Kent and Medway Maths Hub

Sustaining Work Groups
September 2023

Kent and Medway Maths Hub

sus·tain səˈstān

sustained; sustaining; sustains

transitive verb

to give support or relief to

to supply with sustenance : NOURISH

KEEP UP, PROLONG

to support the weight of : PROP *also* : to carry or withstand (a weight or pressure)

to buoy up *sustained* by hope

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Aims:

- To consider the change process
- To consider what teaching for mastery looks like in our schools and reflect on what fidelity to this looks like
- To reflect on how our curriculum supports all pupils to see themselves as mathematicians and to be mathematicians.
- To engage in some maths

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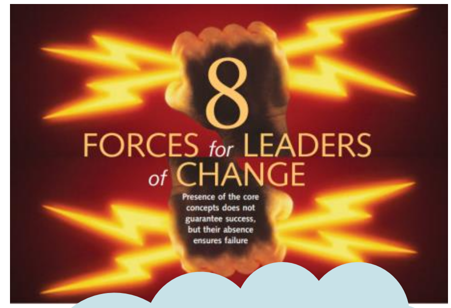
1. Engaging people's moral purposes.
2. Building capacity.
3. Understanding the change process.
4. Developing cultures for learning.
5. Developing cultures of evaluation.
6. Focusing on leadership for change.
7. Fostering coherence making.
8. Cultivating trilevel development.



Presence of these does not guarantee success, but absence ensures failure.

https://michaelfullan.ca/wp-content/uploads/2016/06/13396067650.pdf

Pupil outcomes

Let's consider the evidence that you have you gathered to demonstrate that the outcomes or your Work Group (from last year and previous years) have been met.

Pupil outcomes

Pupil outcomes

In the focused areas of the maths curriculum addressed by the Work Group during the year, pupils will:

- have high expectations of themselves as mathematicians; they will continue to show a positive attitude towards the subject
- demonstrate mathematical behaviours during lessons associated with a teaching for mastery approach

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Mathematical behaviours

What are we looking for?

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Productive dispositions and attitudes

Successful learning also depends on learners' attitudes and productive dispositions towards mathematics, as well as contributing to these. Attitudes can be defined as "a liking or disliking of mathematics, a tendency to engage in or avoid mathematical activities, a belief that one is good or bad at mathematics, and a belief that mathematics is useful or useless" (Neale, cited in Ma & Kishnor, 1997, p.27). The relationship between learners' attitudes and attainment is weak but important, and attitudes become increasingly negative as learners get older (Ma & Kishnor, 1997). Attitudes appear to be an important factor in progression and participation in mathematics post-16 (Brown, Brown & Bibby, 2008). Some learners experience maths anxiety, which can be a very strong hindrance to learning and doing mathematics (Dowker et al., 2016; see also Chinn, 2009). Estimates of the extent of maths anxiety vary considerably from 2-6% among secondary-school pupils in England (Chin, 2009) to 68% of US college students registered on mathematics courses (Betz, cited in Dowker et al., 2016). Kilpatrick et al. (2001) describe productive dispositions as the "habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy" (p. 5) and, thus, as encompassing more than attitudes. These include motivation (Middleton & Spanias, 1999), mathematical resilience (Johnston-Wilder & Lee, 2010), mathematical self-efficacy, the belief in one's ability to carry out an activity (Bandura & Schunk, 1981) as well as beliefs about the value of mathematics. Productive mathematical activity requires self-regulation, which, for the purposes of this review, is defined as the dispositions required to control one's emotions, thinking and behaviour, including one's cognitive and metacognitive actions (Dignath & Büttner, 2008; see also Gascoine et al., 2016). Emerging research suggests the importance of particular dispositions towards mathematics, such as 'spontaneous focusing' on number, mathematical relations or patterns, although it is not clear how, and to what extent, such dispositions are amenable to teaching (e.g., Rathé et al., 2016; Verschaffel, forthcoming).

Hodgen, J., Foster, C., Marks, R., & Brown, M. (2018).

