Name of Policy:

Calculation Policy

Reviewed Edition	2018
Next Review	2020
Person responsible for updating policy	PC
Governors' Committee responsible	CURRICULUM

Contents

Calculation Policy

Introduction

Wallace Fields Junior School has developed a consistent approach to the teaching of written calculations in order to promote the national aims for the 2014 curriculum. These aims are for children to become **fluent** in the fundamentals of mathematics, be able to **reason** their thinking and **solve** problems by applying their mathematical thinking to a variety of routine and non-routine problems.

An emphasis is placed on mental maths for each of the four operations, building on mental skills which provide the basis for informal written recording and jottings, which are practised regularly and is an important part of learning and understanding. Skills are taught, practised and reviewed constantly so that they can lead on to more formal written methods of calculation, which in turn builds **fluency** in the children's thinking and working.

The children have access to manipulatives (practical/concrete) resources to support and develop their learning and **reasoning** skills. By using manipulatives, children can first show why a method works using concrete resources, before moving in to the more abstract method of reasoning using numbers and/or algebraic terms.

During their time at Wallace Fields Junior School, the vast majority of children will progress steadily through each calculation method outlined in this policy but it is important to emphasise here that this is not a learning order to a better way to +,-, x or ÷. In order to ensure that children become mathematical thinkers, transitions between stages should not be hurried as not all children will be ready to move on to the next stage at the same time. The progression in calculations developed in this policy are outlined in stages/year groups, however previous stages may need to be revisited to consolidate understanding when moving on to a new strategy, all of which will be assessed and decided by ongoing formative assessments carried regularly out by the teachers.

Aims

Children should be able to think mathematically and choose an **efficient** method; mental, written or calculator, appropriate to **solve** the given problem.

Children working at the new national expectations and above will have been taught, and are secure with, a compact standard method for each operation.

General Progression

- To establish mental methods based on a good understanding of place value.
- Use of informal jottings to aid mental calculations
- Develop use of an empty number line to help mental imagery and aid recording
- Use of partitioning and recombining to aid informal methods
- Introduce expanded written methods
- Develop expanded written methods into compact standard written form.

Before carrying out a calculation, children should be encouraged to think mathematically, considering:

- Can I do it in my head? (Using rounding, adjustment, number line)
- The size of an approximate answer (estimation)
- Could I do jottings to keep track of the calculation?
- Should I use an expanded or compact written method?

(Children may not refer to these names but will understand the methods.)

While children are developing their written strategies, they will consolidate their underlying Mathematics knowledge of:

Addition and Subtraction

- Do they know addition and subtraction facts to 10? 20? 50? 100? 1000?
- Do they understand place value and can they partition numbers?
- Can they add three single digit numbers mentally?
- Can they add and subtract any pair of two digit numbers mentally?
- Can they explain their mental strategies orally and record them using informal jottings?
- Can they use place value to add and subtract in the context of money?
- Can they add and subtract using a standard written method for numbers up to 4 decimal places?

Multiplication and Division

A deeper emphasis is being placed on multiplication and division knowledge in the lower school, as the latest government news is that an online multiplication test will be bought in nationally at the end of 2019 academic year (summer 2020). Children will be getting weekly times table tests in Years 3 and 4 specifically and any difficulties will be addressed in class lessons as appropriate. Children should be encouraged to practise their times tables at home regularly to promote efficiency and understanding of the key facts.

- Do they know their times tables up 12x12?
- Do they know the result of multiplying by 1 and 0?
- Do they understand 0 as a place holder?
- Can they multiply two and three digit numbers by 10 and 100?
- Can they double and halve two, three and four digit numbers mentally?
- Can they use multiplication facts they know to derive mentally other multiplication facts that they do not know?
- Can they explain their mental strategies orally and record them using informal jottings?
- Can they multiply whole numbers and decimal numbers up to three decimal places by 10, 100 and 1000?
- Can they multiply and divide decimals up to two-decimal places by 1 and 2 digit whole numbers?
- Do children understand the relationship between unit fractions and division?
- Do children recognise division calculations as the inverse of multiplication?

NOTE:

The correct terminology should be used when referring to the value of digits to support children's understanding of place value.

E.g.

68 + 47 should be read 'sixty add forty' **or** 'six 10s' add 'four 10s' **not** 'six add four'

Progression in Addition

Children will be doing a daily mixture of practical, mental and oral work including lots of counting, talking about numbers and using numbers in real life activities. Within the new curriculum requirements, this will include an element of repetition of key skills so that children become **fluent,** improve their ability to use **reasoning** when explaining their mathematics and can use these mental techniques **efficiently**.

