

William Austin Junior School

Policy for Mental Mathematics



Rationale

This policy contains the key mental mathematic procedures that are to be taught at William Austin Junior School. It has been created to ensure consistency and progression throughout the school.

This document should be used in conjunction with our existing calculation policy. While that focuses on pencil and paper procedures, it is important to recognise that the ability to calculate mentally lies at the heart of mathematics.

Mental calculation is not to be taught at the exclusion of written recording, and should be seen as complementary to and not separate from it. In every written method there should be an element of mental processing and checking by using approximate answers. Written recordings help the children to clarify their thinking, supporting and extending the development of more fluent and sophisticated mental strategies.

As with our calculation policy, teachers should use their judgement to decide on the stage of progression of each child and differentiate appropriately.

The children will be encouraged to see mathematics as both a written and spoken language. Teachers must ensure that they and the children use the correct vocabulary at all times.

This policy emphasises the importance of 'The Six Rs' (rehearse, recall, refresh, refine, read and reason). These identify six features of children's mathematical learning that oral and mental work can support.

Aim

Our aim is for the children to be able to select an efficient method of their choice that is appropriate for a given task. They should do this by asking themselves:

- Can I do this in my head?
- Can I do this in my head using jottings or drawings?
- Do I need to use a written method?

Progression through calculations for addition

These are a selection of mental calculation strategies:

Mental recall of number bonds

$$6 + 4 = 10$$

$$25 + 75 = 100$$

$$\square + 3 = 10$$

$$19 + \square = 20$$

Mental recall of doubles

Use near doubles

$$6 + 7 = \text{double } 6 + 1 = 13$$

Addition using partitioning and recombining

$$34 + 45 = (30 + 40) + (4 + 5) = 79$$

Counting on or back in repeated steps of 1, 10, 100, 1000

$$86 + 57 = 143 \text{ (by counting on in tens and then ones)}$$

$$460 - 300 = 160 \text{ (by counting back in hundreds)}$$

Add the nearest multiple of 10, 100 and 1000 and adjust

$$24 + 19 = 24 + 20 - 1 = 43$$

$$458 + 71 = 458 + 70 + 1 = 529$$

Use the relationship between addition and subtraction

$$36 + 19 = 55$$

$$19 + 36 = 55$$

$$55 - 19 = 36$$

$$55 - 36 = 19$$

Vocabulary

Add, addition, more, plus, increase, sum, total, altogether, score, double, near double, how many more to make..., how many more/fewer is... than..., how much more/less is..., is the same as, equals, sign, tens boundary, hundreds boundary, units boundary, tenths boundary, inverse.

Progression through calculations for subtraction

These are a selection of mental calculation strategies:

Mental recall of addition and subtraction facts

$$10 - 6 = 4$$

$$17 - \square = 11$$

$$20 - 17 = 3$$

$$10 - \square = 2$$

Find a small difference by counting up

$$82 - 79 = 3$$

Counting on or back in repeated steps of 1, 10, 100, 1000

$$86 - 52 = 34 \text{ (by counting back in tens and then in ones)}$$

$$460 - 300 = 160 \text{ (by counting back in hundreds)}$$

Subtract the nearest multiple of 10, 100 and 1000 and adjust

$$24 - 19 = 24 - 20 + 1 = 5$$

$$458 - 71 = 458 - 70 - 1 = 387$$

Use the relationship between addition and subtraction

$$36 + 19 = 55$$

$$19 + 36 = 55$$

$$55 - 19 = 36$$

$$55 - 36 = 19$$

Vocabulary

Subtract, take away, minus, decrease, leave, how many are left/left over, difference between, half, halve, how many more/fewer is.../than..., how much more/less is..., is the same as, equals, sign, tens boundary, hundreds boundary, units boundary, tenths boundary, inverse.

Progression through calculations for multiplication

These are a selection of mental calculation strategies:

Doubling and halving

Applying the knowledge of doubles and halves to known facts,

e.g. 8×4 is double 4×4

Using multiplication facts

Tables should be taught and practised regularly. By the end of year 4, children are expected to have memorised their multiplication tables up to 12×12 and show fluency and precision in their work.

