HOLLYMOUNT SCHOOL KS1 CALCULATION POLICY

Hollymount School

Inspiring Success

The Black Pear Trust

Overview of Hollymount School KS1 Calculation Policy

Hollymount's KS1 calculation policy outlines both the mental and written methods that should be taught from Year 1 to Year 2 and looks to build on the skills and understanding highlighted in the school's Early Counting Policy. It is a progressive calculation policy that incorporates written methods for all four operations. The guidance shared in the policy aims to equip all children with mental and written methods which they can apply with independence- choosing which method is appropriate for the problem.

It is our intention that the teaching of addition should precede subtraction and that these two operations should be taught successively. This is to ensure children are able to identify clear links between the two operations and understand and explain the inverse nature of them. This process should also be true for the teaching of multiplication and division.

It is our aim that all children have a secure understanding and accurate application of written methods for all four operations. Mental strategies should continually be encouraged, developed and revisited. The use of concrete and visual resources should be effectively used to support children's relational understanding of calculation (both mental and written). As a school, we focus on developing children's understanding and use of the number line method. Although children are given the opportunity to explore and compare other methods, we have seen the positive impact on children's understanding and progress the consistent teaching of one primary method has. Other methods and representations are highlighted in this policy.

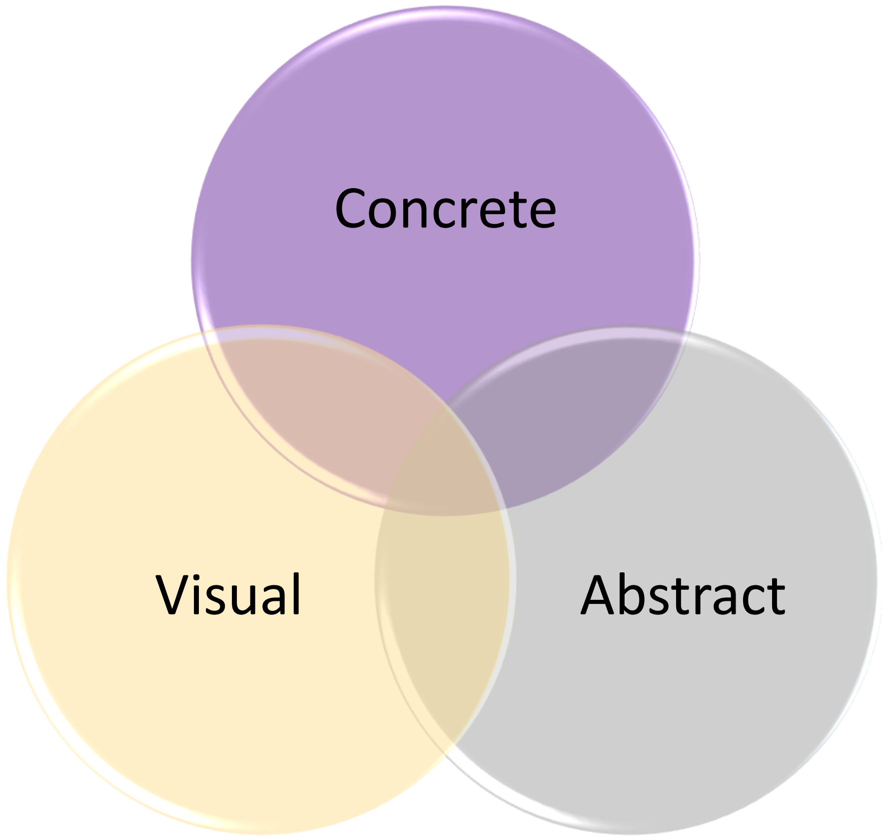
When calculating, children should be able to independently choose whether to use mental or written methods. There will be occasions when examples that can be completed mentally may be shown and modelled as a written method; this is to support and develop children's understanding of the written process.

A range of concrete and visual resources should be incorporated into the teaching of calculation. We encourage a range of resources to be used so children do not associate number with a particular representation, but rather, gain a full appreciation of the abstractness of calculation. Modelling and activities, however, will regularly involve base-ten to help increase familiarity with the resource ready for KS2.

The number line methodology builds on directly from children's understanding of counting as well as being a visual representative they would have experienced when learning to count. The versatility of the number line method means it can be used for all four operations; children's greater exposure to the same representative/method will build familiarity and confidence. The different directions of movement (dependent on the operation) on a number line can also be used by teachers and children to make connections between the inverse relationship of addition and subtraction and multiplication and division. The use of an array in the initial stages of multiplication and division effectively show commutative law within multiplication and the inverse link between multiplication and division.

Children who have had the opportunity to explore the four operations, including the associated methods, and make crucial connections demonstrate a more secure understanding than those who rely solely on rote recall or are 'rushed' through the process. The expectation is that all children will work through each stage of the learning sequence outlined in this policy regarding methods. We believe this necessary to allow children to have a deep understanding of calculation. Within the different stages of the learning sequences, children will be encouraged to explore ways of being more efficient. These will be implemented if teachers deem the child has the secure understanding necessary to appreciate such concepts. Ways to develop efficiency and deepen understanding within calculation are outlined in this policy.

Alongside the careful consideration the policy gives to building up children's understanding of the 4 operations and associated methods, we recognise the challenges involved in developing and applying the necessary presentational and fine motor skills for constructing number lines and arrays. Drawing number lines and arrays is a skill children will need to acquire if they are to work with full independence, however, the drawing of these number lines and arrays can be demanding. Scaffolding of methods- including the use of templates- plays an important role in the policy. At different stages of the learning sequences, "given" number lines and arrays are used to allow children to give their full attention to understanding the mathematical concept and method being taught.



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Switching between the concrete, visual and abstract should not be a linear nor a one-way process. Combining different strategies/resources simultaneously and revisiting the concrete and visual (particularly for discussion purposes) is imperative in providing all children with a deep understanding. The initial stages highlighted in each stage of the learning sequences are especially visual and simplistic- even inefficient - but most importantly will provide the children with a secure grasp of the concepts and methods involved in calculation. This will form the foundation necessary for children to become increasingly efficient and fluent whilst maintaining a relational understanding.

Mental calculation

Mental and written methods complement one another. Children with secure mental strategies and recall will demonstrate greater fluency, accuracy and efficiency when using the written method. Those children who are equipped with a secure written method, will have greater experience of applying and practising mental strategies and known number facts. Furthermore, the visual representative that is created by use of a number line or an array provides a child with the opportunity to recognise and understand new number facts. The number line and array can also act as a tool by children to visualise a calculation when working mentally. For these reasons we believe mental and written methods should be taught parallel to each other rather than sequentially.

It is important children understand the concepts underpinning any number problem they are given. Rote recall of number facts, however, support children become more fluent when calculating and better decide whether a written method is necessary. Teachers should therefore dedicate time to rehearsing key number facts, such as number bonds and times-tables.

Examples of mental calculation strategies:

(these are effective examples that can be employed in the classroom but are not an exclusive list)

Explicit models using visual and concrete representatives should be used by teachers to introduce the purpose and understanding behind the different mental strategies described.

- To add, hold the greater number in your head and count on.
- To subtract, hold the greater number in your head and count backwards.
- Hold the lesser number in your head and count on when subtracting (if more efficient) to find the difference.
- Use known number facts, example: I know 5 + 5 is a number bond to ten so I don't need to work it out.
- Apply number bonds to support bridging ten, example: 6 + 4 = 10, therefore to add 6 + 7 I must count on three more from 10.
- Use known number facts to work out other calculations, example: 6 + 6 = 12, therefore 6 + 7 must be one more than 12.
- Use known times tables facts to find out further times tables by adding or subtracting another 'lot', example: 5 x 5 = 25, therefore 5 x 6 must be 5 more than 25.
- Use understanding of commutative law to recognise further facts for addition and multiplication, example: 5 + 7 = 12 therefore 7 + 5 = 12.
- Use known number facts and understanding of place value to derive number facts to 100, example 6 – 4 = 2, therefore 60 - 40 = 20.
- Encourage the recognition of patterns in numbers/number sequences, example: when I count in twos from an even number, all the other numbers I recite are also even.
- Use understanding of inverse relationships to derive other facts, example: 5 x 4 = 20, therefore 20 ÷ by 5 = 4.

Questioning plays an important role in developing mental strategies. Asking children to explain their own mental process (verbally and/or with the support of resources) has several benefits: describing a mental process can be challenging and offers an opportunity for that child to deepen and evaluate their own thinking; children listening to the strategies used by others can build up their own repertoire of mental strategies; misconceptions can be identified and challenged. From listening to the children, teachers can then describe (again with the support of visual and concrete representations) more sophisticated mental strategies or strategies children, for different reasons, may have overlooked.

