Pol14 – Numeracy Principles & Methods Policy

This policy contains detailed guidance on teaching approaches; it is to be adopted across the school, in relation to Numeracy. It is influenced strongly by the National Numeracy Strategy Primary and Secondary documents.

A. NUMBER

a. Mental Mathematics

1. Every opportunity should be taken to develop students' mental agility and 'feel' for the size of an answer. This will happen in Maths lessons, and in many other subject areas.
2. Mental calculation is an essential feature of all calculations, which are performed using pencil and paper or a calculator.
3. Mental calculation skills need to be practiced constantly to keep them sharp.
4. Where opportunities arise for mental calculation to occur, staff should point these out to students and ask questions/discuss methods.
5. As a minimum staff should expect all students to know,
   i. multiplication tables up to l0 x 10;
   ii. number bonds up to 20 (14 + 19, 16 + 17);
   iii. doubles and halves up to 25 (double 24, half of 22);
   iv. fraction, decimal, percentage equivalents of halves, quarters, tenths, fifths and thirds;
6. The reaction of staff, if students do not know the above, is very important. Members of Staff need to express concern and surprise (in a supportive way!) and then discuss how these facts can be learnt/remembered.

b. Computation

1. Students will come to Olive with a range of methods for carrying out basic computations. Therefore although there are some agreed 'school methods' if a student's method is accurate and reasonably efficient he will not be asked to change it. In fact the comparison of different methods for the same calculation can be a benefit for students understand. Therefore when a student encounters difficulty,
   i. find out what method they are using;
   ii. try to fix the method the student is using;
   iii. only when this fails use other approaches;

2. Every effort should be made to make students familiar with the language used in computation.
3. For simple calculations students should be encouraged to do them mentally. For more complex calculations, students should be encouraged to estimate the answer before using a pencil and paper method or a calculator.
4. Students should **always** be encouraged calculations, to show their method when doing either pencil and paper or calculator.
5. Students should be encouraged to check if their answers make sense, particularly where units or decimals are involved.

c. Estimating

1. The following steps should be taken
   i. Round to the nearest l0 for numbers < 100
   100 for numbers < 1000
   1000 for numbers <10000 etc
   ii. Calculate with these numbers -
   iii. Encourage students to say if the answer is greater or smaller than their estimate, and give reasons.

2. Note:

   i. The interdependent on mental mathematics skills
   ii. Students should be encouraged to use their own methods
   e.g. 880÷12 900÷10=90 880 ÷ 10=88 840÷12=70
   iii. This will eventually be talked about in terms of 1 significant figure approximations.

d. Addition

1. The school is aiming that single digit and most two-digit addition is done mentally.
   Ask students to suggest methods; these will usually be either;
   - a variation on adding tens and units digits and then combining the totals;
   - a variation on a 'counting- on' method, first adding the units, then the tens;
   -E.g. 34 + 47 34 + 7 = 41 41 + 40 = 81
2. For 3 digit or greater addition, use the traditional method

$$\begin{array}{r} 309 \\ \underline{+\ 782} \\ \underline{1091} \\ 1 \end{array}$$

(students should show the carrying figures.)

3. If students are having problems with simple number bonds (e.g. 7 + 8), use physical props, counters, fingers, number line or ruler.

e. Subtraction

1. All 1-digit and many 2-digit subtractions can be solved mentally. Ask students to suggest methods; these will usually be either.
   - i. A variation on subtracting tens and units' digits
   - ii. A variation on a 'counting-back' method, first subtracting the units, then the tens.

e.g. 92 - 47 92 - 7 = 85 85 – 40 = 45

2. For 3-digit subtraction nearly all students use the decomposition method, which is probably the most appropriate for understanding the subtraction process.

e.g

$$\begin{array}{r} {}^{5}6\,{}^{1}4\,{}^{4}5\,{}^{1}7 \\ -\ \underline{3\ 8\ 2\ 9} \\ \underline{2\ 6\ 2\ 8} \end{array}$$

3. Students should be encouraged to
   - i. Make an estimate first
   - ii. Check that the answer makes sense in the context of the work
   - iii. Check subtraction by addition.

4. If students are having problems with simple number bonds (e.g. 17-8), use physical 'props' i.e. Counters, fingers, number line or ruler. It is also helpful to stress the link between addition and subtraction.

f. Multiplication

1. Most students find the 1,2,5 and 10 times tables easier to learn. This is generally followed by the 9 times tables because of the number patterns involved. These leave 36 sums to learn, however, this number can be reduced by half, because 7 x 8 is the same as 8 x 7, so in fact there are 18 sums to learn. There is no easy solution to the times tables problem. Virtually all students are capable of learning them and staff must expect them to know them. Constant reinforcement is needed when opportunities arise.

2. If a student does not know a times table.
   - i. Remind them to use the nearest known number fact to find the answer.
     e.g. 7x8=? 7x5=35, 7x6=42 ,7x7=49 so 7x8=56
   - ii. As a last resort allow them to use a tables sheet, available from the mathematics department.
   - iii. Ask them to write out the fact 5 times, as we would a spelling, ask them again next lesson.

3. In short multiplication most students will either use a mental method, if the numbers are small or the traditional method if the numbers are large.

e.g.
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 67 x
  8
536
  5
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Students should make an estimate (e.g. 70x10 for the calculation above) and show carrying figures.