Using and applying multiplication facts

Children should be able to utilise their times tables knowledge to derive other facts,

e.g. If I know $3 \times 2 = 6$, what else do I know?

$6 \div 3 = 2$ and $2 = 6 \div 3$

also $30 \times 2 = 60$, $60 \div 3 = 20$ and $20 = 60 \div 3$ also $200 \times 3 = 600$ and $600 \div 3 = 200$

Use closely related facts already known

$$13 \times 11 = (13 \times 10) + (13 \times 1)$$

$$= 130 + 13$$

$$= 143$$

Multiplying by 10, 100 or 1000

Knowing that the effect of multiplying by 10 is a shift in the digits of one place to the left.

Knowing that the effect of multiplying by 100 is a shift in the digits of two places to the left.

Knowing that the effect of multiplying by 1000 is a shift in the digits of three places to the left.

Partitioning

$$23 \times 4 = (20 \times 4) + (3 \times 4)$$

$$= 80 + 12$$

$$= 92$$

Use of factors

$$8 \times 12 = 8 \times 4 \times 3$$

Commutativity

$$4 \times 12 \times 5 = 4 \times 5 \times 12 = 20 \times 12 = 240$$

Vocabulary

Lots of, groups of, times, product, multiply, multiplied by, multiple of, once, twice, three times... twelve times, repeated addition, array, row, column, double, halve, group in pairs, threes... twelves, factor, quotient, inverse.

Progression through calculations for division

These are a selection of mental calculation strategies:

Doubling and halving

Knowing that halving is dividing by 2

Deriving and recalling division facts

Tables should be taught and practised regularly. By the end of year 4, children are expected to have memorised their multiplication tables up to 12 and show fluency and precision in their work.

Using and applying division facts

Children should be able to utilise their tables knowledge to derive other facts,

e.g. If I know $3 \times 7 = 21$, what else do I know?

$21 \div 7 = 3$ so $210 \div 7 = 30$, $210 \div 3 = 70$, $210 \div 70 = 3$ etc.

Dividing by 10, 100 or 1000

Knowing that the effect of dividing by 10 is a shift in the digits of one place to the right.

Knowing that the effect of dividing by 100 is a shift in the digits of two places to the right.

Knowing that the effect of dividing by 1000 is a shift in the digits of three places to the right.

Use of factors

$$387 \div 21 \quad 387 \div 3 = 126 \quad 378 \div 21 = 18 \quad 126 \div 7 = 18$$

Use related facts

Given that $1.4 \times 11 = 15.4$ What is $1.54 \div 1.4$ or $1.54 \div 1.1$?

Vocabulary

Lots of, groups of, times, product, multiply, multiplied by, multiple of, once, twice, three times... twelve times, repeated addition, array, row, column, double, halve, share, share equally, one each, two each, three each..., group

in pairs, group in threes... group in twelves, equal groups of, divide, divided by, divided into, divisible by, remainder, factor, quotient, inverse, how many in...

The Six Rs

As mentioned above, this policy emphasises the importance of ‘The Six Rs’. These identify six features of children’s mathematical learning that oral and mental work can support. What follows is a brief description of the learning focus and an outline of possible activities. These are not independent: oral and mental work may address more than one feature of learning and have more than one purpose. It is important that the activity is purposeful and that the children understand what they are engaged in and required to learn during the oral and mental activity. ‘The Six Rs’ provide a vocabulary and guide to use when identifying the purposes of oral and mental work.