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Attitudes

Attitudes can be defined as "a liking or disliking of mathematics, a tendency to engage in or avoid mathematical activities, a belief that one is good or bad at mathematics, and a belief that mathematics is useful or useless" (Neale, cited in Ma & Kishnor, 1997, p.27)

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Dispositions

Kilpatrick et al. (2001) describe productive dispositions as the “habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one’s own efficacy” (p. 5) and, thus, as encompassing more than attitudes. These include motivation (Middleton & Spanias, 1999), mathematical resilience (Johnston-Wilder & Lee, 2010), mathematical self-efficacy, the belief in one’s ability to carry out an activity (Bandura & Schunk, 1981) as well as beliefs about the value of mathematics. Productive mathematical activity requires self-regulation, which, for the purposes of this review, is defined as the dispositions required to control one’s emotions, thinking and behaviour, including one’s cognitive and metacognitive actions (Dignath & Büttner, 2008; see also Gascoine et al., 2016).

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Dispositions

- motivation
- mathematical resilience
- mathematical self-efficacy - the belief in one’s ability to carry out an activity
- beliefs about the value of mathematics

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Emerging research suggests the importance of particular dispositions towards mathematics, such as ‘spontaneous focusing’ on number, mathematical relations or patterns ...

Rathé et al., 2016

Positive changes in our schools

Pupil outcomes:

When analysing the question answered at the end of the year participants noticed that pupils had more resilience. Overall, the explanations that were given by pupils demonstrated a deeper conceptual understanding with pupils with participants citing that the “use of stem sentences and the I do, you do, we all do, has given the pupils confidence and the ability to explain.

Positive changes in our schools

Lead teachers can identify how pupils across school demonstrate a growth mindset towards mathematics, with 100% of participants showing that pupils have a positive attitude towards maths.

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Describe the relationship between the people and the fish.

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1. For every 1 person there are 2 fish.
2. There are 2 fish per person.
3. There is 1 person per 2 fish.
4. For every 2 fish there is 1 person.
5. 1 person has 2 fish. If you multiply the number of people by 4 , you multiply the number of fish by 4.
6. There are more fish than people.
7. There are fewer people than fish.
8. There are twice (2 times) as many fish as there are people.
9. There are half ($\frac{1}{2}$ times) as many people as there are fish.
10. Something else.

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What makes a great mathematician?

— A GOOD mathematician wants to know how. A GREAT mathematician wants to know why.

Ben Orlin mathwithbaddrawing

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There are more fish than people.
There are fewer people than fish.
There are twice (2 times) as many fish as there are people.
There are half (1/2 times) as many people as there are fish.

How many more fish are there than people?
"There are 4 more."
How many times the number of fish are there compared to people?
"There are 2 times the number."
How many fewer people are there than fish?
"There are 4 fewer."
How many times the number of people are there compared to fish?
"There are half ($\frac{1}{2}$ times) the number."

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Reflection
Pupils

What learning behaviours do you already see in your pupils?

What evidence will you be looking for to see that a change in pupils' dispositions is happening in your school?

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Systems

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Ofsted review
Curriculum

In the last few years, a resounding, positive shift in mathematics education has taken place in primary schools:

Curriculum is now at the heart of leaders' decisions and actions.

Generic approaches, such as the expectation that all teaching should always be differentiated, have dissipated.

We now see high quality curriculums, collaborative support for teachers and a focus on mathematics teaching. Leaders intend that pupils 'keep up, not catch up'.

These approaches set out a better path to proficiency for pupils.

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Positive changes in our schools

Participants noticed that the teaching for mastery approach of ‘keeping all children together, created a more cohesive feel to lessons. Children who excel continue to do so and are challenged, whereas those who struggle are supported thoroughly to achieve their best.’

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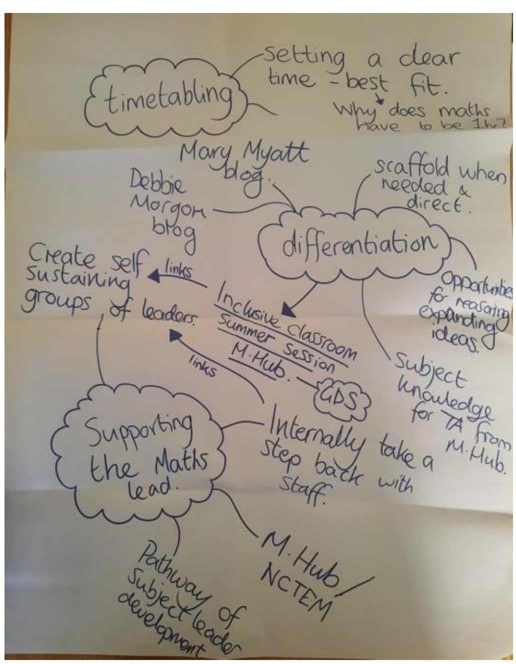

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Being able to do the maths does not mean that it's too easy!