4. In long multiplication, students will use a variety of methods. In this type of calculation an estimate is vital.

e.g. 478 x 52 estimate 500 x 50 = 25,000

Many students will use the traditional method or a slight variation on this

e.g.
```
478
52 x
956
23900
24856
  1
```

If the students can use this method accurately they can continue to do so. They will also be taught the 'box —method'. This is slightly less efficient, but gives a better understanding of the process as the students can see each part of the number being multiplied by every other part. The 'box-method' also provides a better link to algebraic multiplication when students reach that level.

The 'box-method': -

478 x 52 Split the two number into hundreds, tens and units. Then multiply each part with every other part. Then add up the parts.

X	400	70	8
50	20000	3500	400
2	800	140	16

```
 2000
 3500
  400
  800
  140
   16 +
24856
```

g. *Division*

1. Students need to be reminded that there are a number of ways of recording a division calculation.

   16÷8= or 8)‾‾‾‾ or $\frac{16}{8}$

2. If students are having difficulty understanding the concept
   - i. emphasise the concept of sharing
   - ii. demonstrate agreed method to them
   - iii. remind that division and multiplication are inverse operations

   7 x 8 = 56 56 ÷ 7 = 8

3. As with long multiplication, estimating answers first is very important with all types of division calculations.

4. Most students will use the traditional method for short division

   $$\begin{array}{r} \underline{1\;2\;2} \\ 7\,)8^{1}5^{1}4 \end{array}$$

5. For long division students will be taught a variation on the traditional short division method

   $$\begin{array}{r} \underline{32} \\ 16\,)51^{3}2 \end{array}$$

   To calculate how many 16s in 51, and the remainder, the students will use either repeated addition or short multiplication. This will increase their understanding of the process involved.

h. *Multiplication and Division by multiples of 10,100 1000 etc*

When multiplying or dividing by 10, 100, 1000 etc., use headed columns and emphasise that the numbers move, not the decimal point. This also makes it clear why multiplying by 10 adds a zero, etc.

e.g. 34x100=3400

thousands	hundreds	tens	units
		3	4
3	4	0	0

e.g. 5.6 x 1000 = 5600

thousands	hundreds	tens	units	tenths
			5	6
5	6	0	0	

e.g. 230÷10=23

thousands	hundreds	tens	units
	2	3	0
		2	3

The expectation is that in time students will be able to perform this sort of calculation mentally.

2. Students should also be able to work almost mentally with calculations like
2000 x 600 = 1200000
(2 x 6 = 12, make this 1000 times bigger, then 100 times bigger)

The following procedure should be followed when multiplying and dividing by multiples of 10,100 1000 etc:

i. Set out the calculation to be performed
ii. Estimate the answer
iii. Clear display
iv. Key in calculation
v. Interpret the display, compare to estimate, round off if necessary
vi. Use answer in inverse operation as an additional check on answer. Stress to students that what comes out of a calculator is only as good as what went in.

Percentages

1. For all percentage calculations stress to students the need to understand what the whole (100%) is and the link between percentage, fractions and decimals.

2. When performing calculations with money emphasise that percentage means so many pence in the pound, or so many pounds in a hundred pounds.
e.g. 65 of 12   18% of £400
1%= 12p   1% = £4
6%= 72p   18% = £72

3. For percentage calculations involving the following
25% 50% 75% *10%* 20% 30% 40% 50% 60% 70% 80% 90% use the fraction equivalent as part of the calculation.

4. For other 'percentage of' calculations, use the decimal equivalence method along with an estimate first
e.g. 35% of £234
estimate 30% of 200 is about 60 (because 10% is roughly 10)
then 0.35 x234= 81.9
give answer as £81.90

5. When calculating one number as a percentage of another, first give as a fraction, then a decimal, finally as a percentage.

e.g. 17 as a percentage of 22
17 = 17 22 = 0.77 (to 2 decimal places) = 77%

B. **SHAPE AND SPACE**

a. *Measuring*

1. When using any type of measuring instrument remind students
   to start from zero,
   to be clear what the graduations are going up in.

2. Students should know the following metric conversions

10mm	=	1cm
100cm	=	1m
l000m	=	1km
l000g	=	1kg
1000 m l	=	1litre

3. The following approximate metric/imperial conversions will be used in all areas

1 inch	=	2.5 cm
1 yard	=	90cm
1 pint	=	0.5 litres (500 ml)
2.2 lbs	=	1 kg (GCSE)
2 lbs	=	1 kg (Years 7, 8, 9)
1 ounce	=	25g
1 foot	=	30cm

4. All areas will take pi (0) to be 3.14. An abbreviation of 3 may be used in Years 7 and 8.
5. The following physical comparisons will be used across the school

Length small finger	=	2 cm across
Metric rule	=	1 m across
Volume coke can	=	330 ml, about one third of a litre
Weight paper clip = 1g	large apple = 100 g	bag of sugar = 1 kg

C. **DATA HANDLING**

1. Pie charts will usually be drawn using percentages. The percentages will be calculated using the method shown in the percentage section.
2. When drawing a line graph the line will be drawn as a solid line if the horizontal variable is continuous (e.g. temperature recorded at different times of the day) and a dotty line if the horizontal line is

discrete (e.g. the number of cars sold in the UK each year). This will reinforce to students the difference between discrete and continuous data.

3. For most of the data which students collect, for example in questionnaires, they should use equal group widths

e.g. How much pocket money do Year 7 students receive each week?

Amount	Tally	Frequency
0 p - 49p		
50 p - 99p		
£1.00 - £1.49		
£1.50 - £1.99		
£2.00 - £2.49		
£2.50 - £2.99		

4. With all graphs emphasise the importance of 'reading' the graph first to understand the scale etc., before trying to use the graph in any way.