
Teaching for mastery
Introduction

What is mastery?

- Mastering maths means pupils acquiring a deep, long-term, secure and adaptable understanding of the subject.
- The phrase ‘teaching for mastery’ describes the elements of classroom practice and school organisation that combine to give pupils the best chances of mastering maths.
- Achieving mastery means acquiring a solid enough understanding of the maths that’s been taught to enable pupils to move on to more advanced material.

Origins of mastery

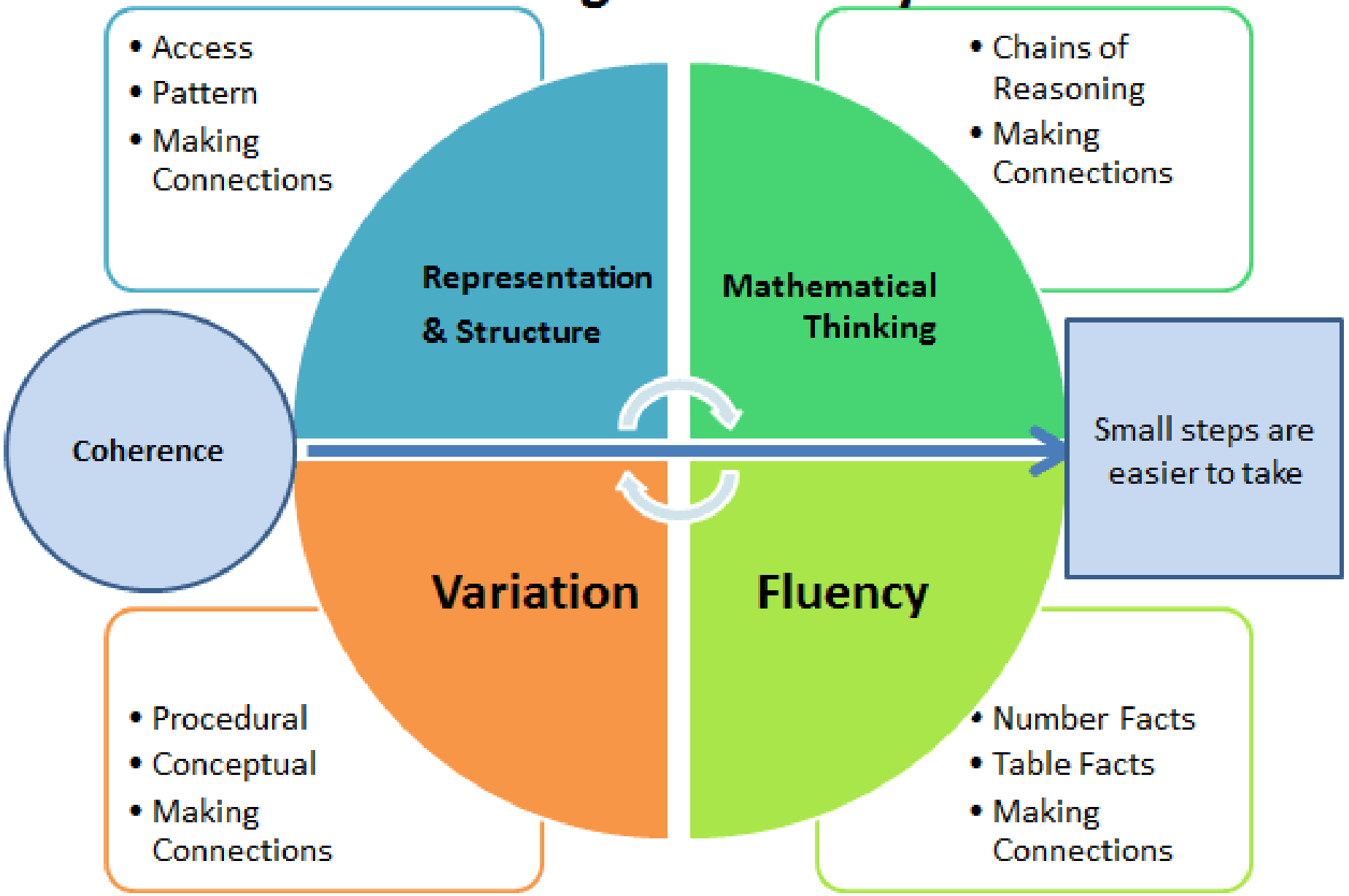
- Until recently, teaching children to ‘follow a process’ had been at the core of Maths education. Explaining how or why something happened became merely an afterthought.
- As long as a child got the answer correct, their comprehension of the method was less important.
- However, by not teaching children conceptually, we left them incapable of making the necessary links required to problem solve
- More importantly, it denied children the opportunity to truly enjoy and engage with mathematics – as it became merely a memory test for many of them.
- With the 2014 new curriculum, this began to change. Increasingly children are required to reason, problem solve, and discuss methods.

What does Mastery look like?

- Variety of strategies
- Breaking the cycle of rote learning
- Gives children the opportunity to grasp ‘real’ maths
- Small steps
- Seeing patterns
- Reasoning
- Growth mindset is important

The 5 big ideas around mastery

Teaching for Mastery



Fluency – what does this mean?

- This is the most known part of maths and probably considered the ‘easy’ part
- A possible answer – recalling facts
- Is there more to it?

Fluency

- Fluency in maths is about developing number sense and being able to the most appropriate method for the task at hand; **to be able to apply a skill to multiple contexts.**
- The National Curriculum states that pupils should become fluent in the fundamentals of mathematics **through varied and frequent practice**. While a part of this is about knowing key mathematical facts and recalling them efficiently, fluency means so much more than this at it allows pupils to delve much deeper.

- The mastery curriculum for primary schools places problem solving at the heart of mathematics with the main aim that every child can learn to solve sophisticated problems in an unfamiliar context.
- To enable them to achieve this, pupils must develop their conceptual understanding, mathematical thinking and use of mathematical language. This is where fluency and reasoning come in.

Intelligent practice

- $2 \times 3 =$
  $2 \times 30 =$
  $2 \times 300 =$
  $20 \times 3 =$
  $200 \times 3 =$
- $6 \times 7 =$
  $6 \times 70 =$
  $6 \times 700 =$
  $60 \times 7 =$
  $600 \times 7 =$
- $9 \times 8 =$
  $9 \times 80 =$
  $9 \times 800 =$
  $90 \times 8 =$
  $900 \times 8 =$
- What do you notice?
- Why do you think this is important?

How does this help?

- A key feature of teaching for mastery is the precise designing of pupil activities and practice questions, so that, rather than pupils repeating a mechanical activity, they are taken down a path where the thinking process is practised with increasing creativity. By working though the calculations a pupil has to carry out the procedural operation of multiplication, but through connected calculations, has the opportunity to think about key concepts involving multiplication and place value.
- The arrangement of these tasks and exercises draw pupils' attention to patterns, structure and mathematical relationships, thus providing 'intelligent practice' and the opportunity to deepen conceptual understanding.

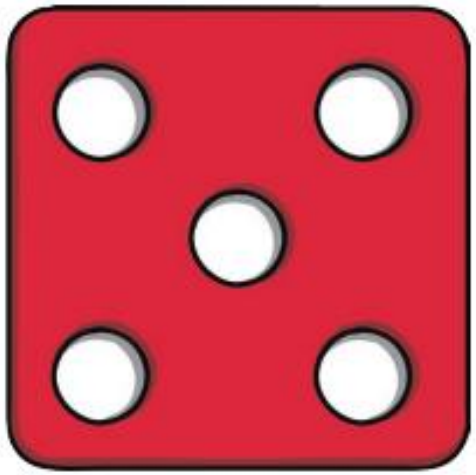
Mathematical thinking – what does this mean?