40. Leaders had moved away from an assumption that correct answers showed that work was 'too easy'.

…discourse includes such features as continuing a conversation even after a correct answer has been given, developing the classroom norm that providing explanations is as important as providing answers, and encouraging students to reference and critique each other's solution methods.

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Ofsted review

92. In some schools, pupils were not explicitly taught how to apply the mathematics they had recently learned to mathematical problems. Their only exposure to solving mathematical problems was through answering the final few questions of a predominantly procedure-focused exercise. Often, many pupils did not reach this stage of the exercise. These pupils, therefore, had very little experience of applying mathematical methods beyond routine and established applications. Pupils in these schools were notably less confident when solving mathematical problems.

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Systems that enable change to happen

A. Teachers do not have the subject knowledge to make effective lesson design choices.
B. Pupils do not know how to learn or know what good learning looks like.
C. There is not enough time to focus on maths as there are other curriculum areas that need to be focused upon.
D. Our school is doing fine – there is no need for change.

…schools can be no better than the teachers and administrators who work within them (Guskey, 2002)

…the majority of programs fail because they do not take into account two crucial factors: (1) what motivates teachers to engage in professional development, and (2) the process by which change in teachers typically occurs (Guskey, 1986).

To maximize the impact of deep learning on students, Fullan encouraged us to create a shared ownership with teachers and reminded us that successful change processes are a function of shaping and reshaping good ideas as they build capacity. This process comes through the creation of collaborative structures, which must be nourished through teacher learning and development.

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According to Fullan, the No. 1 influencer in student achievement was collective teacher efficacy. A successful collective efficacy among teachers can be created in an environment that provides frequent and specific collaboration. He calls it **professional collaboration with purpose.**

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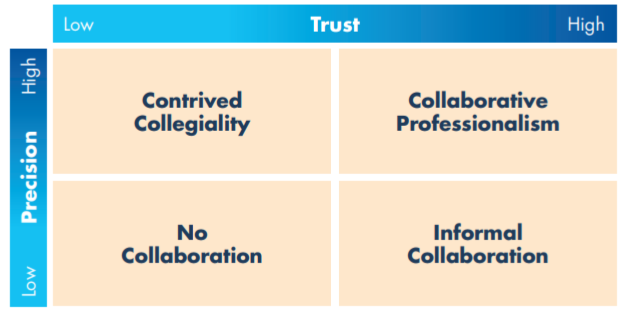
Collaboration

Figure 1. Quadrants of collaboration



- within your school
- across schools - in a trust/ infant to junior/ primary to secondary
- across your Maths Hub
- nationally

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Collaboration in your school – what systems enable…

all teachers to support **all** pupils to access the maths.

all teachers to support each other in your school and across schools?

teacher subject knowledge development?

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Learning is the Work Group

https://www.youtube.com/watch?v=-GRd4ifz-Yk

Collaborative professionalism

…is about how teachers and other educators transform teaching and learning together to work with all students to develop fulfilling lives of meaning, purpose and success.

It is evidence informed, but not data-driven, and involves deep and sometimes demanding dialogue, candid but constructive feedback, and continuous collaborative inquiry.

Finally, collaborative inquiry is embedded in the culture and life of the school, where educators actively care for and have solidarity with each other as fellow-professionals as they pursue their challenging work together in response to the cultures of their students, the society and themselves.

Fullan’s three “big ideas”

1. The purpose of schools is to ensure that all students learn as distinct from simply being taught. This requires the development of shared goals and visions.
2. Helping all students learn requires a collaborative culture and collective effort.
3. All schools will be able to monitor their effectiveness with a results orientation.

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Reflection

- Consider the professional learning that teachers in your school undertake. How does it connect to Fullan’s ideas that learning is the “work”?
- Consider what model of teacher collaboration is currently in place at your school. To what degree is it intentional and focused? How are teachers learning from each other?
- Share thinking about the idea that “there is no greater motivator than internal accountability to oneself and one’s peers”.

