to multiplication and division

**Less than 50%** of children were able to answer questions similar to those illustrated below.

- multiplication tables and related division facts

An office chair costs £59.57.  
How much will it cost for 8 chairs?

Over a tenth did not attempt a question similar to this.

W

A plumber has to cut a length of pipe measuring 59.84 metres into 8 equal pieces.

What is the length of one of these pieces?

Nearly a fifth did not attempt a question similar to this.

W

**Less than 50%** of children were able to answer multiplication calculations involving decimal fractions and **less than a fifth** were able to answer correctly division calculations as illustrated below.

- decimal notation and decimal fractions

Calculate

$$8.65 \times 9$$

W

$$£327 \div 6$$

W

**Less than a third** answered correctly a question similar to the one below.

A television can be bought over a period of 30 months for £18.26 per month.

What is the total cost of the television?

Over a fifth did not answer a question similar to this.

W

**Three quarters of children** were unable to correctly answer a question similar to the one below. Common responses included the use of a “remainder” as opposed to knowing how to form a decimal fraction to carry out the calculation.

Four friends took turns at a computer game which lasted 78 minutes.

Each friend had the same length of time on the game.

How long did each player have?

W

**Only a third** could solve multi step question similar to the one below.

- multi step questions and more than one method to reach an answer

Ella buys a pair of spectacles with tinted lenses.

The frames cost £43

The two lenses cost £26 each.

There is an additional cost of £4 per lens for tinting.

What is the total cost of the spectacles?

Over a fifth did not attempt a question similar to this.

W

**Almost two thirds** were able to calculate each part of the problem, but **less than half** were able to find an answer in questions similar to the one below.

Jenny wants to buy 4 chocolate bars. She can either buy 4 single bars using the offer or the pack of 4.

Which is cheaper and by how much?

Bars	Cost	Offer
1 single	£0.75	2 bars for £1.20
4 pack	£2.30	2 packs for £4.50
12 Multipack	£6.75	Reduced to £5.50

W

**Less than a third** were able to select a strategy to solve problems similar to the one set out below.

John has less than 50 DVDs on his shelf.

- When he puts them in piles of 4, he has 0 left over.
- When he puts them in piles of 7, he has 1 left over.
- When he puts them in piles of 8, he has 4 left over.

How many DVDs does John have?

W

**Less than a quarter** answered correctly questions involving multiplication of a number less than 1 and **less than 50%** of children answered correctly questions involving non-unitary fractions.

- non-unitary fractions linked to multiplication and division

A fifth did not attempt a question similar to this.	Calculate $32 \times 0.8$  W	$\frac{3}{10}$ of 3150  W	Around a fifth did not attempt a question similar to this.
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### Reflective questions

Across our learning community are we consistent in our approaches to:

- planning appropriate challenge and development of problem solving skills?
- development of children's knowledge and understanding of decimal fractions?
- linking multiplication and division to working with fractions?

### Learning and teaching (L & T)

**(L & T)** Interactive BBC session on how to multiply and divide using mental strategies and written form.

[http://www.bbc.co.uk/bitesize/ks2/maths/number/multiplication\\_division/read/3/](http://www.bbc.co.uk/bitesize/ks2/maths/number/multiplication_division/read/3/)



### Career Long Professional Learning (CLPL) resources:

**(CLPL)** Nrich article on using arrays to help develop number sense with multiplication and division.

<https://nrich.maths.org/8773>

## Place value

Children demonstrated an understanding of first level concepts such as how whole numbers are constructed and the link between a digit, its place and its value. However, they cannot extend this understanding to decimal fractions. Whilst there are strengths in the understanding of negative numbers, too many children were not able to work with extended number lines within a given context.

### Areas of strength

- numbers of different values including negative numbers.
- interpret a simple number line extended to include negative numbers

**Almost all** could answer accurately questions similar to the one below.

- numbers of different values including negative numbers.

The attendance at 4 concerts are shown below.  
Put the attendance in order from smallest to largest.

Concert	A	B	C	D
Attendance	24 173	30 812	8 972	22 905

W

**Most** answered correctly questions similar to the one below.

- interpret a simple number line extended to include negative numbers

Here are 5 temperatures.

3 degrees      -2 degrees      5 degrees      0 degrees      5 degrees

Arrange the temperatures starting with the coldest.

W

## Areas for improvement

Based on the responses children's understanding of how to deal with questions involving the following aspects were not well developed.

- larger whole numbers.
- ordering of decimal fractions.
- placing or identifying a negative number on a scale between labelled points

**Only two thirds** of children could write out in figures a large number given in words similar to the question below.

- larger whole numbers.

Around 3 million people living in Wales.

Write this number in figures.

W

Children's lack of knowledge and understanding of decimal notation and place value in decimal fractions impacted on their ability to carry out accurately questions similar to the one below.

- ordering decimal fractions.

Put the following in numerical order starting with the smallest.

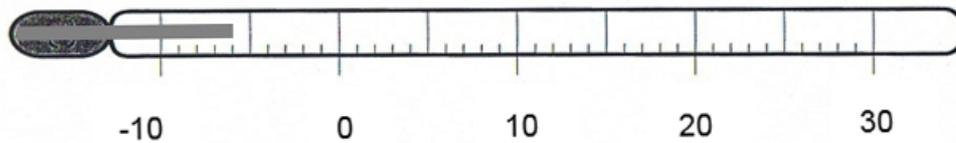
0.25      0.235      0.3      0.026

W

A **third** of children could not identify a negative value on a number line where the graduations were not marked.

- placing or identifying a negative number on a scale between graduation points.

Write down the temperature shown on the thermometer below



W

**Only around 50%** of children could respond accurately to simple real-life contexts involving negative numbers similar to the question below.

At 5 pm the temperature was  $6^{\circ}\text{C}$ . The temperature dropped by 1 degree every hour between 5 pm and midnight.

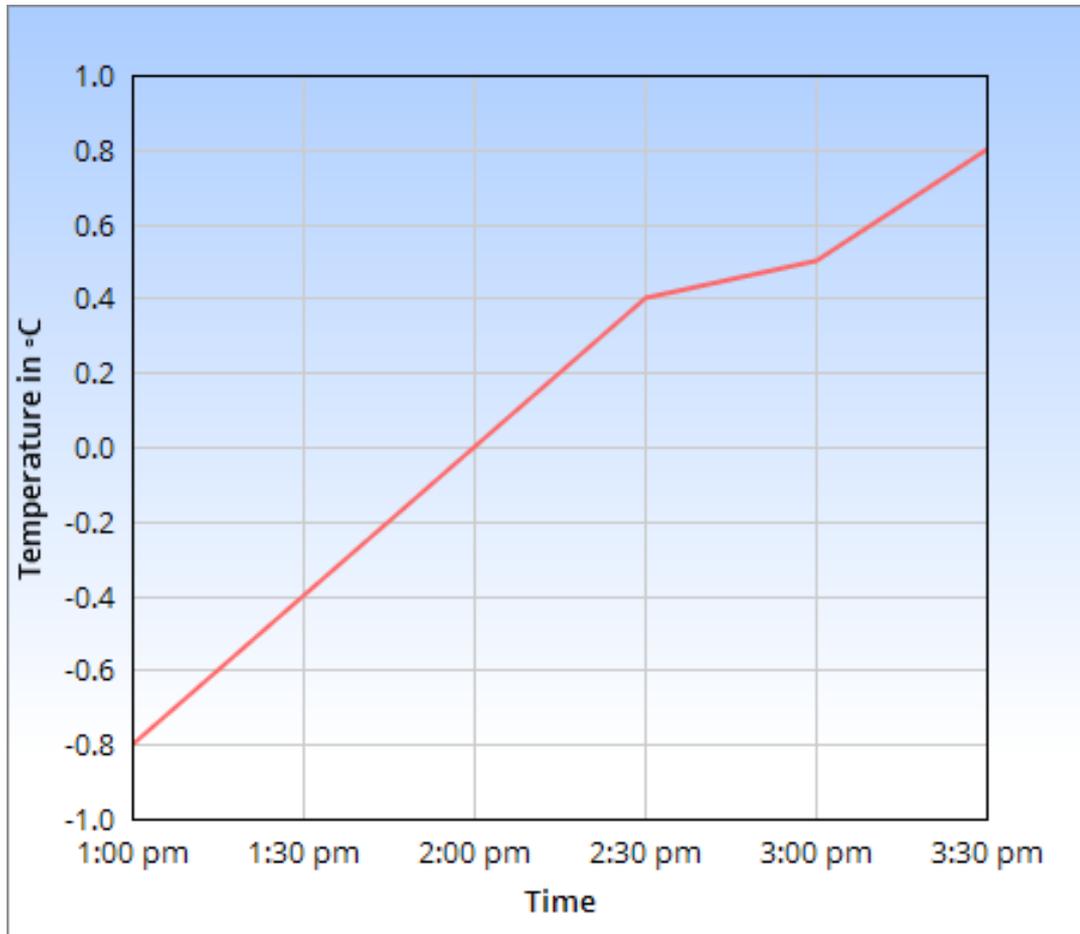
Shade the thermometer to show the temperature at midnight.



W

**Only a quarter** were able to solve a problem involving negative numbers in a relevant context as illustrated below.

In a science experiment, the temperature of a liquid is measured every 30 minutes. By how much did the temperature rise between 1:00 pm and 2:30 pm?



W

### **Reflective questions**

Across our learning community are we consistent in our approaches to:

- planning learning and teaching?
- approaches that focus on place value and the importance of balancing as a tool for solving decimal fraction problems?
- using appropriate contexts for learning to consolidate children's understanding of numbers less than zero?

### **Learning and teaching resources (L & T)**



**(L & T)** BBC link to interactive session explaining negative numbers.

[http://www.bbc.co.uk/bitesize/ks3/maths/number/negative\\_numbers/revision/2/](http://www.bbc.co.uk/bitesize/ks3/maths/number/negative_numbers/revision/2/)

### **Career Long Professional Learning resources (CLPL)**

**(CLPL)** Nrich article on place value as a building block for developing fluency in number.

<http://nrich.maths.org/10769>

**Nrich** articles on the reason for negative numbers and real life contexts.

<http://nrich.maths.org/5747>

## S2 - Third level

Young people at S2 showed strengths in interpreting questions set out in straightforward, familiar and realistic contexts. They could accurately carry out calculations involving simple numbers. They were very successful in calculations involving decimal fraction numbers which all have the same number of decimal places.