Addition

Add one more using concrete objects	Add one more on a given number-line with all indices marked using concrete objects	Add one more on a given number-line with all indices marked	Add one more on a given blank numberline
Add one-digit numbers on a given number-line with all indices marked (including when 10 is bridged)	Add one-digit numbers on a given number-line with all indices marked (including when 10 is bridged) using concrete resources	Add one-digit numbers (including when 10 is bridged) using concrete objects	Add one more on a self-drawn number-line
Add one-digit numbers on a given blank number-line (including when 10 is bridged)	Add one-digit numbers on a self-drawn number-line (including when 10 is bridged)	Add two numbers (which involve a two-digit number and a one-digit number) that equal 10<20 using concrete resources	Add two numbers (which involve a two-digit number and a one-digit number) that equal 10<20 on a given number-line with all indices marked using concrete resources
Add together two two-digit numbers (counting in 1s and then 10s) using concrete objects*	Add two numbers (which involve a two-digit number and a one-digit number) that equal 10<20 on a self-drawn number-line	Add two numbers (which involve a two-digit number and a one-digit number) that equal 10<20 on a given blank number-line	Add two numbers (which involve a two-digit number and a one-digit number) that equal 10<20 on a given number-line with all indices marked
Add together two two-digit numbers (counting on in 1s and then 10s) on a given number-line with all indices marked using concrete objects*	Add together two two-digit numbers (counting on in 1s and then 10s) on a given number-line with all indices marked *	Add together two two-digit numbers (counting on in 1s and then 10s) on a given blank number-line*	Add together two two-digit numbers (counting on in 1s and then 10s) on a self-drawn number line

*When using concrete resources and a given numberline- for the purpose of practicality- answers to these calculations will usually be kept within 30. There will, however, be occassions where teachers and children can model and explore working with representations of greater numbers. If a child has a secure understanding of the concepts involved in additon and subtraction, alongside age-approaite place value understanding, the greater number should not inhbit their accuracy and fluency with calcualtion. Children adding and subtracting with greater numbers would use the numberline in its most abstract form (no indices marked).

Subtraction

Subtract one less using concrete objects	Subtract one less on a given number-line with all indices marked using concrete objects	Subtract one less on a given number-line with all indices marked	Subtract one less on a given blank numberline
Subtract one-digit numbers on a given number-line with all indices marked	Subtract one-digit numbers on a given number-line with all indices marked) using concrete objects	Subtract one-digit numbers using concrete objects	Subtract one less on a self-drawn number-line
Subtract one-digit numbers on a given blank number-line	Subtract one-digit numbers on a self-drawn number-line	Subtract two numbers (which involve a two-digit number and a one-digit number, including when 10 is bridged) that equal <20 using concrete objects	Subtract two numbers (which involve a two-digit number and a one-digit number, including when 10 is bridged) that equal <20 on a given number-line with all indices marked using concrete objects*
Subtract two two-digit numbers (counting back in 1s and then 10s) using concrete resources*	Subtract two numbers (which involve a two-digit number and a one-digit number, including when 10 is bridged) that equal <20 on a self-drawn number-line	Subtract two numbers (which involve a two-digit number and a one-digit number, including when 10 is bridged) that equal <20 on a given blank number-line	Subtract two numbers (which involve a two-digit number and a one-digit number, including when 10 is bridged) that equal <20 on a given number-line with all indices marked
Subtract two two-digit numbers (counting back in 1s and then 10s) on a given number-line with all indices marked using concrete objects*	Subtract two two-digit numbers (counting back in 1s and then 10s) on a given number-line with all indices marked*	Subtract two two-digit numbers (counting back in 1s and then 10s) on a given blank number-line*	Subtract two two-digit numbers (counting backing in 1s and then 10s) on a self-drawn number line

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Multiplication

Double using concrete objects	Double using drawings (a range of templates can be used)	Double making arrays, using concrete objects, on a given grid	Double drawing an array on a given grid
Double on a given blank number-line	Double on a given number-line with all indices marked	Double on a given number-line with all indices marked using concrete objects	Double using self-drawn arrays
Double on a self-drawn number-line	Multiply using concrete objects to make arrays for the 2, 5 and 10 times-tables on a given grid*	Multiply using a drawing of an array for the 2, 5 and 10 times-tables on a given grid*	Multiply using self-drawn arrays for the 2, 5 and 10 times-tables*
Multiply on a self-drawn number-line for the 2, 5 and 10 times-tables*	Multiply on a given blank number-line for the 2, 5 and 10 times-tables*	Multiply on a given number-line with all indices marked for the 2, 5 and 10 times-tables*	Multiply using concrete objects for the 2, 5 and 10 times-tables on a given number-line with all indices marked*

*Teachers may choose to focus on only one multiplier at a time and work through each of the remaining stages before introducing a different multiplier.

