

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

As from September, we began teaching mathematics through a mastery approach across the school and I was therefore interested in how this project could help us to develop this strategy.

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

For children to develop a bank of strong mental images in order to gain a deeper understanding of mathematical facts and become more fluent in applying them to a range of situations. The plan was to achieve this through a more regular and varied use of models and images in lessons, particularly in KS2.

What did your project involve?

The teachers and teaching staff all participated in professional development training regarding maths mastery and Numicon at the start of the Autumn Term. We decided to start to use Numicon as a resource across the whole school and not just for the younger or least able children. I worked with the Year 6 teachers following this training to explore how Numicon could be used to support learning with their classes particularly in relation to fractions and percentages. I also taught a lesson in Year 4 to demonstrate how to use Numicon to support children's understanding of the link between the 4 and 8 times table.

I have been developing medium term plans for each year group that fit in with the mastery approach. These plans are used as a starting point for teachers when doing their planning and include some examples of models and images that could be used during lessons:

Year 6

Models and Images

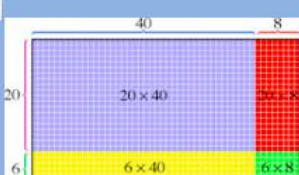
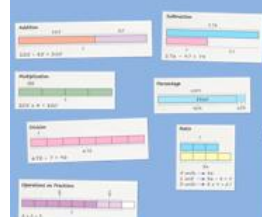
$$\begin{array}{r} 46 = 40 + 6 \\ \times 68 = 60 + 8 \\ \hline 2400 = 60 \times 40 \\ 360 = 60 \times 6 \\ 320 = 8 \times 40 \\ 48 = 8 \times 6 \\ \hline 3128 \end{array}$$

$$6.18 \times 4.6 =$$

6	0.7	0.08
2.4	0.0	0.0
2.8	0.0	0.0
6	3.6	4.2
0.4	0.4	8
3	1.8	8

$$3 \overline{) 63} = 21$$

I know that $63 \div 3 = 21$, so $63 \div 21 = 3$, and $21 \times 3 = 63$, so $3 \times 21 = 63$.



$$\begin{array}{r} 327 \\ \times 53 \\ \hline 981 \\ 16350 \\ \hline 17331 \end{array}$$

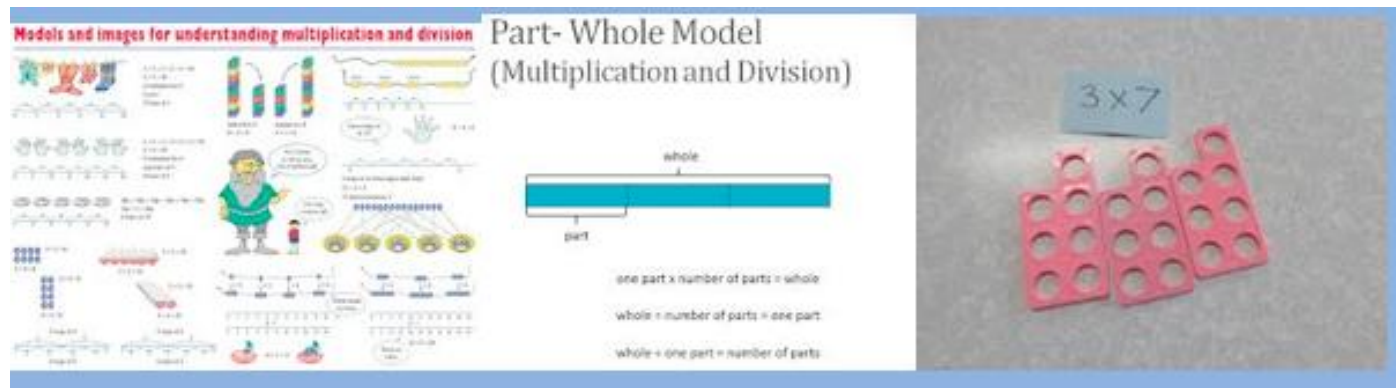
327 x 3
327 x 50

Subtract the value of 30% from the £10.



£7

Year 3



I led a maths training session in January for the teachers. This further explored the idea of mastery. We looked at the bar model as an example of a pictorial representation that could be used to cover a wide variety of topics in the maths curriculum.

Eg $30-20=$

30	
20	

We also explored some strategies that could be used to deepen children's understanding of facts and therefore aid fluency. These strategies are also listed on the medium term plans:

KEY STRATEGIES

What's the same and what's different?

Convince me.....

Another and another.....

Maths stories

Peculiar, obvious, general

What else do you know?

Do then explain

If this is the answer, what is the question?

Always, sometimes, never true

Hard and easy

True or false?

Odd one out

What do you notice?

What comes next?

Spot the mistake

What did you find out throughout carrying out your project?

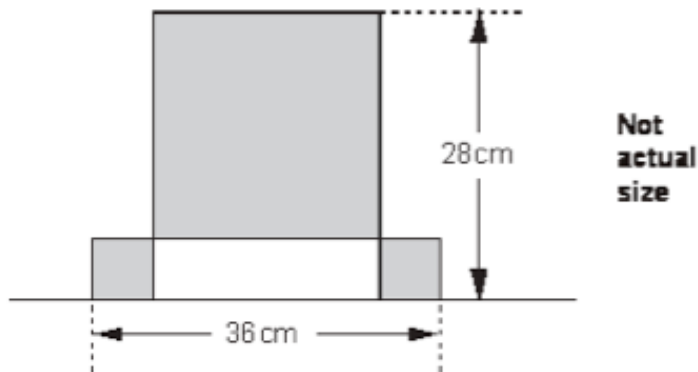
At the beginning of the project, a range of evidence (planning scrutiny, book scrutiny, lesson observations and staff questionnaires) showed that more concrete apparatus was being used with the younger children but not as much with the older children. Although KS2 teachers supported children with concrete and pictorial representations for some areas of the curriculum eg time, measurement etc they did not use these as often in number and calculating work. The children were sometimes moved on too quickly between concrete apparatus and abstract maths.

As the maths mastery curriculum was introduced across the school, teachers required support in a shift of thinking from moving children on through content to spending longer on broadening and deepening understanding. They needed more ideas of how to present information in a variety of ways.

The use of models and images not only supported the children in their learning but also made it easier to spot children's misconceptions. For example Y6 had the following problem to solve:

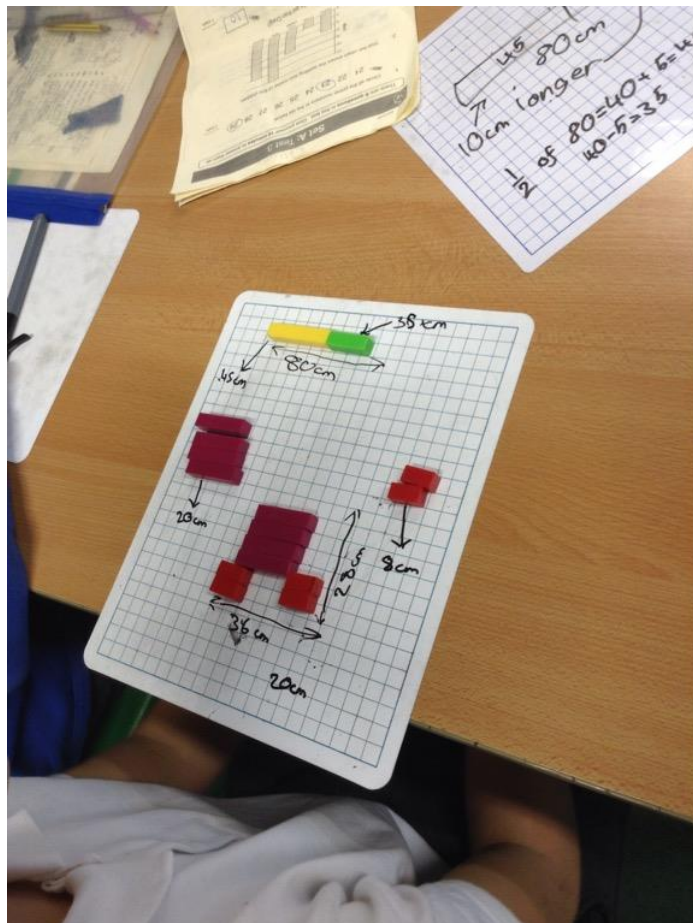
This design has **one large square and two identical small squares.**

The design measures 36 centimetres by 28 centimetres.



Calculate the length of a side of the large square.

They were asked to replicate the image using Cuisenaire Rods. By doing this, it was clear to see which children had misconceptions about the image as some children initially did not make it correctly, this would not have been as evident through discussion. Once the children had made the correct image, it was easier for them to see the shapes. The teacher used the 'What's the same and what's different' strategy to help children to spot the extra square on one side.



What differences did it make to your learners?





It is too early to see an impact on children's fluency as these models and images are not yet embedded enough in our practice. However teachers feel that the use of visual images has helped the children to explain their reasoning more clearly and are positive about the impact that this will have on the children's fluency as we continue using these representations in the future.

Despite some initial scepticism regarding older children using apparatus, the pupils that I spoke to during the project have said that the apparatus was useful. For example, Year 6 were observed using Cuisenaire Rods to order fractions and they stated that this made it much easier to see which fractions were bigger or smaller.

Year 2 children were observed solving a mix of addition questions (see below). When asked which ones they preferred some children said the question with circles as they could count them, some children liked the bar model.

5.3.16

Addition W2

1. $23 + \boxed{27} = 54$ *	9. Tom buys a bouncy ball for 70p. Finn buys a car for 25p. How much did the boys spend altogether? $70p + 25p = 95p$ ✓				
2. $\boxed{19} + 11 = 30$ ✓	10. $\boxed{0} + \boxed{0} = 0$ ✓				
3. $\boxed{40} + \boxed{3} = 43$ ✓	11. Ann buys some bananas for £1 and some grapes for £2. She pays with a green note. How much change will she get? $£2 + £1 = £3$ *				
4.  +  = 36 ✓	12. Write out these number sentences putting in the correct signs. <, > or =. $5 + 7$ $\boxed{<}$ $9 + 7$ ✓ $76 + 11$ $\boxed{=}$ $11 + 76$ ✓ $23 + 14$ $\boxed{>}$ $5 + 22$ ✓ $33 + 54$ $\boxed{>}$ $9 + 71$ ✓				
5. What do I need to add to these numbers to get 50? Write the answers as full number sentences. 9 42 $42 + 9 = 50$ *	13. Add the number of circles together.   26 ✓				
6. $9 + \boxed{5} < 20$ ✓	14. <table border="1" data-bbox="622 1657 957 1724"><tr><td>24</td><td>55</td></tr><tr><td colspan="2">> 9 ✓</td></tr></table>	24	55	> 9 ✓	
24	55				
> 9 ✓					
7. $\boxed{35} > 16 + 13$ ✓	15. <table border="1" data-bbox="622 1747 957 1814"><tr><td>61</td><td>7</td></tr><tr><td colspan="2">< 8 ✓</td></tr></table>	61	7	< 8 ✓	
61	7				
< 8 ✓					
8. $\boxed{27} + 22 < 38$ *	16. I have 1 silver coin and 3 bronze coins. What's the largest amount of money that I could have? 50p *				

Whilst children were using these methods in the questions where the model was present, they were not choosing to apply them when they were stuck on questions that did not have a visual aid. This is something that we need to work on as a next step.

What difference did it make to your school?

Before the project, teachers were unsure whether it was suitable to use apparatus with the rapid graspers or older children as they felt that perhaps they did not require this support and that the work would be too easy. They were also unsure of how to use apparatus such as Numicon to teach more complex objectives.

Feedback following the project has been positive. The teachers have reported that the use of apparatus and visual images has been helpful for all pupil groups including the rapid graspers. Teachers were particularly pleased to see the positive impact that this strategy had on children's mathematical talk and explanations. Maths has become more interactive across the school with children exploring maths further and not just stopping when they get an 'answer'.

The teachers are interested to see the longer-term impact of this project as they embed it into their classrooms and extend the range of models and images that they use. This also fits in with our new mastery teaching, broadening children's experiences rather than moving on to new content.

What did you learn yourself?

Working in a group with teachers from a range of schools over a period of time was very useful. The professional discussions and wider reading helped me to develop my understanding of mastery and fluency further so that I am now better able to lead the professional development of maths at my school.

I have found exploring variation theory particularly useful and I have been interested to see how children across the primary age range can use variation to develop their understanding. It has been interesting to hear children in Foundation Stage and Year 3 explaining what they notice about linked calculations and see them find the correct number in some of the calculations that I was not expecting them to get right. This is a strategy that I would like to explore further across the whole school.

Any other comments / How someone else might use this project / What difference could this project make to other schools?

I will be very interested to see how this project develops over the coming months in my school. For all schools, it is important to embed these images in children's minds and when they are solving problems away from direct teaching, discuss which images they could use as jottings. This is important in enabling children to solve problems, particularly in order to demonstrate what they are capable of in SATs tests now that they are no longer able to use apparatus in Year 2. This project has also been particularly useful in developing children's maths talk and explanations.