Children will be encouraged to use practical equipment such as place value cards and counters, diennes, bead strings, 100 squares and then, as they develop confidence, they will progress in to using mental strategies; such as number lines in their heads.

E.g. "17 add 12. Think of 17, add on the two 1's, and then add on the 10. What do you have?"

They may also record what they've done with pictures and numbers. These jottings will help them to understand what is happening and to show how they've worked something out. Children will carry on using horizontal recording of addition to support their mental calculations, until they become **fluent** and **efficient** with their mental calculations.

With both mental and written number lines, children will be encouraged to try and add on the 1's first and then the 10's, etc. This will aid progression into the more structured written methods. Children may use partitioning to aid their jottings.

Once children have a firm grasp of the methods outlined above, they will be taught written, expanded methods, for those calculations that they cannot do 'in their heads'. Here is an example:

	10'S	1'S
74	+70	+ 4
+25	20	+ 5
99	90	+ 9

These methods mean that children may have to write a little more at this stage but, because it helps and supports their understanding, it enables them to become much more confident and **efficient** in the long run. It will also enable them to consider where mistakes may have been made during the process.

Once children really understand what they are doing they can be quickly taught how an 'expanded method' can be 'squashed' step by step into the 'compact' method that you may recognise!

Here is an example:

```
  7 8 3
+1 3 5
-------
    8
 1 1 0
 8 0 0
-------
 9 1 8
```

```
  7 8 3
+1 3 5
1
-------
 9 1 8
```

Children will then extend written methods to include column addition of decimals with up to 3 decimal places including amounts of money, length and masses.

(Further details about the equipment and representations that can be used by teachers to promote progression in the children's calculation skills are provided at the end of this document.)

Progression in Subtraction

Children will be doing a daily mixture of practical, mental and oral work including lots of counting, talking about numbers and using numbers in real life activities. They will be encouraged to use practical equipment such as place value cards and counters, diennes, bead strings and 100 squares. Children may record what they've done with pictures and numbers. These recordings will help them to understand what is happening and to show how they've worked something out.

Children will carry on using horizontal recording of subtraction to support their mental calculations. They will use drawings, diagrams and blank number lines to support their thinking. All number lines will work chronologically with the smallest number always being to the left and the largest to the right. Children will be encouraged to count backwards from the right first of all to reinforce the concept that subtraction is equal to 'taking away' from the starting number. They will then progress on to 'finding the difference' which can include counting on from the smaller number. Children will be able to use different number lines to support these different calculations. Children should be able to choose the most **efficient** and appropriate method for each calculation.

Once children really understand what they are doing they can again move on to being taught, step by step, the compact method.

Here is an example of a subtraction problem without any decomposition (breaking down of numbers):

Example: 467-234 =

100'S		10'S		1'S
400	+	60	+	7
200	+	30	+	4 –
200	+	30	+	3

$$\begin{array}{r} 467 \\ -234 \\ \hline 233 \end{array}$$

As children progress they will be able to use decomposition to aid their subtraction calculations.

For example:

652-437 =

100'S		10'S		1'S
600	+	50	+	2
400	+	30	+	7 -

100'S		10'S		1'S
600	+	40 ~~50~~	+	12
400	+	30	+	7 -
200	+	10	+	5

$$\begin{array}{r} 652 \\ -\ 437 \\ \hline 215 \end{array}$$

Children will extend subtraction methods to include decimal numbers up to 3 decimal places.

Examples of progression in addition and subtraction from the National Curriculum are:

789 + 642 becomes

```
      7 8 9
    + 6 4 2
    -------
    1 4 3 1
      1 1
```

Answer: 1431

874 – 523 becomes

```
      8 7 4
    – 5 2 3
    -------
      3 5 1
```

Answer: 351

932 – 457 becomes

```
      8  12  1
      ~9 ~3  2
    – 4  5  7
    ---------
      4  7  5
```

Answer: 475

932 – 457 becomes

```
        1  1
      9  3  2
    – ~4 ~5  7
      5  6
    ---------
      4  7  5
```

Answer: 475

Progression in Multiplication and Division

Concepts in multiplication and division are very closely linked and should be developed together.

Multiplication/Division

Children will learn multiplication facts and current expectations state that they should begin key stage 2 already knowing the facts for x2, x3, x5 and x10, including being able to count in 10's from any number. Current expectations are such that children will continue learning key facts through year 3 and 4 in order to apply those facts to problem solving in years 5 and 6. To secure these key facts, children may use equipment, pictures and other modelled representations as a way of recording what they have done and what they understand to be happening (key ideas that can be used by teachers are included at the end of this document).