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Lesson Design
Teachers

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Ofsted review
Representations

Teachers help pupils to understand new concepts. Networks of support, such as the Maths Hubs, provide regular and highly useful training. This helps teachers to adopt new and improved ways of explaining and modelling concepts. Often, teachers use physical resources and pictorial representations to help pupils see underlying mathematical structures. They also teach and model new vocabulary, regularly check pupils' understanding and swiftly pickup misconceptions.

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Changes in our schools

Participants expressed that through this year and supporting individual teachers "with subject knowledge, meant that teachers expressed how this was very useful both for them and their children." One participant felt that they would like to do this with other teachers across the school. I feel like teachers in the upper years would benefit from more input around subject knowledge and methods of teaching the more complex ideas'

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Changes in our teachers

100% of participants agree that the teachers in their school plan and teach mathematics lessons in a way that reflects a teaching for mastery approach. When discussing this with participants we felt that although not all of the teachers in their schools are fully aware of all the principles of mastery yet due to the scheme of learning that is used you can see a teaching for mastery approach in all lessons.

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Questions

What does teaching for mastery mean to you and your school?

How does your curriculum and the resources you have to implement it maximise the principles of TfM?

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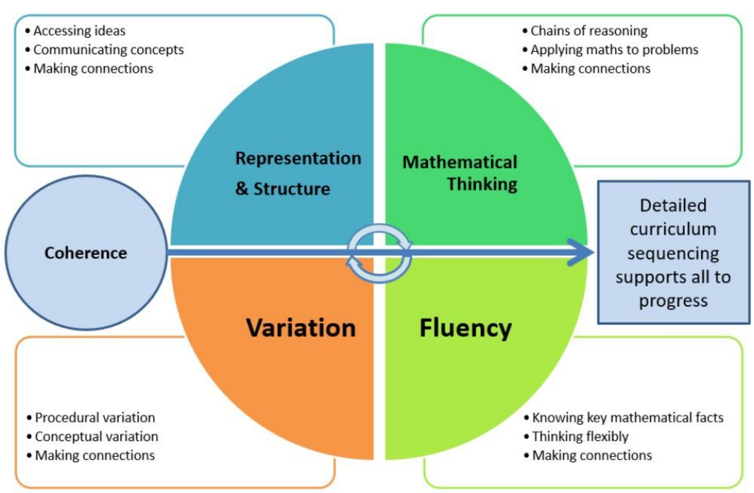
Teaching for Mastery



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THE ESSENCE OF MATHEMATICS TEACHING FOR MASTERY

Underpinning principles, lesson design, and how mastery works in the classroom

Mathematics teaching for mastery assumes everyone can learn and enjoy mathematics.

Mathematical learning behaviours are developed such that pupils focus and engage fully as learners who reason and seek to make connections.

Teachers continually develop their specialist knowledge for teaching mathematics, working collaboratively to refine and improve their teaching.

Curriculum design ensures a coherent and detailed sequence of essential content to support sustained progression over time.

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Critical consumer of resources

- Is our curriculum well-sequenced so that the maths unfolds enabling all pupils to make connections and secure generalisations?
- What's the secure understanding my pupils bring to this sequence of learning?
- Do lesson resources support teachers to develop their subject knowledge so that they can be critical consumers of the resource?
- Are pupils applying what they have learned both in the short and the long term?

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Think of a maths story that involves multiplication

Tell your story to the person you are sat next to.
Both write down the equation that represents the story.

Make sure everyone shares a story and for each an equation is written.

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Just using your contexts…

Multiplication always makes bigger.

Agree or disagree?

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Sometimes, always or never

A. Multiplication always makes bigger.
B. Division always makes smaller.

Give examples to show how you made your decision.

Making connections

Multiplying by 0
Multiplying by 1
Multiplying by a number greater than 1
Multiplying by a number greater than 0 and less than 1

$$50 \times 0 = 0$$
$$50 \times 1 = 50$$
$$50 \times 2 = 100$$
$$50 \times \frac{1}{10} = 5$$

What is there to notice?