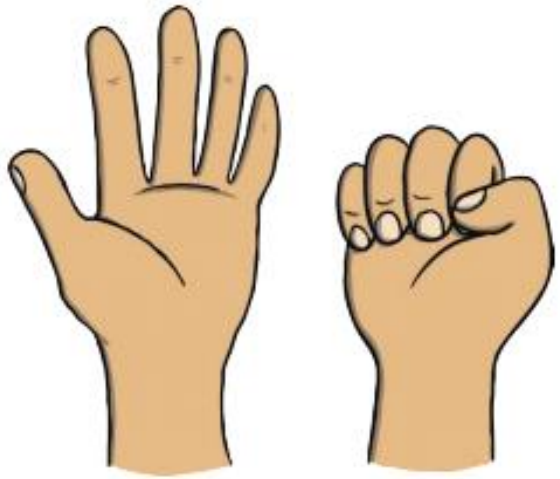
- If taught ideas are to be understood deeply, they must not merely be passively received but must be worked on by the student: thought about, reasoned with and discussed with others
- Mathematical thinking involves: looking for pattern in order to discern structure; looking for relationships and connecting ideas; reasoning logically, explaining, conjecturing and proving.

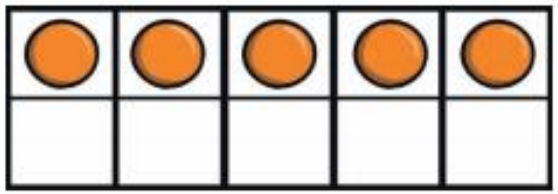
- This is all linked with REASONING – we will discuss this in a later session in more detail

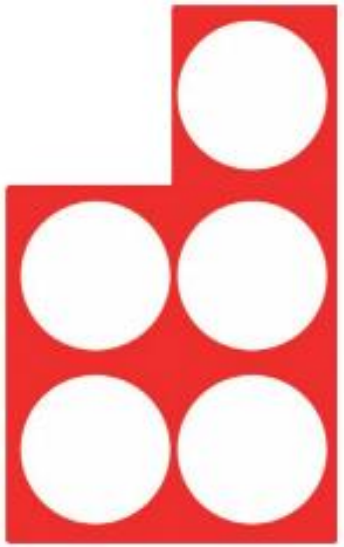
Representation and structure

- Representations used in lessons expose the mathematical structure being taught, the aim being that students can do the maths without using the representation
- When introducing and developing the understanding of a concept, children need to experience multiple representations in order to build an understanding
- What it is? What it isn’t?
- How does it connect to other aspects of maths?









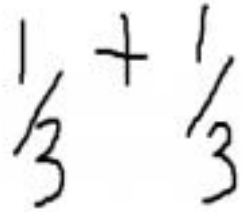
five

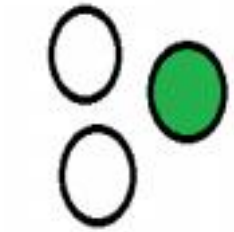
Fractions: $\frac{2}{3}$

These representations allow children to build a picture that a fraction can be:

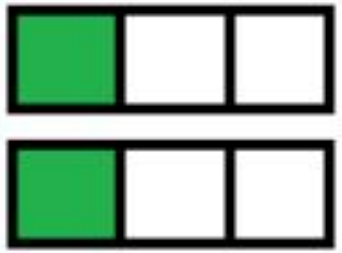
- part of a whole
- part of a set
- the result of a division
- a number
- a proportion

$2 \div 3 = 0.666\ldots$





"what is left from the whole after I take a third away"

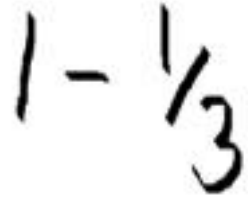


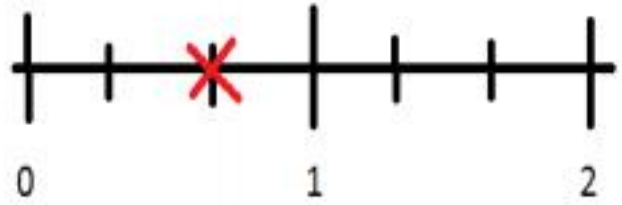
"two thirds"

"two out of three"

1:2

the proportion of goals scored by the winners if the final score is 2-1"





Variation – what does this mean?

