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 2

How confident are you that you understand and can support children to use a first, then and now story to explore the structures of augmentation (addition) and reduction (subtraction)?

1 ☐   2 ☐   3 ☐   4 ☐

How would you respond …?

a. **Can you create an augmentation story to describe the relationships in the image?**

First   Then   Now

b. **What representations could you use to support children to identify the structure of this problem?**

> **Daisy receives £40 for her birthday. She buys a new t-shirt for £12, a baseball cap for £4 and some sunglasses for £7. How much money does she have left?**

Responses

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

Did you notice that…?

a. When creating a story for the augmentation structure, there is only one element and that element is increased by an amount. For example, *'I had three flowers and I picked four more. How many flowers do I have now?'* For the picture in part **a**, you could create a story, such as:

- First, there were two children in the book corner.
- Then, four more children came into the book corner.
- Now, there are six children in the book corner.

b. Augmentation can be represented with pictorial images, such as in part a. However, to develop children's understanding, a bar model could be used to identify the structure.

| £40			
£12	£4	£7	?

Augmentation (addition) and reduction (subtraction) structures

This section focuses on the structures of **augmentation** and **reduction,** how they are represented and the importance of using the correct language.

Addition, as augmentation, is where there is one element. The initial quantity of that element (*the augment*) is increased by an amount (*the addend*) and an addition is required to find the augmented value or *sum*. For example: *'Amelia has 14 trading cards. Seb gives her 23 more. How many trading cards does she have now?'*

The inverse of the augmentation structure is the reduction structure, which is one that children are commonly familiar with as a *'take away'*. Subtraction, as reduction, is where there is one element. The initial quantity of the element (*the minuend*) is decreased by an amount (*the subtrahend*) and a subtraction is required to find the reduced value or difference.

The structures for augmentation and reduction can be seen on a bar model, enabling children to identify the calculations needed to solve a problem. For example:
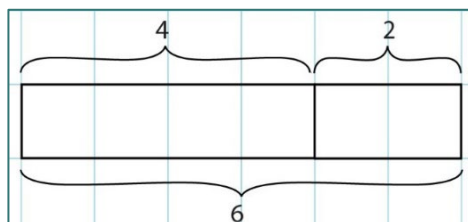
First, Sarah had £4.
Then, her mum gave her £2 more.
She now has £6 (augmentation).
Or
Sarah had £6.
She spent £2.
She now has £4 (reduction).

The bar model also enables children to see the relationship between augmentation and reduction, developing their understanding of inverse, which will enable them to answer missing number questions.

By spending time discussing mathematical structures with the children, rather than focusing on finding the answer, the children will become more aware of the importance of understanding the structure behind the problem, rather than just looking for numbers or key words. These foundations are important for them to be successful in solving missing number problems, or multi-step problems, later in the curriculum.

When children are confident describing the structures of the problems, they should then begin selecting a method to solve the calculation. They can start at a fixed point on a number line and will either count on (augmentation) or back (reduction). Initially, they may move in smaller amounts, but as they become more confident, they may choose to jump, by partitioning the addend or subtrahend in different ways, or by bridging through multiples of 10.

When teaching subtraction, it is important that the subtraction sign is not referred to as *'take away'*, for example *'ten, take away four'*, as this is not the only structure for subtraction. It is only accurate when discussing the reduction structure. It is important that children understand that the reduction structure is when a quantity is being reduced; whereas, in the partitioning model, nothing is lost, it is being split into parts.

Although finding change is a reduction structure, the finding the difference strategy is commonly used when working with money and calculating change. Children work forwards from the **subtrahend** as it is a more efficient method than working backwards from the **minuend**.

If I spend £3.40, how much change will I get from five pounds? £5 − £3.40 = ?
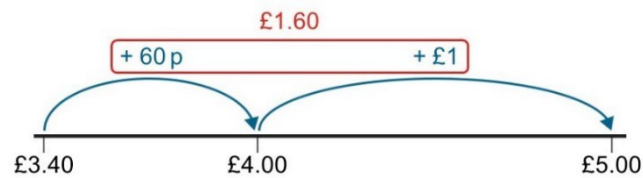
Common errors in this area may include:

- children referring to the subtraction symbol as 'take-away' for all subtraction models.

What to look for

Can a child:
- create first, then and now stories for calculations?
- explain that the addend is added to the augend?
- explain that the minuend is being reduced by the value of the subtrahend?
- use a number line as an informal calculation strategy?

Links to supporting materials:

NCETM Primary Professional Development materials, Spine 1: Number, Addition and Subtraction:
- Topic 1.6: Additive structures: introduction to augmentation and reduction
- Topic 1.11: Addition and subtraction: bridging 10

Notes:

Key learning from support material and self-study:

What I will focus on developing in my classroom practice: