

DEVELOPING MASTERY IN MATHEMATICAL FLUENCY

How can we improve outcomes for pupils in maths through developing mastery in mathematical fluency for all pupils including disadvantaged pupils?

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Why did you choose to develop mastery and fluency in mathematics?

I joined Trinity in September 2015 as Maths Subject Leader and, following discussions with the Headteacher, it was apparent that improving pupils' achievement and progress in mathematics was a high priority in the School Development Plan. It was agreed that mathematics at Trinity would be taught using the Mastery approach but I was aware that this approach was new to many staff within the school.

I was also aware that 'mastery in mathematics' was a particular focus nationally and featured in many mathematics CPD courses. In these circumstances, I was keen to develop my own knowledge and understanding of mastery in mathematics so that I could use this to increase the mathematical fluency of the pupils in my own class, as well as provide support and professional development to other members of staff.

In what way were you planning to develop mastery in fluency?

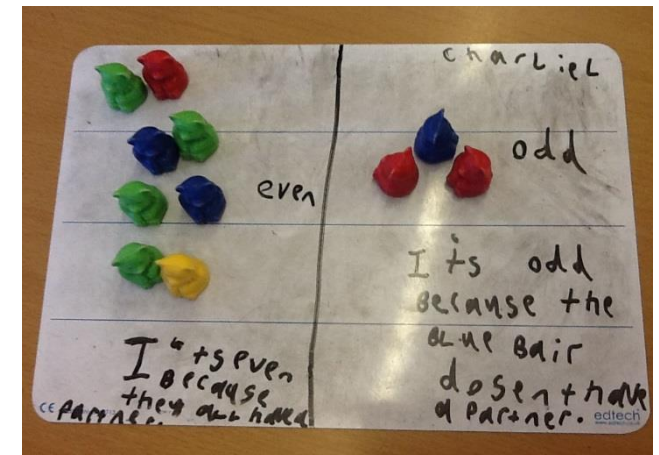
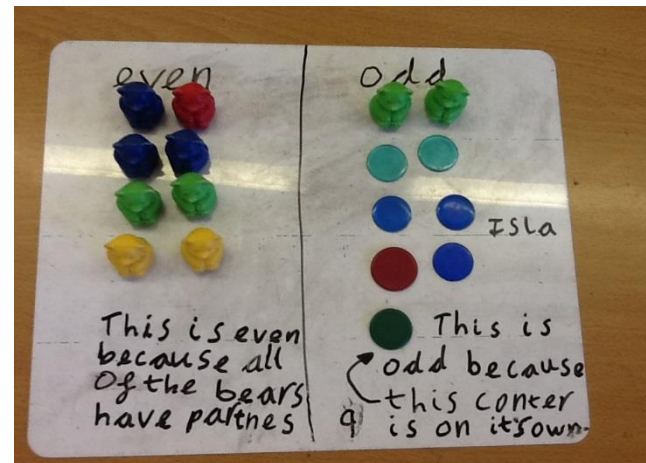
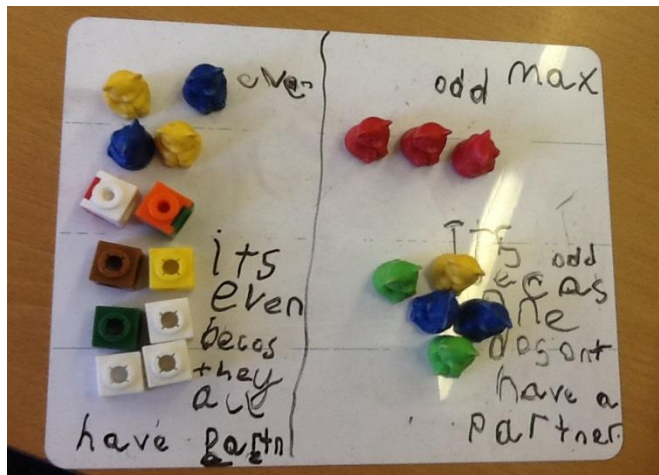
I decided to focus on developing fluency in number sense, particularly in KS1. As a teacher in Year 2, I was aware that some pupils were still struggling with their basic understanding of number, especially when I was teaching place value.

In these circumstances, I was keen to ensure that pupils were given opportunities to investigate number in different ways. This included exploring different representations, subitising and using variation to spot patterns and relationships.

What did your project involve?

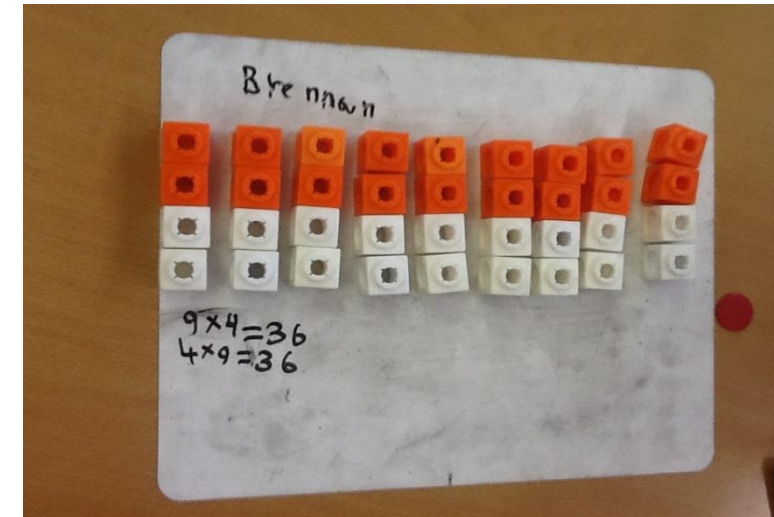
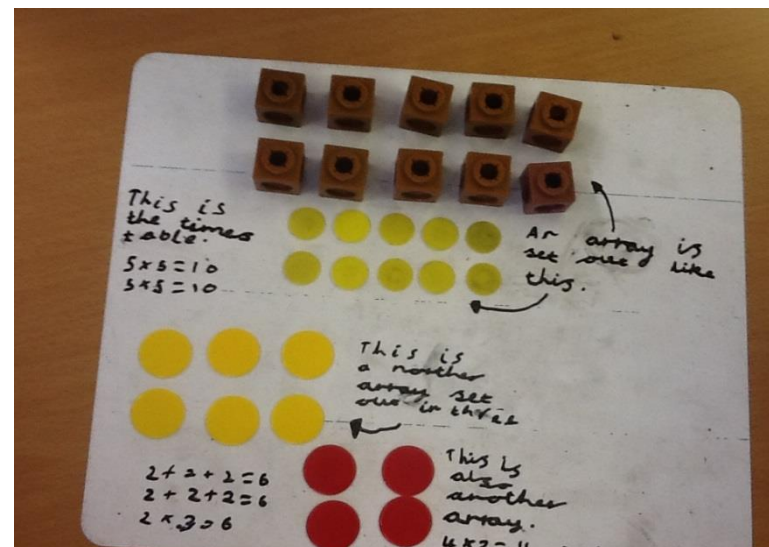
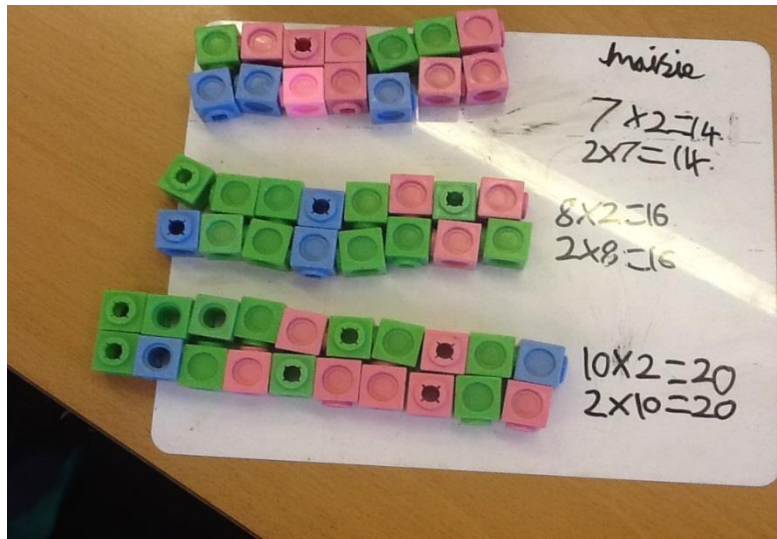
1. I planned lessons that ensured that concepts were introduced and explored practically and through different representations.

Pupil's work exploring odd and even numbers and why they are odd or even:



What did your project involve?

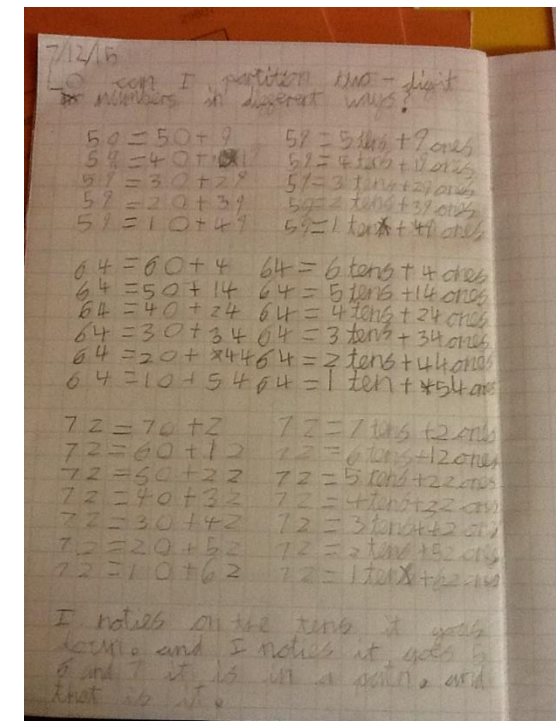
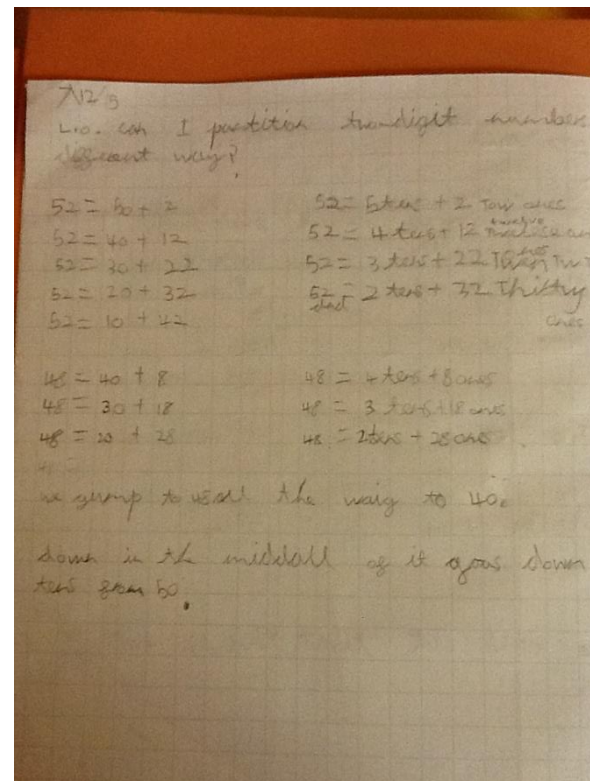
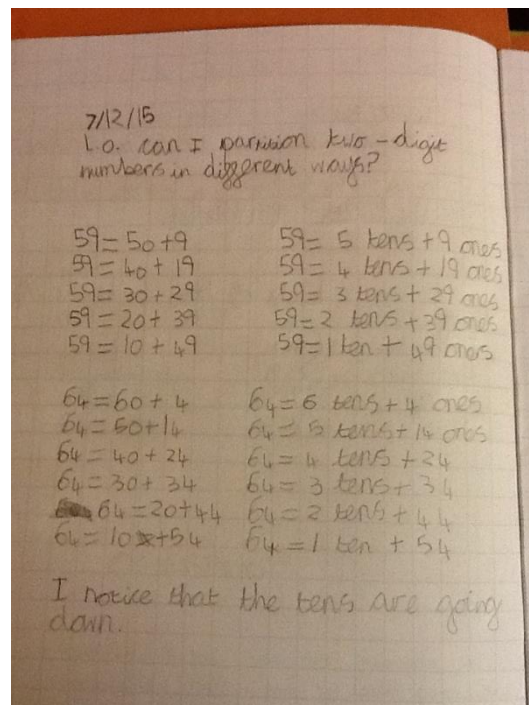
Pupil's work exploring arrays:



What did your project involve?

2. I planned activities using variation which gave pupils an opportunity to spot patterns and relationships and discuss what they noticed.

Pupil's work exploring partitioning of two-digit numbers in different ways:



What did your project involve?

Pupil's work exploring relationships between 5 and 10 times tables as well as the inverse of multiplication and division:

The pattern goes 5, 10,
5, 10

$$1 \times 5$$

$$1 \times 10$$

$$2 \times 5$$

$$2 \times 10$$

$$3 \times 5$$

$$3 \times 10$$

What do you notice?

The numbers at the
beginning go up in ones.

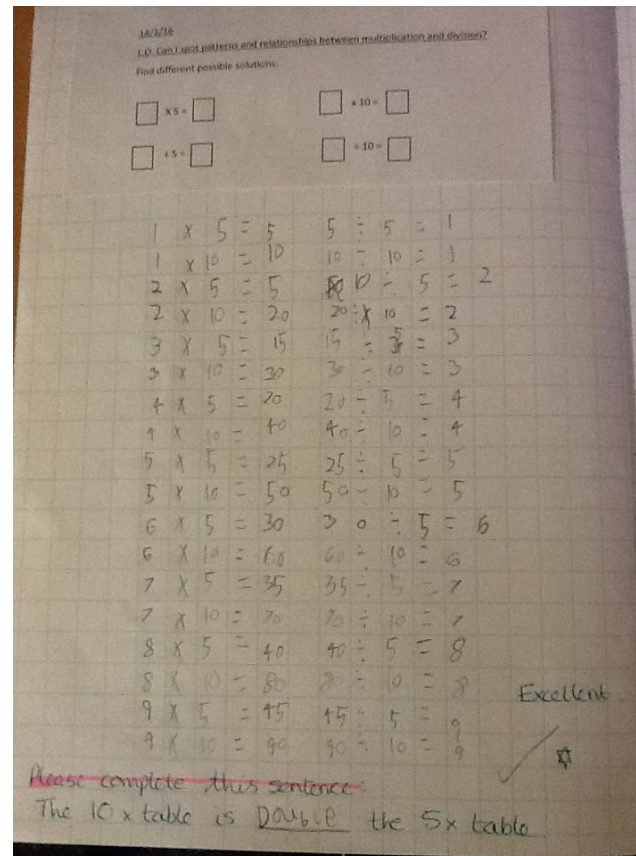
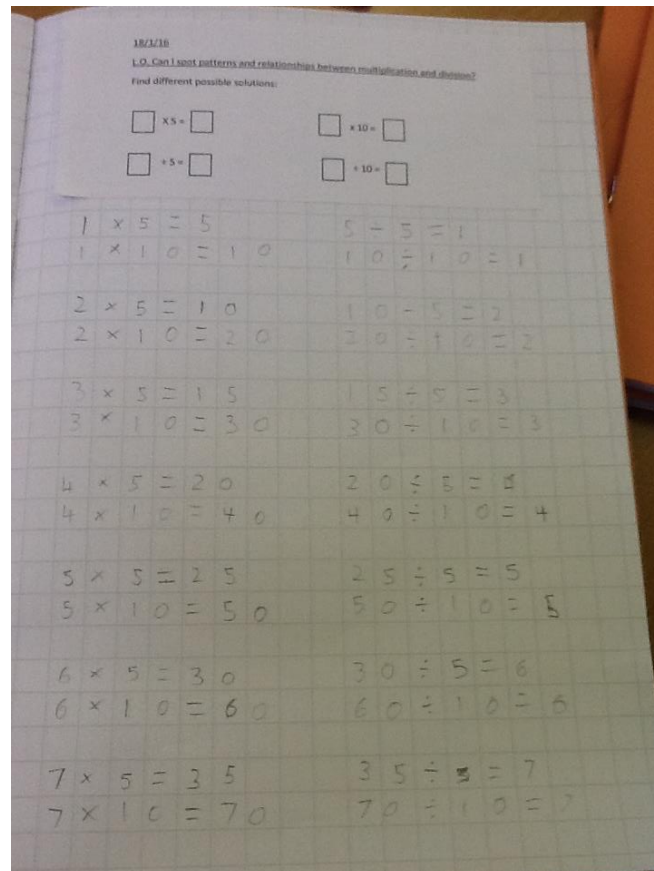
Ten is double five.

They all have a times
sign in them

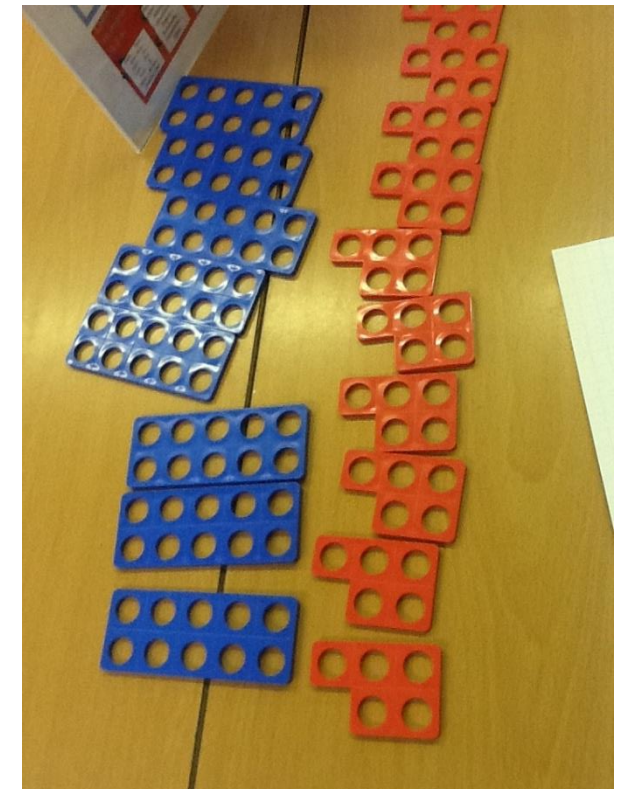
Speech bubbles indicate some of the
pupil responses from oral discussion.

What did your project involve?

Pupil's work following on from oral discussions on previous slide:

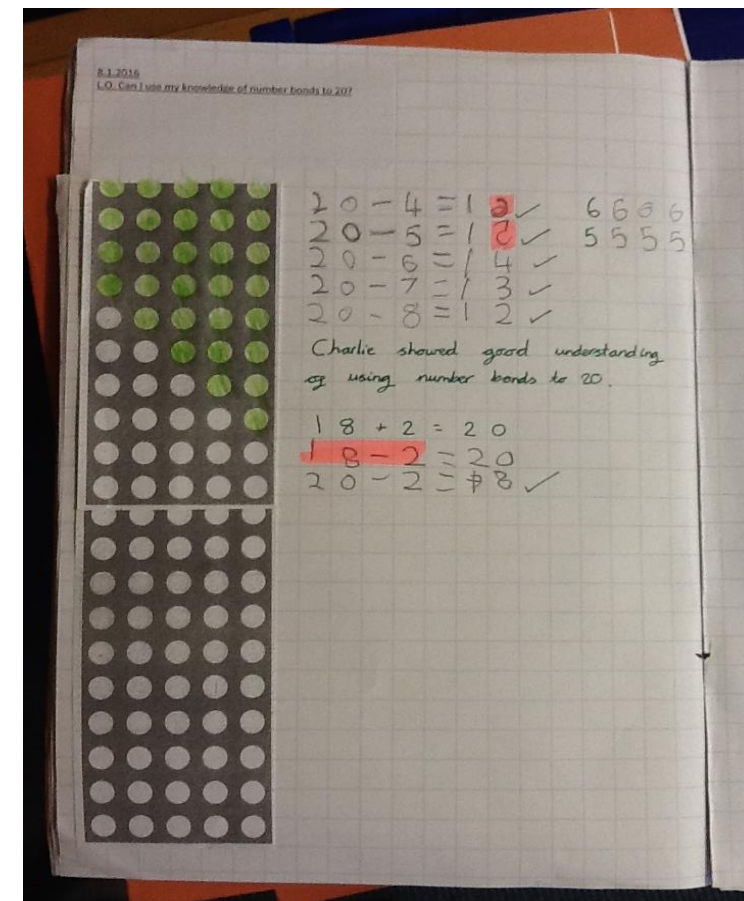
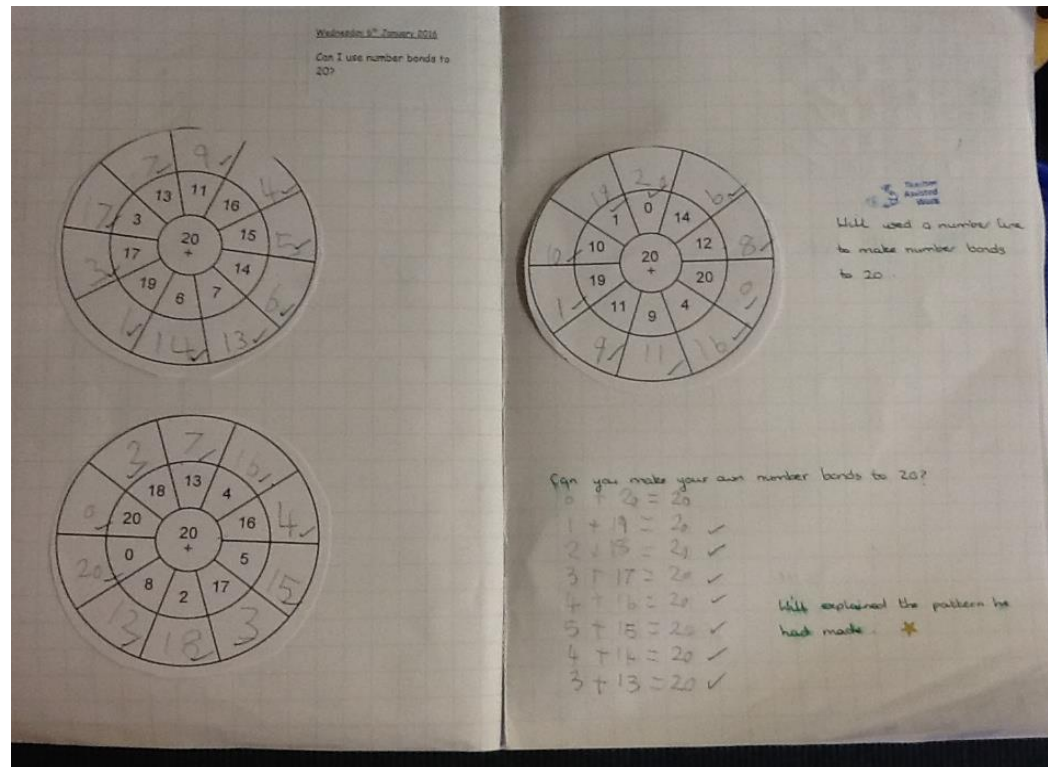


Using numicon to discuss relationships orally with LA children



What did your project involve?

Evidence of pupils' work on number bonds using different representations in Year 1:



What did your project involve?

Sharing good practice across the school and wider cluster:

During this project, as well as carrying out activities relating to developing fluency in number sense within my own class, I have shared ideas in school staff meetings. I created a Number Sense booklet (a copy of which follows this slide) and discussed this with other teachers.

I also jointly led some further training to teachers within our cluster which involves approximately 60 teachers. This training centred around subitising and how important it is to enable children to become fluent in number sense.

Number Sense

To promote mastery in mathematical fluency

Clare Pickering

2015

The National Curriculum (2014) for mathematics aims to ensure that all pupils become fluent in the fundamentals of mathematics including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.

In order to become fluent in number sense, children need to have experience of many different representations. They need to be able to spot patterns and relationships between numbers and calculations. Awareness of relationships leads to the ability to work flexibly i.e. to interpret new problems and use what they already know.

Children who are moving slower in mathematics are often not identifying links and relationships.

Talking in maths is very important to build up children's number sense – they need to be given opportunities to develop their mathematical understanding through reasoning.

Remember:

Symbols

Language

Actions

Models

Children should be given opportunities to develop good number sense in:

- Counting;
- Subitising;
- Number bonds;
- Doubling and halving;
- Multiplication facts;
- Spotting patterns and relationships.

Principles of counting

One-to-one principle: need to count a group of objects (not placed in a line) and know when all the objects have been counted.

Stable order principle: numbers are always counted in the same order.

Cardinal principle: be able to answer 'How many have you got?'

Order irrelevance principle: the number of objects does not change although they can be arranged in different ways.

After children have mastered the principles of counting they should be moved on to other representations so that they don't over rely on counting everything.

Subitising

Children should be able to instantly recognise a number of objects in a small group without the need to count them individually.

The first level of fluency is to know the dice and domino patterns. This should include double 9 and double 12 dominoes, as well as double 6 dominoes.

Activity ideas:

- Children should be carrying out lots of investigations using these patterns as well as other representations such as Numicon to enable them to develop this instant recognition.
- Show some dots on a powerpoint slide and hide it again after 2-3 seconds. Ask 'What did you see?' and 'How did you see it?'

Children should be able to unitise numbers, particularly 10 so that they see that number as a single 'object'.

Number bonds

Children should become fluent with number bonds in order to have a strong number sense. Use the language part whole. As children become more familiar with this language, they can easily make links to addition and subtraction.

Activity ideas:

- 'Ten frames' can be used to develop number bonds (see Maths Resources in STAFFCOMMON).
- Egg boxes are another useful resource – children can place counters in some of the sections and immediately see how many are missing. Consider collecting a range of different size egg boxes to explore different number bonds.
- 'Snap it' – use multilink cubes to make a 'train' of a particular number e.g. 8. Snap it in two and hold one part behind back and show children the other part. The children have to work out how many are missing. This could then be done in pairs.
- How many are hiding? A similar activity could be to hide some objects under a cup and tell the children how many there are in total. The children have to work out how many are hiding.

Multiplication facts

Children will memorise multiplication facts better through rich, engaging activities rather than reciting tables and being tested.

Ensure children have the opportunity to gain a secure understanding of different representations through comparing and reasoning about them.

Initially, children should become fluent at doubling and halving numbers so that they can apply this understanding to other problems.

It is important that children understand the concept of multiplication and see the link with repeated addition.

Activity ideas:

- How close to 100? Provide children with a blank hundred square. They play the game in pairs by throwing two dice and drawing the corresponding array on the hundred square. For example, they throw a 3 and 4 and draw an array of 3 rows of 4. They then record $3 \times 4 = 12$. They keep playing until they cannot fit any more arrays onto the hundred square.
- Pepperoni Pizza: Roll a dice twice. The first roll tells the children how many pizzas to draw and the second roll tells them how many pieces of pepperoni to draw onto each pizza. For example, they may roll a 3 then a 5. They will draw 3 pizzas and then draw 5 pepperoni on each pizza.
- Matching different representations: Provide cards with different representations on that they have to match up and then talk about. The representations could include: 4×9 , 9×4 , 36, an array showing 4 rows of 9, 4 dots shown 9 times and 4 dominoes with nine dots on.

Spotting patterns and relationships

When practising different concepts, it is important not to just set random calculations but focus on relationships and connections. For example:

9 – 5	7 + 2	19 + 7
	8 x 7	
8 – 5	17 + 2	20 + 6
	16 x 7	
7 – 5	7 + 12	21 + 5
	4 x 7	
6 – 5	17 + 12	22 + 4
	2 x 4 x 7	

ASK: What's the same and what's different? OR What do you notice?

Other useful resources (see Maths Resources in STAFFCOMMON)

Models and Images documents
 Mastery Assessment documents
 Teaching Children to Calculate Mentally
 Fluency without Fear

Useful websites

www.nrich.maths.org
www.ncetm.org.uk

What did you learn yourself?

I found out that there is a lot more to fluency than the ability to retain and recall number facts quickly. I learned that fluency is much more about recognising different representations of number so that children gain a deeper understanding of the 'how' and 'why'. This fluency in number sense enables children to apply their knowledge in a more flexible way.

I have developed a much better understanding of how to develop children's fluency in number sense and now have more ideas and activities that I can draw upon to engage the children in my class and across the school.

What differences did it make to your learners?

The pupils in my class have thoroughly enjoyed the practical activities and the level of engagement in maths lessons increased. Overall, I have seen the children's confidence improve and they are enthusiastic about talking about their maths work and explaining their ideas about maths.

I only have one pupil premium child in my class but I have been amazed at her progress over the last term. Using our new assessment system, which includes a points system, her progress improved by 8 points. The average expected progress is 4 points.

What difference did it make to your school?

Feedback from
Teachers following
introduction of
Number Sense
booklet

We found the discussions about different methods and approaches really useful. The children responded well to questions such as 'What's the same and what's different?'

Reception teachers

I found the ideas that have been shared useful, particularly the websites. I am planning to use more ideas relating to number sense this term.

Year 1 teacher

I have used some of the ideas relating to place value number sense which the children found helpful. I am intending to carry out more work on subitising this term.

Year 3 teacher

How might this be developed further in the future?

I intend to develop mastery in fluency further in the following ways:

- I will continue to improve my own practice so that all my lessons include opportunities to develop the fluency of number sense of all children within my class;
- I will share further evidence of good practice and pedagogy with other teachers within my school – these will also be clearly evident in our calculation policies;
- I will ensure that activities and ideas to promote mastery in fluency are being used in all year groups;
- I will provide training for teaching assistants within school so that they can access the ideas and activities when working with groups of children within the class, or when carrying out intervention.
- I will share evidence of good practice with other Maths Subject Leaders within the cluster so that they can disseminate this within their own schools.
- As members of teaching staff return from maternity leave, I will ensure that I meet with them to share what I have introduced since September 2015.