Children will be able to multiply numbers up to 4-digits by TO (10's and 1's).

Children will learn their multiplication facts and understand that multiplication and division are inverse operations – if you know your times tables, you know your division tables.

Children will understand the language of prime numbers and prime factors and will be able to recognise square and cube numbers.

Some children may still view division as repeated subtraction and multiplication as repeated addition and may require pictures or jottings to support their calculations.

Children will understand the effect of multiplying and dividing by 10, 100 and 1000.

Children will start to formally multiply using the structure often called grid multiplication.

37 x 3=

X	30	7
3	90	21

90+21 = 111

Children will be encouraged to

move on to:

```
  3 7
    x 3
  -----
  1 1 1
```

Grid multiplication uses knowledge of number facts and the idea of partitioning a number into its parts to help children understand the process of multiplication. When children are able to successfully multiply TO by TO using the grid method, they should be taught the column method outlined below.

Example 1

```
  37
x12
----
  14     (2x7)
  60     (2x30)
  70     (10x7)
 300    (10x30)
----
 444
```

Example 2

```
   3 7
 x1 2
-----
   7 4
 3 7 0
-----
 4 4 4
 1
```

(Other examples, including multiplying decimals can be seen at the end of the document.)

The children will be taught that division is repeated subtraction and number lines will initially be used to show and clarify this. Their next step will be to learn how to use vertical recording to take multiples of 10, so as to take larger multiples away.

Children will start formal calculations in division by, again, using a regrouping method of division.

For example:

72 ÷ 3 =

72	72
30 - (**10**x3)	60- (**20** x 3)
42	12
30 - (**10**x3)	12- (**4** x 3)

12 0

12 - (**4** × 3)

0

Therefore 72 ÷ 3 = 24

Children will find remainders as whole numbers first.

The children will be taught how to express a remainder as a fraction of the whole and then as a decimal.

Once children are able to use the method outlined above, they will be taught short division, including numbers with remainders shown as fractions or decimal fractions.

<u>For example:</u>

```
  1 2 2
6 |7 3 2
```

Children will extend their use of written methods and will be taught long division, including numbers with up to 2 decimal places, initially in practical contexts such as money and measures.

```
     142
16 |2272
   -16↓
     67
    -64
      32
     -32
```

Examples of progression in multiplication and division from the National Curriculum are:

Short multiplication

24 × 6 becomes

```
      2 4
  ×     6
  -------
  1 4 4
    2
```

Answer: 144

342 × 7 becomes

```
      3 4 2
  ×       7
  ---------
  2 3 9 4
    2 1
```

Answer: 2394

2741 × 6 becomes

```
      2 7 4 1
  ×         6
  -----------
  1 6 4 4 6
    4 2
```

Answer: 16 446

Long multiplication

24 × 16 becomes

```
      2
      2  4
  ×   1  6
  -------
  2  4  0
  1  4  4
  -------
  3  8  4
```

Answer: 384

124 × 26 becomes

```
      1  2
      1  2  4
  ×      2  6
  ----------
  2  4  8  0
     7  4  4
  ----------
  3  2  2  4
  ----------
  1  1
```

Answer: 3224

124 × 26 becomes

```
      1  2
      1  2  4
  ×      2  6
  ----------
     7  4  4
  2  4  8  0
  ----------
  3  2  2  4
  ----------
  1  1
```

Answer: 3224

Short division

98 ÷ 7 becomes

```
        1  4
      ------
      2
7 | 9  8
```

Answer: 14

432 ÷ 5 becomes

```
           8  6  r 2
        ----------
        3
5 | 4  3  2
```

Answer: 86 remainder 2

496 ÷ 11 becomes

```
           4  5  r 1
        ----------
        5
1 1 | 4  9  6
```

Answer: 45 $\frac{1}{11}$

Long division

432 ÷ 15 becomes

```
           2  8  r 12
        ----------
1 5 | 4  3  2
      3  0  0
      ---------
      1  3  2
      1  2  0
      ---------
         1  2
```

Answer: 28 remainder 12

432 ÷ 15 becomes

```
           2  8
        ----------
1 5 | 4  3  2
      3  0  0      15×20
      ---------
      1  3  2
      1  2  0      15×8
      ---------
         1  2
```

$\frac{12}{15} = \frac{4}{5}$

Answer: 28 $\frac{4}{5}$

432 ÷ 15 becomes

```
           2  8 · 8
        ----------
1 5 | 4  3  2 · 0
      3  0      ↓
      ---------
      1  3  2
      1  2  0
      ---------
         1  2  0
         1  2  0
         ---------
               0
```

Answer: 28·8