NCETM
NATIONAL CENTRE FOR EXCELLENCE IN THE TEACHING OF MATHEMATICS

Additive Reasoning

This document is part of a set that forms the subject knowledge content audit for Key Stage 1 and Key Stage 2 maths. Each document contains: audit questions with tick boxes that you can select to show how confident you are (1 = not at all confident, 2 = not very confident, 3 = fairly confident, 4 = very confident), exemplifications; explanations; and further support links. At the end of each document, there is space to type notes to capture your learning and implications for practice. The document can then be saved for your records.

Question 5

How confident are you that you understand and can support children to use and apply a range of mental strategies to support efficient calculation?

1 ☑ 2 ☐ 3 ☐ 4 ☐

How would you respond …?

a. Can you explain how the pupil has calculated 69 + 69?

$$\mathbf{69} + \mathbf{69} = \boxed{138}$$
$$70 + 70 = \boxed{140}$$
$$- 2$$

b. What reasoning would you expect to hear when children are sorting these strategies?

Sort these calculations according to the most efficient strategy.'

810 – 680
276 – 43
720 – 130
561 – 495
56 – 49

Working back / partitioning	Working forward / finding the difference

c. Which mental strategies could be used to answer this question? Which is the most efficient and why?

'Show three different ways to solve 398 + 495.

Responses

Note your responses to the questions here before you engage with the rest of this section:

Did you notice that…?

a. Adjustment strategies enable fluent mental calculation, as the children are able to work with numbers they are comfortable with. By understanding how to adjust calculations, they can simplify the arithmetic, manipulating numbers to support fluent mental calculation.

In part a, the children are able to adjust the near doubles, adding one to each addend when adjusting. They then subtract the total amount the addends were adjusted by, to find the solution. This method is particularly useful when working with money and calculating prices, e.g. **£1.99 + £3.99.**

b. In part b, children should consider how close the numbers are to each other, or how well the numbers are suited to mental calculation, when deciding whether they are more efficient as a partitioning or finding the difference calculation.

For example, **810 – 680** would be better suited to a finding the difference calculation, as the numbers are close to each other and easy to work with; they are multiples of 10. Whereas 276 – 43 would be better suited to a partitioning calculation.

It is important to allow children the opportunity to discuss their reasoning, recognising that they may have a different, preferred strategy. This is fine as long as they are able to calculate efficiently and confidently.

c. In part c, children are encouraged to think about the different strategies they have been taught and consider how efficient they are to solve the calculation. The following strategies may be suggested:

- Adjusting **–** adjusting the calculation so instead of 398 + 495 the calculation becomes 400 + 493.
- Partitioning **–** partition the five ones in 495 into a 3 and 2. Add the 2 to 398 and then add on the remaining 493.
- Compensation **–** change 398 to 400, then add on 495 before subtracting the 2 to compensate.

How efficient would you consider each of these strategies to be? Is there a different one that you would use?

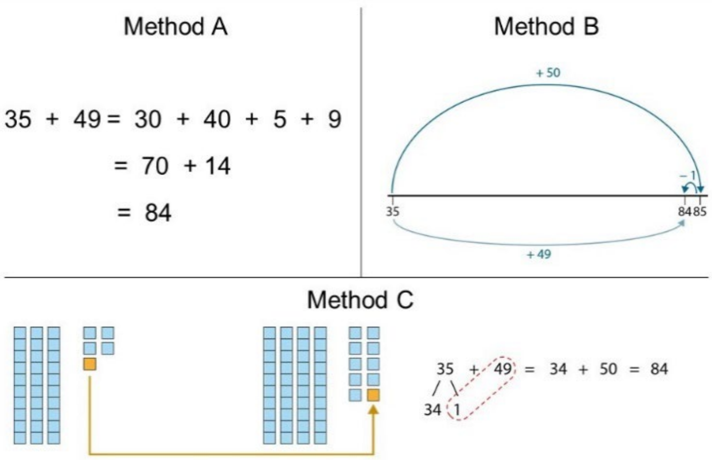
Developing mental calculation strategies

The aim of this section is to highlight the importance of fluent calculation, with children being able to use efficiency, accuracy and flexibility when applying mental calculation strategies. Children should be able to confidently select the most appropriate strategy, looking for relationships to simplify calculations, rather than learning a range of rote strategies that have no meaning for them. Having said this, specific teaching of some key mental strategies is essential, providing that children understand how they can be applied.

There is often a misconception that mental strategies should not be written down; however, this is not the case. When children are working mentally, the focus is on developing fluent calculations. Informal jottings, such as pictures or a number line, can be used to record interim steps and support working memory. When solving multi-step problems, there is no reason why both mental and column addition or subtraction cannot be used at appropriate stages of the process; it is not the case that one must be used in place of the other.

Classroom discussion, with a focus on the strategies used, rather than the solution, will enable children to consider the efficiency of the different strategies. By developing their reasoning, children will not only gain a deeper understanding of how and when different strategies should be drawn upon, but also that there is more than one way to approach a question.

For example: *'Consider the calculation 35 + 49. How would you mentally calculate this? Jot down your strategy. Did you use one of the methods here or a different strategy?'*



The strategy that children use should be guided by the numbers in the calculation. For example, you would not use the same strategy for 301 – 50 as you would for 301 – 5. Throughout their time in Key Stage 2, children should have opportunities to develop their confidence in mental addition and subtraction strategies, with appropriate three-digit numbers. Even when children are confident with formal written algorithms, they should consider which is the most efficient way to calculate and have frequent opportunities to rehearse a range of different strategies in different contexts.

Common errors in this area may include:

- children not understanding when different strategies are appropriate to use
- errors when compensating
- relying on written calculations or writing all the steps for a mental calculation
- trying to mentally calculate with numbers that would be better suited to a written calculation.

What to look for

Can a child:

- identify when numbers allow for easy mental calculation?
- select an appropriate method to mentally calculate?
- use appropriate jottings to support mental calculation when needed?
- explain why they have chosen to use a strategy?
- consider different strategies for efficiency?

Links to supporting materials:

NCETM Primary Professional Development materials, Spine 1: Number, Addition and Subtraction

- Topic 1.19: Securing mental strategies: calculation up to 999

Notes:

Key learning from support material and self-study:

What I will focus on developing in my classroom practice: