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Mathematics

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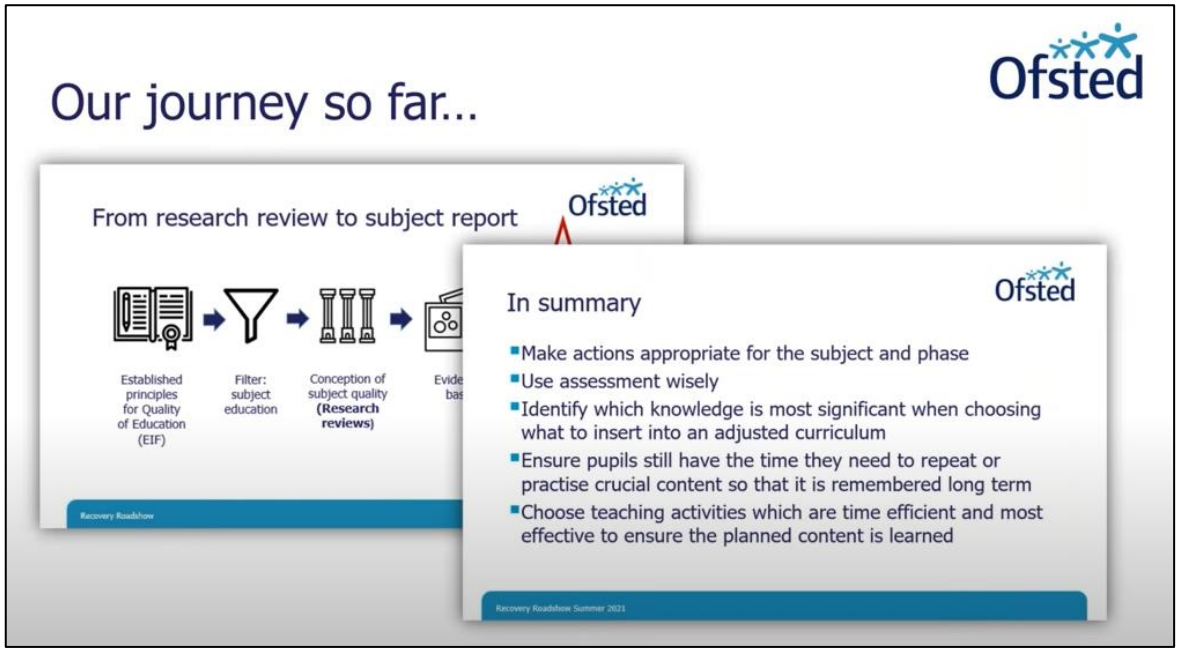
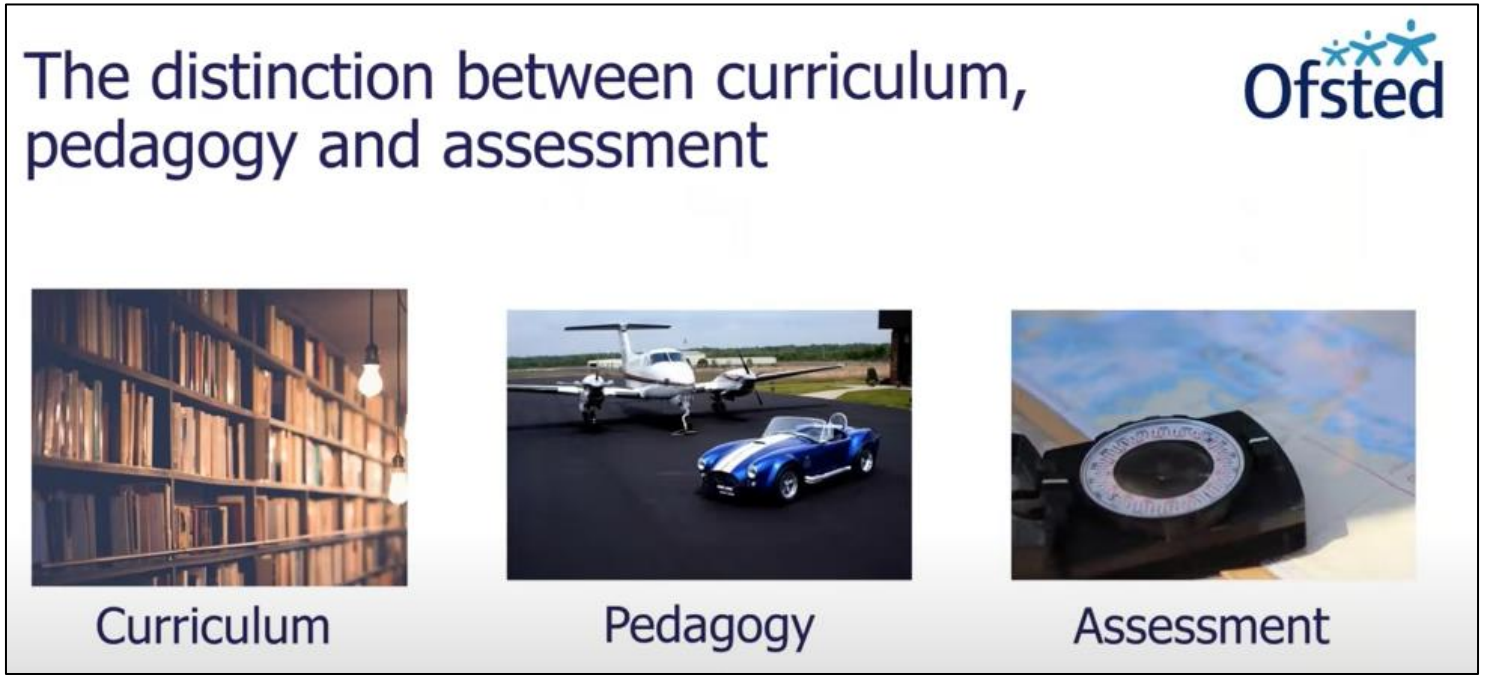
A webinar from the North-West region: mathematics