However, there were important weaknesses in several aspects of young people's performance. In particular, they were poor at carrying out calculations mentally. Many seem to be unaware of strategies for carrying out mental calculations, and seem to be trying to apply written algorithms in their heads.

They also had difficulty in carrying out calculations involving larger or more complicated numbers, especially where differing numbers of decimal digits are involved. In part this seems to be due to a poor understanding of place value and the nature of inverse operations.

Significant numbers of young people at this stage were making no attempt at questions. They seem to be easily put off by situations which are relatively unfamiliar, require a number of steps to find a solution, or simply involve numbers which are complicated or including more digits. Young people's knowledge and understanding was not as strong in the aspects highlighted in red.

Second level	Third level	Fourth level
<p><i>I have extended the range of whole numbers I can work with and having explored how decimal fractions are constructed, can explain the link between a digit, its place and its value.</i></p> <p style="text-align: right;"><b>MNU 2-02a</b></p> <p><i>Having determined which calculations are needed, I can solve problems involving whole numbers using a range of methods, sharing my approaches and solutions with others.</i></p> <p style="text-align: right;"><b>MNU 2-03a</b></p> <p><i>I have explored the contexts in which problems involving decimal fractions occur and can solve related problems using a variety of methods.</i></p> <p style="text-align: right;"><b>MNU 2-03b</b></p>	<p><i>I can <b>use a variety of methods to solve number problems in familiar contexts</b>, clearly communicating my processes and solutions.</i></p> <p style="text-align: right;"><b>MNU 3-03a</b></p> <p><i>I can <b>continue to recall number facts quickly and use them accurately when making calculations.</b></i></p> <p style="text-align: right;"><b>MNU 3-03b</b></p> <p><i>I can <b>use my understanding of numbers less than zero to solve simple problems in context.</b></i></p> <p style="text-align: right;"><b>MNU 3-04a</b></p>	<p><i>Having recognised similarities between new problems and problems I have solved before, I can carry out the necessary calculations to solve problems set in unfamiliar contexts.</i></p> <p style="text-align: right;"><b>MNU 4-03a</b></p>

<i>I can show my understanding of how the number line extends to include numbers less than zero and have investigated how these numbers occur and are used.</i>		
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*MNU 2-04a*

## **Addition and subtraction**

In S2, young people showed some strengths in carrying out addition and subtraction calculations, including those involving decimal fractions. They performed best when given decimal fractions with the same number of decimal places, or when calculating with money. However, weaknesses appeared when they were required to balance the calculation to carry out the required operation. At the P7 stage it was noted that children's understanding of how to deal with questions involving this aspect was not well developed, and this is impacting negatively on performance by S2. While young people could carry out very simple calculations mentally, they were not proficient overall at a level expected by this stage. Young people's responses to questions indicate an application of a 'rule' learnt at either an earlier stage or within another concept being inappropriately applied to decimal fraction calculations.

### **Areas of strength**

Young people demonstrated that they could:

- carry out addition and subtraction calculations within the context of money
- carry out calculations involving decimal fractions where the number of decimal places are balanced.
- carry out simple calculations involving negative numbers within a given context

**Most** young people could carry out addition calculations involving money, particularly where contexts were simple or familiar.

- carry out addition and subtraction calculations within the context of money

A young person buys some items for his bedroom

How much does he spend altogether?

Inflatable chair	£6·99
Cushion	£5·10
Picture frame	£3·70
Total spent	£ _____

W

**Around two thirds** of young people could carry out subtraction calculations, particularly where contexts were simple or familiar.

Lucy has saved £14·65. She wants to buy a pair of shoes which costs £37·20.

How much more does she need to save?

Answer: £ \_\_\_\_\_

W

Where a calculation with no context was set out, as illustrated below, or where the number of decimal places is balanced **most** young people answered correctly.

- carry out calculations involving decimal fractions where the number of decimal places are balanced

Calculate

$$3\cdot2 + 4\cdot3 + 1\cdot6$$

Answer: \_\_\_\_\_

W

**Most** young people were able to carry out calculations within a familiar context and involving the same number of decimal places accurately as illustrated below.

A caterer buys 2.3 kg of apples, 1.6 kg of grapes and 2.8 kg of bananas and puts them in a box.

What is the total weight of the fruit in the box?

Answer: \_\_\_\_\_ kg

W

Attendance figures for theme parks, in millions, are given below:

Magic Realm	Animal Realm	Adventure Island	All at Sea
18.588	9.998	7.981	5.358

Calculate the difference between the attendance at Animal realm and All at Sea.

Answer: \_\_\_\_\_ million

W

**Most** young people were able to identify a valid strategy to calculate the answer to simple questions similar to the one illustrated below

What must you add to 4.3 to make 7?

Answer: \_\_\_\_\_

W

**The majority** of young people were able to apply their knowledge of the relationship between different units of measure to undertake calculations similar to the one illustrated below.

A carton container holds 1 litre of oil. Tricia pours 750 millilitres into her car engine. How much oil is left in the container?

Answer: \_\_\_\_\_

W

**Most young people** can work with negative numbers in the context of temperature, such as in a question like this, even when asked to calculate mentally.

- carry out simple calculations involving negative numbers within a given context

The temperature in Antarctica is  $-15^{\circ}\text{C}$ . The temperature in Scotland is  $8^{\circ}\text{C}$  higher than in Antarctica.

What is the temperature in Scotland?

Answer: \_\_\_\_\_  $^{\circ}\text{C}$

W

### Areas for improvement

Based on their responses, young people's understanding of how to deal with questions involving the following aspects was not well developed:

- balancing the calculation to carry out the required calculation
- understanding and using decimal notation and place value including the place of zero
- mental agility
- appreciating and using the fact that subtraction is the inverse of addition

Even in some simple questions, a significant minority of S2 young people made errors or did not make an attempt. Only **a quarter** of young people got a straightforward question like this wrong.

- balancing the calculation to carry out the required calculation

$$\begin{array}{r} 0.03 \\ 0.991 \\ 1.007 \\ 0.98 \\ + 2.1 \\ \hline \\ \hline \end{array}$$

6% of young people did not attempt this question.

W

A plumber buys pipe to complete a job.

She needs lengths of 3 m, 0.45 m, 2.05 m and 1.2 m.

What is the total length of pipe needed?

Answer: \_\_\_\_\_ m

Almost a tenth did not attempt a question similar to this

W

**Only around a half of** young people had a firm grasp of how to subtract decimal fractions. Common errors included:-

The application of a rule learnt at either an earlier stage or within another context and applying this to decimal fractions calculations e.g. subtracting the smaller digit from the larger digit within an amount.

- understanding and using decimal notation and place value including the place of zero

Calculate

$$7.203 - 4.504$$

Answer: \_\_\_\_\_

A tenth made no attempt to answer a question similar to this. A common error was to subtract 4 from 7 and 203 from 504

W

**Around a half of** young people correctly answered questions like these correctly, which require them to identify and apply an appropriate mental strategy.

- mental agility

*(I'll read it to you twice, then you can tell me your answer)*

Jen has saved £499.50 in the bank. She saves another £56.50. How much money has she saved now?

M

*(I'll read it to you twice, then you can tell me your answer)*

Add two hundred and ninety nine to nine hundred and ninety nine

M

A digital television normally costs £499. It is reduced by £205.50 in the sale. What is the sale price?

*(Allow pupils approximately 15 seconds to read question [from prompt card] and work out answer mentally).*

Can you tell me your answer now?

M

**Only about a quarter** of young people were able to answer a question like this correctly, demonstrating a lack of knowledge and understanding of mental strategies

A fifth of young people did not offer a response to this type of question.

*(I'll read it to you twice, then you can tell me your answer)*

Subtract 199 (one hundred and ninety nine) from 3050 (three thousand and fifty).

M

**Less than half** of young people correctly answered addition calculations and **around half** of young people correctly answered subtraction calculations similar to the questions below. They were unable to balance the calculation to undertake the required operation.

- appreciating and using the fact that subtraction is the inverse of addition

A chef uses 0.625 kg from a 20 kg container of butter.

How much butter is left?

Answer: \_\_\_\_\_

Almost a fifth did not attempt a question similar to this

W

The following questions illustrate that young people were not able to identify and apply appropriate strategies to solve problems.

**Only a fifth** of young people found the correct answer to a question similar the one below.

Each evening, Mairi and Susan cycle from Mairi's house to the bridge, from the bridge to the castle and then back to Mairi's house.  
In total, they cycle 36 km.  
It is 19.4 km from the bridge to the castle and 8.9 km from the castle to Mairi's house.

How far is it from Mairi's house to the loch?

A fifth did not attempt a question similar to this

Answer: \_\_\_\_\_

W

**Only 13%** of young people were able to work out the value of the symbols in a question similar to the one below. A common error was to ignore the fact that it was a subtraction calculation involving thousands and apply a learnt rule. e.g. "Always take the smaller digit from the larger digit."

What do the symbols \* and □ represent in this subtraction sum?

$$\begin{array}{r} 6 * 1 3 \\ - 4 1 3 \square \\ \hline \underline{2 2 8 1} \end{array}$$

Answer: \* = \_\_\_\_\_ and □ = \_\_\_\_\_

W

This question was presented to both P7 and S2. At P7 16% identified the digit represented by the \* compared to 14% at S2. The same number of pupils identified the other missing digit (62%.)

## Reflective questions

Across our learning community are we consistent in our approaches to

- continually developing young people's mental agility skills?
- supporting young people to recognise the difference between calculating mentally and the use of written algorithms?
- developing and progressing young people's numeracy skills across all curricular areas?
- the type and frequency of questions involving decimal fractions?