- The central idea of teaching with variation is to highlight the essential features of a concept or idea through varying the non-essential features.
- When giving examples of a mathematical concept, it is useful to add variation to emphasise: a. What it is (as varied as possible); b. What it is not.
- When constructing a set of activities / questions it is important to consider what connects the examples; what mathematical structures are being highlighted?
- Variation is not the same as variety – careful attention needs to be paid to what aspects are being varied (and what is not being varied) and for what purpose.
- Two types of variation:
  - Procedural variation
  - Conceptual variation

Procedural Variation:

- Is dynamic; where I move between one calculation and the next there is a connection.
- Provides the opportunity
  - ❖ to focus on relationships, not just the procedure
  - ❖ to make connections between problems using one problem to work out the next
- Should not be repetitive in a way that leads children to stop thinking.

Children need to be taught from an early age to look for and recognise these connections.

What do you notice?

What's the same?

What's different?

Procedural variation

- This links with intelligent practice.

- Have a go at these sums:

253 + 45 =
253 + 46 =
253 + 34 =
253 + 24 =

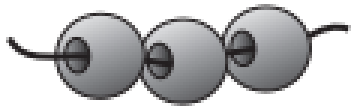
- How did you work it out?
- Is there a pattern?

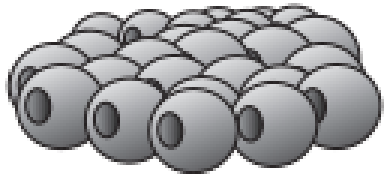
- Introducing these patterns and relationship early is important so when they get to KS2 they can answer questions like this:

Layla makes jewellery to sell at a school fair.

Each bracelet has **53** beads.

She makes **68** bracelets.





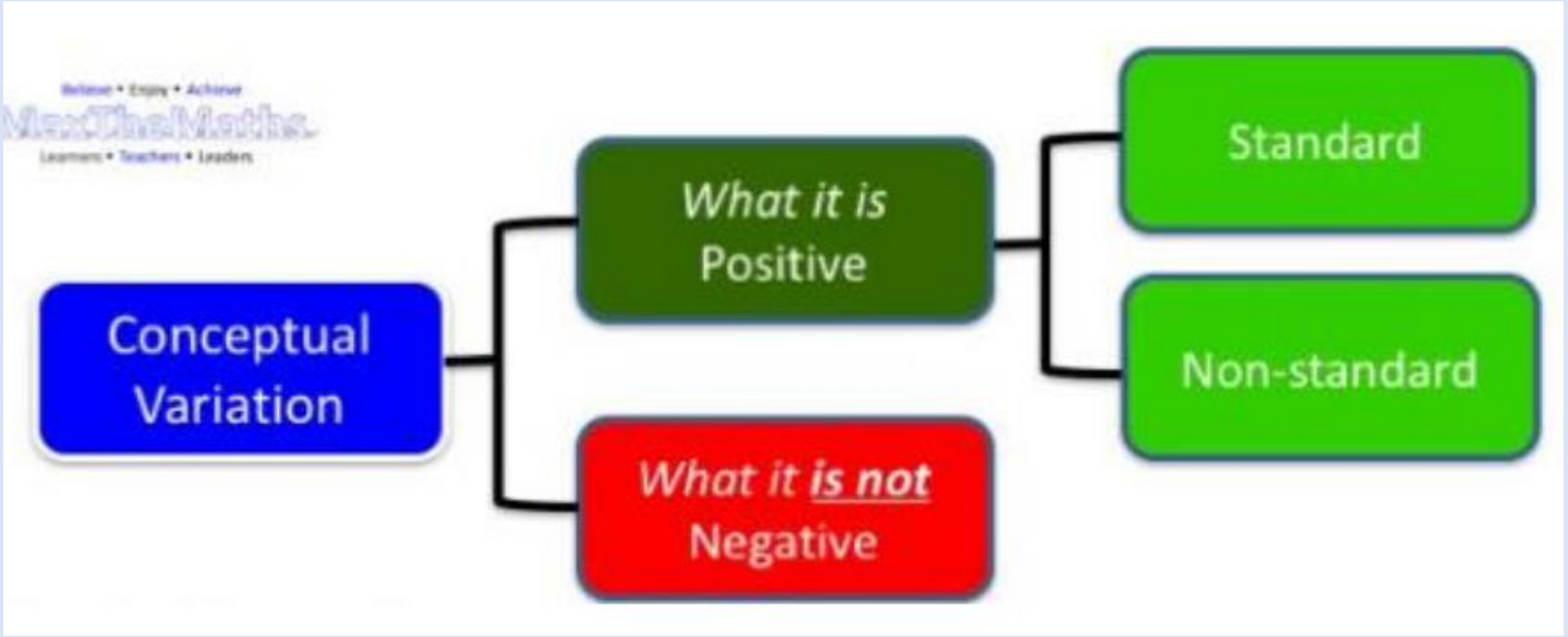
Each necklace has **105** beads.

She makes **34** necklaces.

How many beads does Layla use **altogether**?

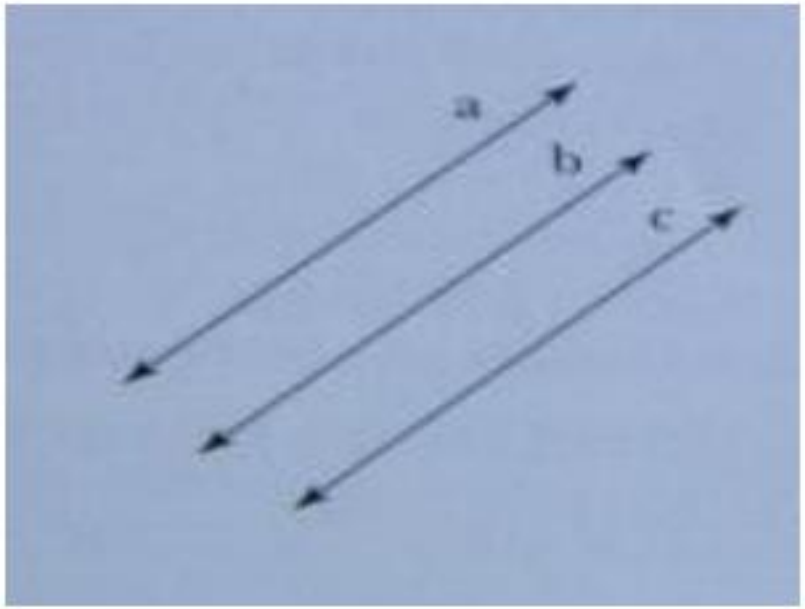
Conceptual and Non-Conceptual (Examples and non examples)

- An elephant
- A non-elephant

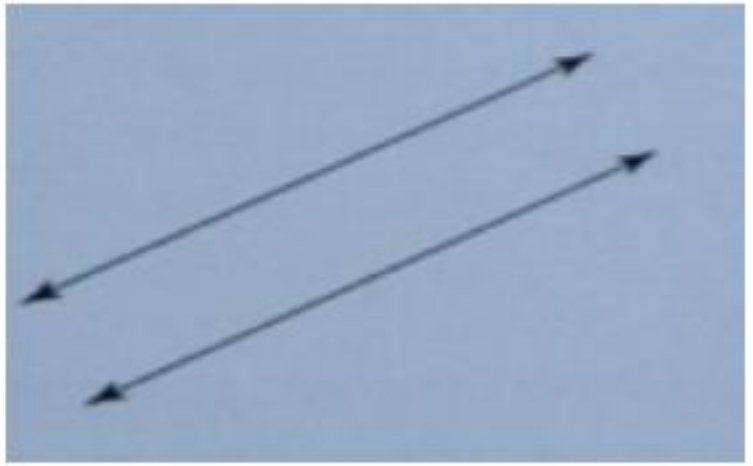

Conceptual Variation
What it is Positive
What it is not Negative
Standard
Non-standard

Standard and non-standard examples

11 year olds were asked: Is line a parallel to line c?