Steve Wren, HMI and subject lead for mathematics, on curriculum, pedagogy and assessment [November 2021]

A session about how pupils make progress in mathematics and how the principles of catch-up might apply to maths.

The messages will replicate much of the content in Ofsted's research review (May 2021).





'*When thinking about how all pupils can develop expertise in mathematics, it's really useful to draw a distinction between the* ***curriculum****,* ***pedagogy*** *and* ***assessment***.'

- Curriculum: what pupils will learn.
- Pedagogy: the nature of the teaching and the rehearsal.
- Assessment: what is known, understood and remembered.

Curriculum thinking should happen first, followed by the pedagogies. This helps to avoid situations where pedagogies are considered first, rather than pupils' intended learning.

What knowledge do pupils need to learn in mathematics?

It's important to have an understanding of the nature of content and progression in mathematics.

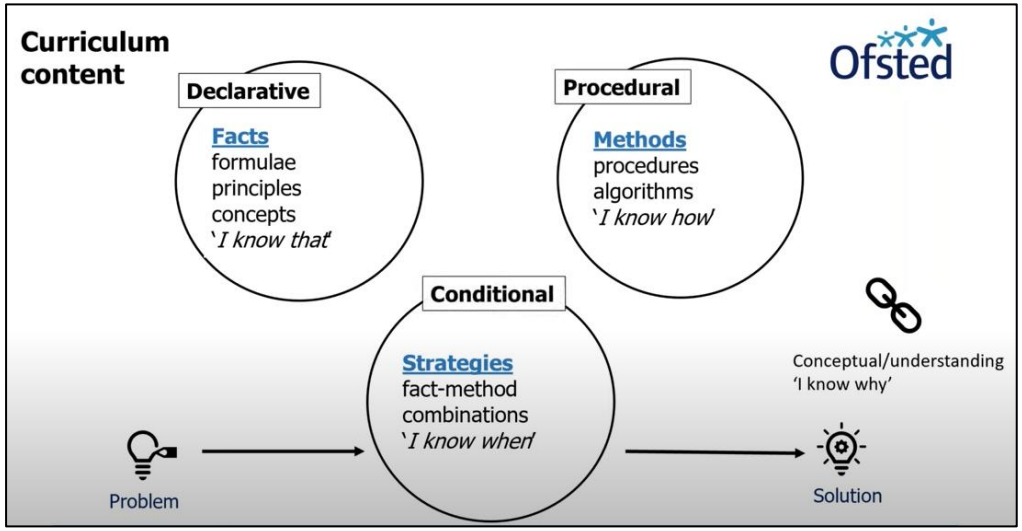
There are three types of curriculum content: ***declarative***; ***procedural***; and ***conditional***.
Also, these help us to consider features of curriculum progression.
[NB There are other ways of classifying mathematical knowledge.]

Declarative: facts, static and declarable … anything that can be talked about using **"I know that …"**

Procedural: methods … anything that can be talked about using **"I know how …"**

Conditional: combines **facts** and **methods** … this is what pupils need to be confident problem solvers. It's the **"I know when …"** of maths knowledge.

'*Because strategies consist of combinations of facts and methods, this gives us our first clue about the nature of progression in mathematics. Pupils need to be familiar with the facts and methods before they can be expected to apply them to increasingly complex scenarios and problems*.'



Curriculum thinking

- Engineering success
- The importance of facts
- The importance of methods
- The journey to problem solving proficiency

Engineering success

This is about taking a 'systems' approach … '*this ensures that curriculum plans, teaching approaches and rehearsal plans, assessments and the mechanics for involving each aspect align well*.' Progression is by '*intelligent design*' (not by chance, choice or random mistake).

'*The more proactive we can be, and the less that's left to chance, the better and more equitable the outcomes for pupils*'.

'*When success is engineered, pupils are more likely to become proficient in the subject … and enjoy it more*.'

The primary focus of SLs is to provide a curriculum where the content is taught, rehearsed and remembered.

New learning is predicated on pupils' security with prior ***facts***, ***methods*** and ***strategies*** (this has implications for 'education recovery').

'*As we return to normal schooling, it's crucial that teacher and leaders carefully consider the necessary component knowledge and understanding for each new topic to be studied*.'

Curriculum thinking

- Engineering success
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<u>The importance of facts</u>

The acquisition of core maths facts predicts later success.

'*Key facts are like the corner and side pieces of a jigsaw; they help to reveal the bigger picture*.' For example, when pupils are simplifying a fraction, if they have their times table facts to hand, it is so much easier.

<u>The importance of methods</u>

'*Procedural knowledge of mathematical methods enables pupils to calculate, solve, measure (and integrate)*.'

Pupils will benefit from a curriculum that focuses on ensuring they all have the chance to learn to <u>automaticity</u> efficient and accurate methods so they can use them now and in the future.

Curriculum thinking

- Engineering success
- The importance of facts
- The importance of methods
- The journey to problem solving proficiency

- Facts and methods first
- Familiarity with problems of the same type: pupils make links between problems and taught strategies
- 'Doing' problem solving does not make a problem solver

<u>The journey to problem solving efficiency</u>

The appearance of expertise and journey to expertise are very different.

'*Expert mathematicians can manoeuvre their way through problems, drawing on a rich schema of knowledge and familiarity with different problems … it looks effortless and they enjoy the process*.'

The 'novice' (mathematician) must emulate the 'journey' of the 'expert' … by acquiring a rich schema of knowledge and familiarity with different problem types.

Experts have 'facts' and 'methods' to automaticity so their working memories are not overloaded … and they need experience in combining them as strategies to solve problem types.

When time is short, what can we do?

- Identify core mathematical knowledge
- Make the most of the time that we have

The logical thing is to look for ways to make the limited time in our classrooms count. Here, we are thinking about **pedagogy** and **assessment**.

Implications for pedagogy:

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- Effective
- Efficient
- Equitable

There are three key themes that have implications for catch-up pedagogy.
Implementation of curriculum plans work well when pedagogical approaches are ***effective***, ***efficient*** and ***equitable***.

Effective

- Systematic instructional approaches
- Clarity of explanations
- Alignment: curriculum, instruction & rehearsal

Rehearsal opportunities must be balanced in order to give pupils the opportunity to recall and deploy as well as to explain and reason.

Efficient

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- Maximise proportion of time that pupils are thinking about content
- Minimise time lost to transitions, distractions, resource choices & guesswork
- Balance 'finding out' with 'rehearsal [to automaticity]'
- Assessment should be fit for purpose

Lesson time needs to be used efficiently, possibly with the offer of 'new learning' alongside retaining automaticity.

Equitable

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- Opportunity to learn
- Opportunity to be part of the mathematical 'conversation'

This allows all pupils to flourish and grow as mathematicians … ie they learn facts, methods and strategies for problem solving success. We need to focus on the journey to expertise, not the activities of the 'experts'.

In summary

- Curriculum vs. Pedagogy vs. Assessment
- Declarative, procedural and conditional knowledge – categories and progression
- Engineering sucess
- Effective, efficient and equitable pedagogy