## Learning and Teaching (L&T) resources

### (L&T) Nrich: Number pyramids

Generate the number at the top of the pyramid through addition

<http://nrich.maths.org/2281>



### (L&T) Nrich: Cryptarithms

Solve these cryptarithms – numbers have been replaced with letters

<http://nrich.maths.org/11107>

### (L&T) Nrich: Number operations and calculation methods

A selection of solving problems activities which use the four operations.

<http://nrich.maths.org/8468>

## Career-Long Professional Learning (CLPL) resources:

### (CLPL) Suffolk maths: approaches to calculation

Teaching methods to support development of calculation strategies using subtraction as a focus

[http://www.suffolkmaths.co.uk/pages/Teaching\\_Assistants/Mathematics%20Study%20Modules/1%20Approaches%20to%20Calculation.pdf](http://www.suffolkmaths.co.uk/pages/Teaching_Assistants/Mathematics%20Study%20Modules/1%20Approaches%20to%20Calculation.pdf)

### (CLPL) Standard algorithms versus pupils' own methods

<http://www.fmd.uni-osnabrueck.de/ebooks/erme/cerme1-proceedings/papers/g2-hedren.pdf>

Research paper: "The teaching of traditional standard algorithms for the four arithmetic operations versus the use of pupils' own methods" Rolf Hedrén.

### (CLPL) Nrich: Improving reasoning

Improving Reasoning: Analysing Alternate Approaches. Article by Malcolm Swan. Includes links to activities.

<http://nrich.maths.org/7812>

### (CLPL) Nrich: Exploration versus calculation

Article by Bernard Bagnall.

<http://nrich.maths.org/4902>

## Multiplication and division

Young people were more successful with multiplication and division calculations involving a single digit number as multiplier or divisor and multiplying by 10.

Young people were unable to apply their knowledge and understanding of the interrelationship between decimal fractions and fractions to ease multiplication calculations or to convert between equivalent forms e.g  $0.5 = \frac{5}{10} = \frac{1}{2} = 50\%$

Mental calculation skills were not strong and again demonstrate the need for young people to experience regular opportunities to develop these skills. In particular, their responses indicated a lack of understanding as to how to apply their knowledge of multiples and factors to calculate efficiently.

### Areas of strength

Young people were able to:

- multiply a whole number and decimal fraction by 10
- multiply and divide whole numbers by a single digit
- multiply and divide by a power of 10
- calculate a unitary fraction of a whole number
- multiply a decimal fraction by a single digit number

**Almost all young people** could correctly answer questions like these.

- multiply a whole number and decimal fraction by 10

$$463 \times 10$$

Answer: \_\_\_\_\_

W

**Two thirds of young people** answered questions like these correctly.

- multiply a decimal fraction by 10

To set a table 10 place mats are needed. Each place mat costs £3.25.

What is the total cost?

Answer: £ \_\_\_\_\_

W

**Almost three quarters** of young people answered a question like this correctly.

- multiply by a whole number by a single digit

John saved £91 in 7 months.  
He saved the same amount each month.

How much did he save each month?

Answer: £ \_\_\_\_\_

W

**Most** young people could carry out a calculation like this.

- divide a whole number by a single digit

David cycles a total of 2400 metres to and from school each day.

How far does he cycle to and from school in 5 days?

Answer: \_\_\_\_\_ metres

W

**Around two thirds** of young people answered a question like this correctly.

- calculate a unitary fraction of a whole number

There are 910 employees in a company.  $\frac{1}{7}$  of them are managers.

How many employees are managers?

Answer: \_\_\_\_\_

W

**Around two thirds** of young people answered a question like this correctly.

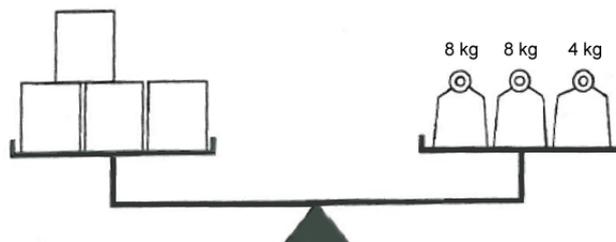
- multiply a decimal fraction by a single digit number

$$\begin{array}{r} 13.45 \\ \times 7 \\ \hline \end{array}$$

W

**Three quarters** of young people were able to reason out a simple problem like this correctly.

This set of scales is balanced. Each of the boxes on the left hand side has the same weight.



What is the weight of each of the boxes?

Answer: \_\_\_\_\_

W

## Areas for improvement

Based on their responses, children's understanding of how to deal with questions involving the following aspects were not well developed, this includes identifying and applying strategies to solve problems.

- multiplying decimal fractions by a multiple of a hundred and a thousand
- making use of factors and multiples when carrying out multiplications
- interrelationship between decimal fractions and fractions
- carrying out mental calculations

**Less than a third** of young people correctly answered a question like this

- multiplying decimal fractions by a multiple of 100

$$7.492 \times 500$$

Answer: \_\_\_\_\_

A fifth of young people gave no response to questions similar to this one.

W

**Only a fifth** of young people answered a question like this correctly.

- multiplying decimal fractions by a multiple of a hundred and thousands

Twenty thousand rugby fans each paid £18.75 for a ticket for the Rugby World Cup Final.