| The Six Rs | Learning focus | Possible activities |
|-------------------|---|--|
| Rehearse | To practise and consolidate existing skills, usually mental calculation skills, set in a context to involve children in problem solving through the use and application of these skills; use of vocabulary and language of number, properties of shapes or describing and reasoning. | Interpret words such as <i>more, less, sum, altogether, difference, subtract</i> ; find missing numbers or missing angles on a straight line; say the number of days in four weeks or the number of 5p coins that make up 35p; describe part-revealed shapes, hidden solids; describe patterns or relationships; explain decisions or why something meets criteria. |
| Recall | To secure knowledge of facts, usually number facts; build up speed and accuracy; recall quickly names and properties of shapes, units of measure or types of charts, graphs to represent data. | Count on/back in steps of constant size; recite the 6x table and derive associated division facts; name a shape with five sides or a solid with five flat faces; list properties of cuboids; state units of time and their relationships. |
| Refresh | To draw on and revisit previous learning; to assess, review and strengthen children’s previously acquired knowledge and skills relevant to later learning; return to aspects of mathematics with which the children have had difficulty; draw out key points from learning. | Refresh multiplication facts or properties of shapes and associated vocabulary; find factor pairs for given multiples; return to earlier work on identifying fractional parts of given shapes; locate shapes in a grid as preparation for lesson on coordinates; refer to general cases and identify new cases. |
| Refine | To sharpen methods and procedures; explain strategies and solutions; extend. | Find differences between two two-digit numbers, extend to three-digit numbers. |
| Read | To use mathematical vocabulary and interpret images, diagrams and symbols correctly; read number sentences and provide equivalents; describe and explain diagrams and features involving scales, tables or graphs; identify shapes from a list of their properties; read and interpret word problems and puzzles; create their own problems and lines of enquiry. | Tell a story using an interactive bar chart, alter the chart for children to retell the story; start with a number sentence (e.g. $2 + 11 = 13$) children generate and read equivalent statements for 13; read values on scales with different intervals; read information about a shape and eliminate possible shapes; set number sentences in given contexts; read others’ results and offer new questions and ideas for enquiry. |
| Reason | To use and apply acquired knowledge, skills and understanding; make informed choices | Sort shapes into groups and give reasons for selection; discuss why alternative methods of |

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|--|---|---|
| | and decisions, predict and hypothesise; use deductive reasoning to eliminate or conclude; provide examples that satisfy a condition always, sometimes or never and say why. | calculation work and when to use them; decide what calculation to do in a problem and explain the choice; deduce a solid from a 2-D picture; use fractions to express proportions; draw conclusions from given statements to solve puzzles. |
|--|---|---|

Supporting pupils with special educational needs

Pupils with special educational needs may have difficulties with mental calculation. They generally demonstrate inconsistencies with basic computation of addition, multiplication, division and subtraction. Mental calculation requires the use of short-term working memory and pupils with learning difficulties often have poor memory skills.

Pupils with specific learning difficulties often struggle with mental arithmetic or learning the times tables. The DfE defines dyscalculia as:

“A condition that affects the ability to acquire arithmetical skills. Dyscalculic learners may have difficulty understanding simple number concepts, lack an intuitive grasp of numbers, and have problems learning number facts and procedures. Even if they produce a correct answer or use a correct method, they may do so mechanically and without confidence.”

The following strategies/resources will support pupils to calculate number facts and to improve the accuracy of their work:

- Use of a ruler to add and subtract numbers to 30
- Use of a hundred square to add and subtract numbers to 100
- Use of multiplication grids to find multiplication facts up to 10 x 10
- Finger method for working out 9 times tables facts
- Use of coin method for working out multiplication facts, e.g. using 5p and 2p coins to work out multiples of 7
- Use of Numicon to support and develop pupils' mental imagery

Useful document:

- The daily mathematics lesson: Guidance to support pupils with dyslexia and dyscalculia (copies of this document can be obtained from DfES Publications Ref: DfES 0512/200).

Review

This policy is monitored by the Senior Leadership Team and the Achievement Leaders through:

- Regular scrutiny of children's books to find evidence of mental calculation jottings;
- Regular monitoring of teaching plans to find evidence of the discrete teaching of mental strategies;
- Evaluation and review of assessment data;
- Lesson observations to monitor the quality of teaching and implementation of teaching plans;
- Pupil interviews.

This policy should be read in conjunction with our policy on mathematics.

This policy will be monitored and reviewed by the Numeracy subject leader on an annual basis.

Policy updated: November 2013

Staff responsible: Ben Oxley

This policy was ratified by the Governing body on:

20th November 2013

Signed on behalf of the Governing Body: _____(signature)

Mr Stan Boelman