$50 \times 0 = 0$
$50 \times 1 = 50$
$50 \times 10 = 500$
$50 \times \frac{1}{10} = 5$

A

$50 \times 0 = 0$
$50 \times \frac{1}{10} = 5$
$50 \times 1 = 50$
$50 \times 10 = 500$

B

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Sequencing learning

A. Multiplying by 0
B. Multiplying by 1
C. Multiplying by a number greater than 1
D. Multiplying by a number less than 1

Discuss the order these would appear in a coherent curriculum.

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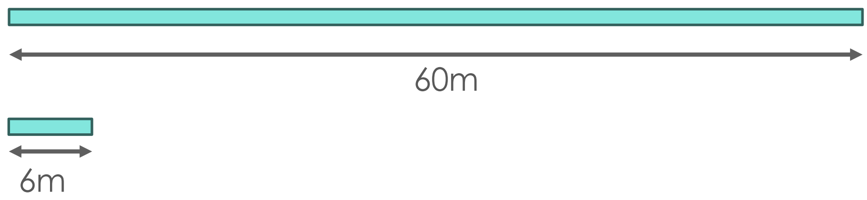
Agree or disagree with these statements?



60m is 10 times bigger than 6m.

6m is 10 times smaller than 60m.

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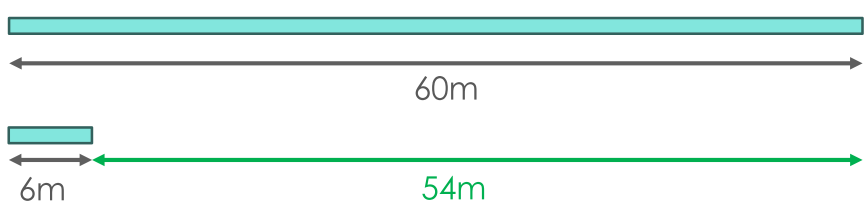
Describe the additive relationship between the 60m and 6m.



60m is 54m longer than 6m.
6m is 54m shorter than 60m.
Add 54m to 6m to equal 60m.
Subtract 54m from 60m to equal 6m.

60m – 6m = 54m

6m + 54m = 60m

60m – 54m = 6m

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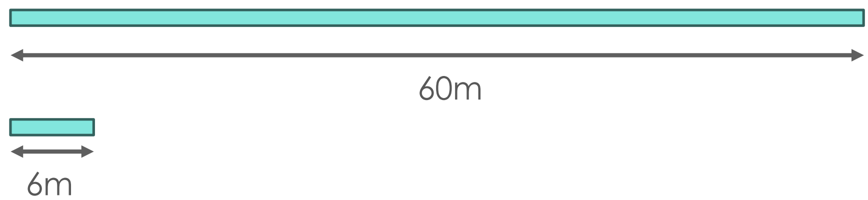
Describe the multiplicative relationship between 60m and 6m.
Write the equations to match your description.



60m is 10 times 6m.

6m is $\frac{1}{10}$ of 60m.

6m, 10 times is 60m.

$6\text{m} \times 10 = 60\text{m}$

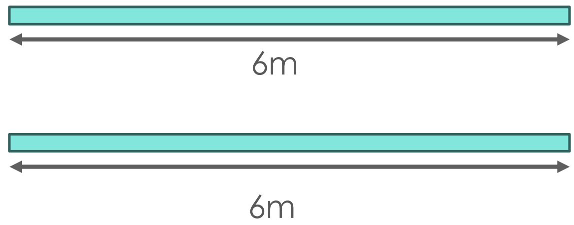
$10 \times 6\text{m} = 60\text{m}$

$60\text{m} \div 10 = 6\text{m}$

$\frac{1}{10} \times 60\text{m} = 6\text{m}$

$6\text{m} \div \frac{1}{10} = 60\text{m}$

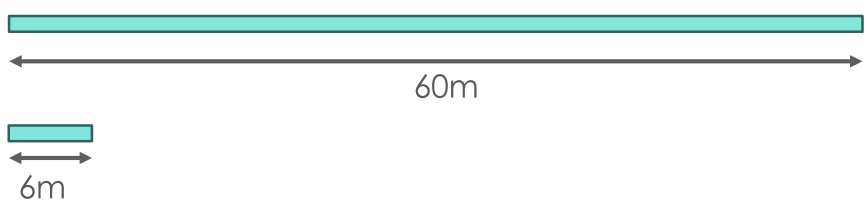
$60\text{m} \div 6\text{m} = 10$



6m is 1 time bigger than 6m.