How much money is this altogether?

Answer: \_\_\_\_\_

A third of young people gave no response to questions similar to this one.

W

Similarly, **less than a third** of young people could answer a question like this correctly.

- making use of factors and multiples when carrying out multiplications

A theatre has 54 rows of seats.  
Each row has 32 seats.

A quarter of young people gave no response to questions similar to this one.

1700 people want to buy tickets for a show. Are there enough seats?

Explain your answer, giving numbers.

Answer: \_\_\_\_\_  
\_\_\_\_\_

W

**Only a fifth** of young people could answer a question like this correctly. Almost as many gave an incorrect answer ten times the correct answer.

- interrelationship between decimal fractions and fractions

Calculate

$$9.5 \times 0.5$$

Answer: \_\_\_\_\_

W

**Only just over half** of young people could answer a question like this correctly.

- carrying out mental calculations.

A baked potato bar orders 1300 potatoes. The potatoes are packed in bags of 20. How many bags are ordered?

*(Allow pupils approximately 15 seconds to read question [from prompt card] and work out answer mentally).*

Can you tell me your answer now?

M

**Less than a fifth** of young people answered a question like this correctly.

There are 25 seats in a row. How many seats are there in 21 rows?

*(Allow pupils approximately 15 seconds to read question [from prompt card] and work out answer mentally).*

Can you tell me your answer now?

M

**Only just over half** of young people could answer a question like this correctly. While division by a simple power of ten was carried out well the success rate decreased when the question involved a multiple of 10.

A baked potato bar orders 1300 potatoes. The potatoes are packed in bags of 20. How many bags are ordered?

*(Allow pupils approximately 15 seconds to read question [from prompt card] and work out answer mentally).*

Can you tell me your answer now?

M

Similarly, **only a quarter of** young people answered a mental question like this correctly. Where the question was shown to young people, the success rate improved only marginally.

A fifth of young people gave no response to questions similar to this one.

*(I'll read it to you twice, then you can tell me your answer)*

Rhamin buys 8 CDs costing £9.99 each. How much does he pay?

M

**Only a quarter** of young people could carry out correctly a division calculation similar to the question below.

Almost a half of young people gave no response to questions similar to this one.

$$60.3 \div 9 =$$

*(Allow pupils approximately 15 seconds to read question [from prompt card] and work out answer mentally).*

Can you tell me your answer now?

M

In a question similar to this, **only a quarter** of young people calculated the correct answer. This question required young people to use their knowledge and understanding of conversion of units or place value.

Almost a quarter of young people gave no response to questions similar to this one.

*(I'll read it to you twice, then you can tell me your answer)*

A roll of cable 6 metres long is cut into 100 equal pieces. How long is each piece?

M

**A third of young people** could not carry out multiplication calculations and only **just over a half** managed to carry out division calculations correctly,

Calculate

$$1250 \times 7$$

Answer: \_\_\_\_\_

W

Calculate

$$37.45 \div 7$$

Answer: \_\_\_\_\_

W

**Only 16%** of young people answered a question like this correctly.

A large roof is covered in solar panels.  
The roof measures  $7000 \text{ m}^2$ .  
The power output from  $10 \text{ m}^2$  of solar panels is 0.4 kilowatts.

Calculate the total power output of the solar panels on the roof.

Answer: \_\_\_\_\_ kilowatts.

W

Over a third of young people did not give a response to a question similar to this one.

**Only 15%** of young people gave the correct answer to a question like this illustrating that they were unable to identify an appropriate strategy such as working backwards, especially when the answer is a decimal fraction.

I think of a number.  
I multiply it by 4 and then divide it by 3.  
The answer I get is 7.

What was the number I started with?

Answer: \_\_\_\_\_

W

A third of young people did not give a response to a question similar to this one.

In a multi-step question like this one **less than a half** of young people gave the correct answer.

Mr Asif took his three children to the dinosaur exhibition. He paid for the four tickets with a £20 note.

Dinosaur Exhibition	
Adults £3.50	Children £2.75

Less than half of young people answered a question like this correctly

How much change did he get from his £20 note?

Answer: £ \_\_\_\_\_

W

### Reflective questions

Across our learning community are we consistent in our approaches to:

- planning an appropriate blend in the nature and frequency of examples selected to ensure appropriate challenge and development of problem solving skills?
- development of young people's knowledge and understanding of decimal fractions and interrelationship with fractions?
- planning for progression within mental agility?
- planning regular opportunities to reinforce and revisit young people's mental agility skills?