Division

Halve using concrete objects	Halve using drawings (a range of templates can be used)	Halve making arrays, using concrete objects, on a given grid	Halve drawing an array on a given grid
Halve on a given blank number-line	Halve on a given number-line with all indices marked	Halve on a given number-line with all indices marked using concrete objects	Halve using self-drawn arrays
Halve on a self-drawn number-line	Divide using concrete objects to make arrays for multiples of 2, 5 and 10 on a given grid*	Divide using a drawing of an array for multiples of 2, 5 and 10 on a given grid*	Divide using self-drawn arrays for multiples of 2, 5 and 10*
Divide on a self-drawn number-line for multiples of 2, 5 and 10 times-tables*	Divide on a given blank number-line for multiples of 2, 5 and 10*	Divide on a given number-line with all indices marked for multiples of 2, 5 and 10*	Divide using concrete objects for multiples of 2, 5 and 10 on a given number-line with all indices marked*

*Teachers may choose to focus on only one divisor at a time and work through each of the remaining stages before introducing a different divisor.

How to develop children's efficiency and deepen understanding within the different stages of the learning sequences

Within each stage of the learning sequences, opportunities to develop greater efficiency and deepen children's understanding should be sought.

Examples of how to demonstrate greater efficiency:
(these are effective examples that can be employed in the classroom but are not an exclusive list)

- Use cardinality of number to count on or backwards from a number. Children do not always need to start a number line at zero.
- Children appreciate the commutative nature of addition and therefore count on from the greater number as opposed to the lesser number.
- Encourage use of known number bonds when bridging 10. For example, I know 3 add 7 is 10 therefore I need to count on two more when adding 5 and 7. The child can make 'bigger' jumps when using the number line.
- Children use a secure understanding of stable-order principle to omit writing every numeral on a number line.
- Use understanding of how a two-digit number can be partitioned to then make bigger jumps on the number line. For example, 15 is one ten and 5 ones. When I take 8 from 15, I know to get from 15 to 10 I just need to do one jump of 5 then make 3 more jumps of 1.
- Children to count in 2s, 5s and 10s when working with arrays rather than counting one at a time.
- Count concrete resources two at a time rather than individually.

Examples of activities which promote a deeper understanding:
(these are effective examples that can be employed in the classroom but are not an exclusive list)

- Explore commutative law by completing addition and multiplication calculations in the opposite order.
- Prove subtraction and division are not commutative by completing subtraction and division calculations in the opposite order.
- Use missing number problems to develop understanding of inverse relationships.
- Investigate the inverse relationships between addition and subtraction and multiplication and division by checking their work using the inverse operation.
- Identify and correct errors in calculations (incorrect examples given by the teacher).
- Present children with incomplete arrays to complete.

It is crucial the wider mathematics curriculum, when appropriate, is brought into each unit of work even when there is a specific operation underpinning the unit. Applying the mental and written methods in different contexts ensures the mathematics curriculum we deliver is broad and balanced, and children are suitably challenged. The application of methods to different areas of the mathematics curriculum should happen throughout the different stages of each of the learning sequences outlined in the policy, rather than 'bolted on' at the end. Problem-solving which incorporates the wider mathematics curriculum provides greater opportunity for children to reason whilst continuing to develop their accuracy and fluency in calculation.

Other methods and representations

To support children gain a full understanding of the different concepts involved in calculation and an awareness there are other strategies that could be used, teachers may choose to expose them to other methods in addition to the number line. This is likely to happen more often in year 1 when children are exploring the four operations with greater focus for the first time. Time spent exploring other methods is unlikely to be sustained for significant periods. Exposure to alternative methods and representations should enhance understanding rather than discourage children from using the number line as a primary method.

100 number square

Bar model

Part-part whole

Formal written method

Halving mats

“Lady birds” for doubling