Most answered, 'No, because line b is in the way.'

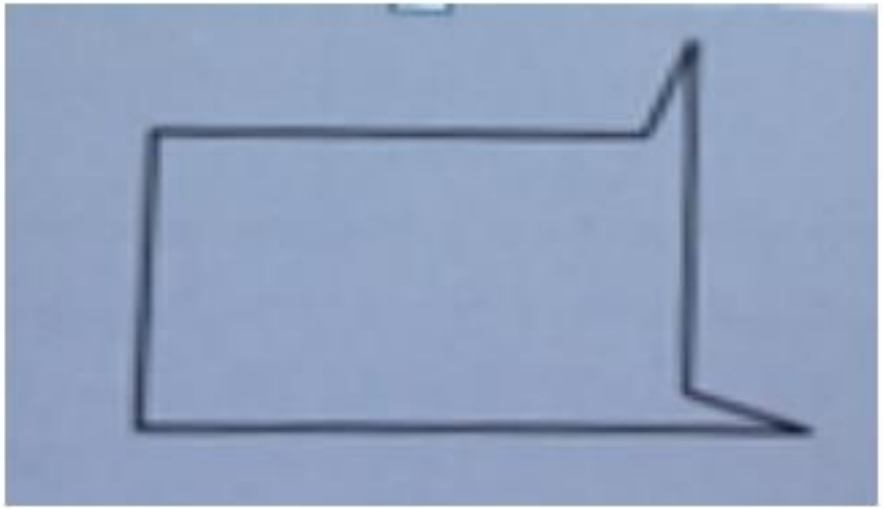


The concept of parallel lines is almost always illustrated like this.

Boaler, Jo. (2016) Mathematical Mindsets

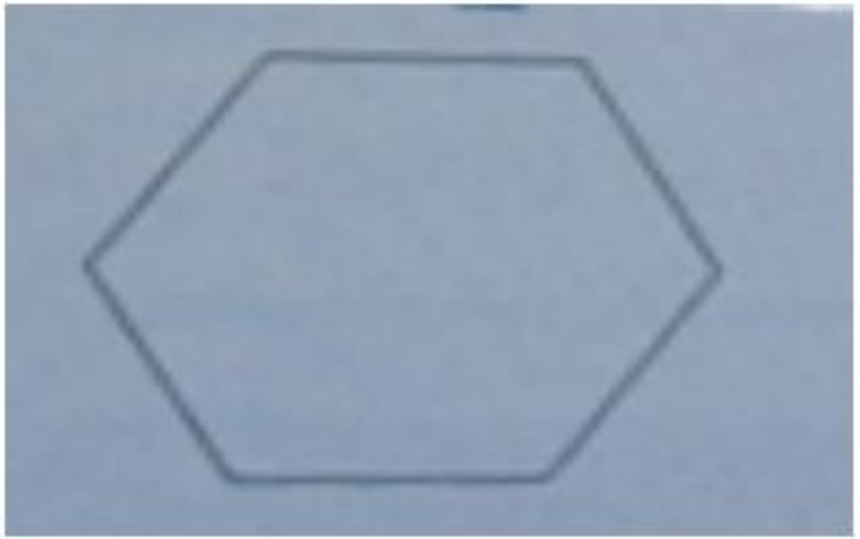
Standard and non-standard examples

They were asked to name this shape:



Most were unable to …

because hexagons are usually shown like this:



Coherance

- Coherence underpins the other 4 principles of mastery. It is about developing a comprehensive learning overview that focuses on the journey of conceptual understanding by ensuring planning is built around incremental steps. Explicit links need to be made throughout this journey in order for children to develop their mathematical thinking and their flexibility in understanding. Planning will predict and prevent misconceptions developing, while every step in learning is carefully thought through to ensure children are noticing key mathematical structures.