### Learning and Teaching (L&T) Resources



**(L&T) Nrich:** *Napier's location arithmetic*

Interactive multiplication strategy

<http://nrich.maths.org/5816>

**(L&T) Nrich:** *Up and Down game*

Interactive game – add on in increments, aiming for a multiple of ten

<http://nrich.maths.org/5415>

**(L&T) Nrich: Missing multipliers**  
Interactive game to practice multiplication tables.  
<http://nrich.maths.org/7382>

## **Career-Long Professional Learning (CLPL) resources:**

**(CLPL) The National Strategies: Teaching children to calculate mentally**  
[“Principles of teaching mental calculation” – pages 12-19.](#)  
[“Multiplication and division strategies” – pages 51-68.](#)  
Primary focus, but also relevant at secondary.  
<http://dera.ioe.ac.uk/778/1/735bbb0036bed2dcdb32de11c7435b55.pdf>

**(CLPL) Nrich: Divisibility tests**  
Strategies for identifying if numbers are divisible by 4, 5, 6, 8, 9, 11, 12  
<http://nrich.maths.org/1308>

### **Place value**

Young people demonstrated an understanding of second level concepts such as how decimal fractions are constructed and the link between a digit, its place and its value. However, they did not demonstrate that they have a firm grasp of how to order decimal fractions or how to decompose a decimal fraction. Whilst there were strengths in the understanding of negative numbers, too many young people were not able to work out the graduations on extended number lines within a given context.

### **Areas of strength**

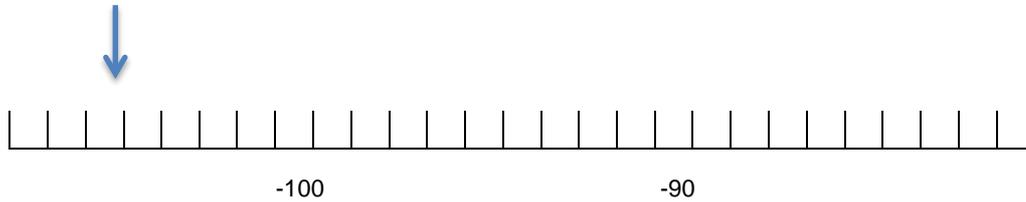
Young people could

- order and compare decimal fractions with the same number of decimal places
- work out the positions of negative numbers and decimal fractions on the number line, where the scale is straightforward



**Almost two thirds** of young people correctly labelled a negative number on a number line.

Here is part of a number line.



What is the number shown by the arrow?

Answer: \_\_\_\_\_

W

### Areas for improvement

Based on their responses, children's understanding of how to deal with questions involving the following aspects were not well developed,

Young people were less successful in:

- ordering decimal fractions with different numbers of decimal places.
- decomposing a decimal fraction.
- negative numbers in a simple real life context.

**Fewer than half** of young people answered a question like this correctly.

- ordering decimal fractions with different numbers of decimal places.

In which list are the numbers ordered from greatest to least?

- A    0.344, 0.4, 0.43, 0.443
- B    0.4, 0.43, 0.443, 0.344
- C    0.443, 0.43, 0.4, 0.344
- D    0.43, 0.344, 0.443, 0.4

W

**Only a half** of young people answered a question like this correctly, where they had to decompose a decimal fraction.

- decomposing a decimal fraction.

Write the missing number in the box to make the statement correct.

$$64.85 = 60 + 4 + 0.8 + \boxed{\phantom{00}}$$

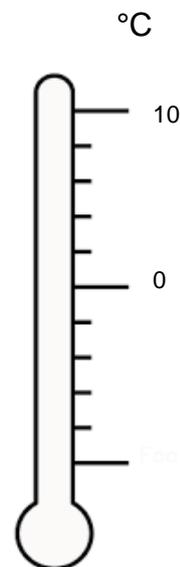
W

**Only a quarter** of young people answered a question like this correctly, using negative numbers in a simple real life context. **Almost a half** of young people made a simple error with the scale.

- negative numbers in a simple real life context.

The temperature at sunset was  $2^{\circ}\text{C}$ .  
By midnight, the temperature had dropped by  $5^{\circ}\text{C}$ .

Draw a line on the thermometer scale to show the Temperature at midnight.



W

## Reflective questions

Across our learning community are we consistent in our approaches to:

- planning teaching and learning approaches that focus on place value within decimal fractions?
- using appropriate contexts for learning to consolidate young people's understanding of numbers less than zero within relevant contexts?

## Learning and Teaching (L&T) resources:

**(L&T) Nrich:** *Place value, integers, ordering and rounding – stage 4*

A selection of solving problems activities.

<http://nrich.maths.org/8464>



**(L&T) Study jam:** *place value of decimal fractions*

[Interactivity on place value and decimal fractions.](#)

<http://studyjams.scholastic.com/studyjams/jams/math/numbers/place-value.htm>

**(L&T) Nuffield Foundation:** *Investigations*

Applying mathematical processes investigations and practical explorations

<http://www.nuffieldfoundation.org/applying-mathematical-processes/nuffield-amp-investigations>

## Career-Long Professional Learning (CLPL) resources:

**(CLPL) Education.com:** *impact of place value on mathematics*

Why is it important that young people understand place value?

<http://www.education.com/reference/article/impact-place-value-mathematics/>

**(CLPL) Math.harvard.edu:** *Deepening teachers' understanding of place value*

Understanding the concept of place value. Research article by Theresa M Hopkins and Jo Ann Cady.