6m is 1 time smaller than 6m.

How might we refine these statements?



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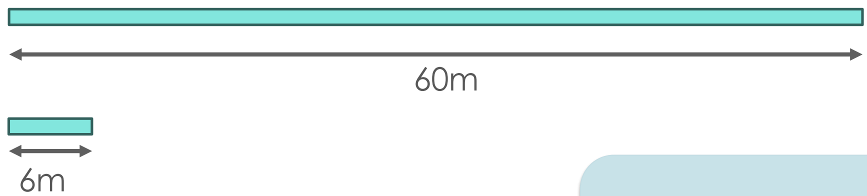
Agree or disagree with these statements?



60m is 10 times 6m.

6m is $\frac{1}{10}$ of 60m.

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What systems are in place in your school for this to happen?

Teachers continually develop their specialist knowledge for teaching mathematics, working collaboratively to refine and improve their teaching.

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Lesson design

Lesson design links to prior learning to ensure all can access the new learning and identifies carefully sequenced steps in progression to build secure understanding.

Examples, representations and models are carefully selected to expose the structure of mathematical concepts and emphasise connections, enabling pupils to develop a deep knowledge of mathematics.

Procedural fluency and conceptual understanding are developed in tandem because each supports the development of the other.

It is recognised that practice is a vital part of learning, but the practice must be designed to both reinforce pupils' procedural fluency and develop their conceptual understanding.

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A mathematical task pertains to a pedagogical tool used to promote student learning, that is, advancing from current to intended schemes (Watson & Sullivan, 2008).

Tzur et al., (2013)

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Gu's concept of procedural variation emphasizes the dynamic nature of concepts, and how they evolve and can be applied to new situations. Procedural variation can help students to understand where the knowledge came from and where it can be applied, thus allowing well-structured knowledge to be constructed. It can help students to form concepts, solve problems, construct a system of activity experience and comprehend different components of knowledge as a structure with non-arbitrary relationships between new and prior knowledge.

Huang, R., & Li, Y. 2017

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…'progressively unfold the mathematical activities'

Other important BS concepts proposed by Gu (1994) include 'potential distance' and 'Pudian.' The potential difference is the difference between what the learner already knows and the new situation to which he or she can (or needs to) transfer and apply the knowledge. Procedural variation can be regarded as introducing a physical or conceptual artifact that the learner can use to bridge that distance (Gu et al., 2004, p. 126), which may include learning materials, activities, tasks, or problems.

Huang, R., & Li, Y. 2017

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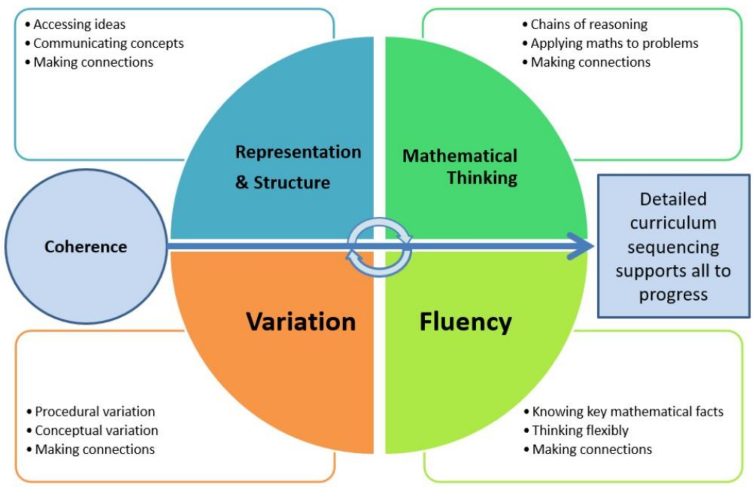
Teaching for Mastery



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Reflection

<u>Subject knowledge</u>

What is currently having a positive impact?

How do we continue to develop and refine this across our schools?

Lesson design discussions/ observing learning/ evaluating impact on pupils/ …

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Reflection

Consider the next steps for your school as you engage in a Sustaining Work Group

- How will collaboration support you to bring about sustainable changes in your school?
- What systems will you refine?

new staff

staff new to a year group/ phase

new pupils

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The Answer Is Only the Beginning: Extended Discourse in Chinese and U.S. Mathematics Classrooms

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