Metacognition and maths

- What is metacognition?
- How does this relate to maths?

Metacognition

- Growth mindset -

Individuals who believe their talents can be developed (through hard work, good strategies, and input from others) have a **growth mindset**. They tend to achieve more.

- Fixed mindset –

In a **fixed mindset**, people believe their qualities are **fixed** traits and therefore cannot change. These people document their intelligence and talents rather than working to develop and improve them. They also believe that talent alone leads to success, and effort is not required.

Growth mindsets

- Expectations of pupils

Resilience and perseverance is important – they keep working at a problem even if they find it difficult.

- Pupil's attitudes and self-talk

Changing their mindsets from 'I can't do this' to 'I can't do this yet.'

EEF report

- Education endowment foundation (EEF) have created 5 points to improve maths within early years and KS1 (although all of these can also be used in KS2).

1. Develop practitioners' understanding of how children learn mathematics

- Professional development should be used to raise the quality of practitioner' knowledge of mathematics, of children's mathematical development and of effective mathematical pedagogy.
- Developmental progressions show us how children typically learn mathematical concepts and can inform teaching.
- Practitioners should be aware that developing a secure grasp of early mathematical ideas takes time, and specific skills may emerge in different orders.
- The development of self regulation and metacognitive skills are linked to successful learning in early mathematics.

2. Dedicate time for children to learn mathematics and integrate mathematics throughout the day

- Dedicate time to focus on mathematics each day.
- Explore mathematics through different contexts, including storybooks, puzzles, songs, rhymes, puppet play, and games.
- Make the most of moments throughout the day to highlight and use mathematics, for example, in daily routines, play activities, and other curriculum areas.
- Seize chances to reinforce mathematical vocabulary.
- Create opportunities for extended discussion of mathematical ideas with children.

3. Use manipulatives and representations to develop understanding

- Manipulatives and representations can be powerful tools for supporting young children to engage with mathematical ideas.
- Ensure that children understand the links between the manipulatives and the mathematical ideas they represent.
- Ensure that there is a clear rationale for using a particular manipulative or representation to teach a specific mathematical concept.
- Encourage children to represent problems in their own way, for example with drawings and marks.
- Use manipulatives and representations to encourage discussion about mathematics.
- Encourage children to use their fingers—an important manipulative for children.

4. Ensure that teaching builds on what children already know

- It is important to assess what children do, and do not, know in order to extend learning for all children.
- A variety of methods should be used to assess children's mathematical understanding, and practitioners should check what children know in a variety of contexts.
- Carefully listen to children's responses and consider the right questions to ask to reveal understanding.
- Information collected should be used to inform next steps for teaching. Developmental progressions can be useful in informing decisions around what a child should learn next.

5. Use high quality targeted support to help all children learn mathematics.

- High quality targeted support can provide effective extra support for children.
- Small-group support is more likely to be effective when:
  - a. children with the greatest needs are supported by the most experienced staff;
  - b. training, support and resources are provided for staff using targeted activities;
  - c. sessions are brief and regular; and
  - d. explicit connections are made between targeted support and everyday activities or teaching.
- Using an approach or programme that is evidence based and has been independently evaluated is a good starting point.

Summary

- What makes a good mathematician?
- Growth mindset
- Reasoning skills
- Can see patterns and relationships
- Applying their learning to different contexts and when using different variations
- Don’t just know the facts but knows the maths behind them

Gap task

- Each session I will try and give a gap task

- Watch the following video https://www.youtube.com/watch?v=PN1dkawXoo0
- Doesn’t have to be the full clip.

- How is teaching for mastery shown in this lesson?