<http://www.math.harvard.edu/~engelwar/MathE300/PlaceValueArticle.pdf>

## Appendix

### Performance overview in Number and number processes

From the more detailed analysis of children's and young people's performance within **number and number processes**, the following strengths and areas for improvement were identified in the 2013 Scottish survey of Literacy and Numeracy:

	First level	Second level	Third level
<b>Strengths</b>	<p><b>Addition and subtraction</b></p> <ul style="list-style-type: none"> <li>• add numbers involving multiples of ten and single digits</li> <li>• add two digit numbers including bridging across tens</li> <li>• subtract a single digit number from a two digit number with no bridging</li> <li>• mentally subtract a two digit multiple of ten from a two digit number</li> </ul> <p><b>Multiplication and division</b></p> <ul style="list-style-type: none"> <li>• mentally multiply by 5</li> <li>• divide two digit numbers by either 2 or 5 where the answer is a whole number</li> </ul> <p><b>Place value</b></p> <ul style="list-style-type: none"> <li>• identify numbers on a number line with graduations in units and hundreds</li> <li>• identify the highest and lowest numbers from a group of three digit numbers</li> <li>• identify the place value of a digit in a four-digit number</li> </ul>	<p><b>Addition and subtraction</b></p> <ul style="list-style-type: none"> <li>• carry out straightforward addition and subtraction calculations, including those involving money</li> <li>• carry out addition and subtraction calculations set within familiar contexts</li> <li>• extract and use information from simple diagrams, tables and charts</li> </ul> <p><b>Multiplication and division</b></p> <ul style="list-style-type: none"> <li>• 2-digit whole numbers multiplied or divided by a single-digit number</li> <li>• multiplication by 10</li> <li>• unitary fractions of an amount</li> </ul> <p><b>Place value</b></p> <ul style="list-style-type: none"> <li>• numbers of different values, including negative numbers</li> <li>• interpret a simple number line extended to include negative numbers</li> </ul>	<p><b>Addition and subtraction</b></p> <ul style="list-style-type: none"> <li>• carry out addition and subtraction calculations within the context of money</li> <li>• carry out calculations involving decimal fractions where the number of decimal places are balanced</li> <li>• carry out simple calculations involving negative numbers within a given context</li> </ul> <p><b>Multiplication and division</b></p> <ul style="list-style-type: none"> <li>• multiply a whole number and decimal fraction by 10</li> <li>• multiply and divide whole numbers by a single digit</li> <li>• multiply and divide by a power of 10</li> <li>• calculate a unitary fraction of a whole number</li> <li>• multiply a decimal fraction by a single digit number</li> </ul> <p><b>Place value</b></p> <ul style="list-style-type: none"> <li>• order and compare decimal fractions with the same number of decimal places</li> <li>• work out the positions of negative numbers and decimal fractions on the number line, where the scale is straightforward</li> </ul>

<b>Areas for improvement</b>	<p><b>Addition and subtraction</b></p> <ul style="list-style-type: none"> <li>• adding and subtracting two digit numbers mentally and in contexts</li> <li>• money calculations involving both pounds and pence</li> </ul>	<p><b>Addition and subtraction</b></p> <ul style="list-style-type: none"> <li>• straight forward addition and subtraction calculations involving decimal fractions</li> <li>• forming a decimal fraction to complete a calculation, both within and outwith a context</li> <li>• balancing a calculation to carry out the required operation</li> <li>• strategies to work out more complex questions</li> </ul>	<p><b>Addition and subtraction</b></p> <ul style="list-style-type: none"> <li>• balancing the calculation to carry out the required calculation</li> <li>• understanding and using decimal notation and place value including the place of zero</li> <li>• mental agility</li> <li>• appreciating and using the fact that subtraction is the inverse of addition</li> </ul>
	<p><b>Multiplication and division</b></p> <ul style="list-style-type: none"> <li>• carrying out multiplication and division calculations outwith the 2 and 5 times tables</li> <li>• knowledge and understanding multiplication and division and the links to the times tables</li> <li>• calculating a fraction of an amount</li> </ul>	<p><b>Multiplication and division</b></p> <ul style="list-style-type: none"> <li>• multiplication tables and related division facts</li> <li>• decimal notation and decimal fractions</li> <li>• multi step questions and more than one method to reach an answer</li> <li>• non-unitary fractions linked to multiplication and division</li> </ul>	<p><b>Multiplication and division</b></p> <ul style="list-style-type: none"> <li>• multiplying decimal fractions by a multiple of a hundred and a thousand</li> <li>• making use of factors and multiples when carrying out multiplications</li> <li>• interrelationship between decimal fractions and fractions</li> <li>• carrying out mental calculations</li> </ul>
	<p><b>Place value</b></p> <ul style="list-style-type: none"> <li>• the place of zero within the number system</li> <li>• conversion from written to numerical form</li> <li>• applying reasoning skills</li> </ul>	<p><b>Place value</b></p> <ul style="list-style-type: none"> <li>• larger whole numbers</li> <li>• ordering decimal fractions</li> <li>• placing or identifying a negative number on a scale between labelled points</li> </ul>	<p><b>Place value</b></p> <ul style="list-style-type: none"> <li>• ordering decimal fractions with different numbers of decimal places</li> <li>• decomposing a decimal fraction</li> <li>• negative numbers in a simple real life context</li> </ul>