Hampshire Services
HIAS SCHOOL IMPROVEMENT

Tackling Educational Disadvantage in Maths

Access and Success for All: Ideas and Strategies

Jo Lees: Jo.Lees@Hants.gov.uk

Hampshire County Council

The Importance of Explicit Modelling when tackling educational disadvantage

Jo.Lees@hants.gov.uk

Teaching and Learning

'Raising attainment of disadvantaged children, closing the gap, improving their attendance and behaviour, increasing the participation of their parents in their education and so on, these are all worthy targets to pursue. ***But underpinning all this has to be high-quality teaching. Evidence shows that disadvantaged children are disproportionately hampered by bad teaching.'***

- Sir John Dunford

EEF Guidance Documents

IMPROVING LITERACY IN KEY STAGE ONE
Guidance Report

IMPROVING LITERACY IN KEY STAGE TWO
Guidance Report

IMPROVING MATHEMATICS
IN KEY STAGES TWO AND THREE
Guidance Report

1 Develop pupils' language capability to support their reading and writing

Purposeful speaking and listening activities support the development of pupils' language capability and provides a foundation for thinking and communication.

Purposeful activities include:

- reading books aloud and discussing them;
- activities that extend pupils' expressive and receptive vocabulary;
- collaborative learning activities where pupils can share their thought processes;
- structured questioning to develop reading comprehension;
- teachers modelling inference-making by thinking aloud; and
- pupils articulating their ideas verbally before they start writing.

EVIDENCE STRENGTH
VERY EXTENSIVE
EXTENSIVE
MODERATE
LIMITED
VERY LIMITED

see page 8

2 Support pupils to develop fluent reading capabilities

Fluent readers can read quickly, accurately, and with appropriate stress and intonation.

Fluent reading supports comprehension because pupils' cognitive resources are freed from focusing on word recognition and can be redirected towards comprehending the text.

This can be developed through:

- guided oral reading instruction—teachers model fluent reading of a text, then pupils read the same text aloud with appropriate feedback; and
- repeated reading—pupils re-read a short and meaningful passage a set number of times or until they reach a suitable level of fluency.

It is important to understand pupils' current capabilities and teach accordingly. Most pupils will need an emphasis on developing reading fluency, but some pupils may need a focus on more basic skills, such as decoding and phonological awareness.

EVIDENCE STRENGTH
VERY EXTENSIVE
EXTENSIVE
MODERATE
LIMITED
VERY LIMITED

see page 10

3 Teach reading comprehension strategies through modelling and supported practice

Reading comprehension can be improved by teaching specific strategies that pupils can apply both to monitor and overcome barriers to comprehension. These include:

- prediction;
- questioning;
- clarifying;
- summarising;
- inference; and
- activating prior knowledge.

The potential impact of these strategies is very high, but can be hard to achieve, since pupils are required to take greater responsibility for their own learning.

The strategies should be described and modelled before pupils practise the strategies with feedback. Support should then be gradually reduced as pupils take increasing responsibility.

Texts should be carefully selected to support the teaching of these strategies.

EVIDENCE STRENGTH
VERY EXTENSIVE
EXTENSIVE
MODERATE
LIMITED
VERY LIMITED

see page 12

4 Teach writing composition strategies through modelling and supported practice

Purpose and audience are central to effective writing. Pupils need to have a

and son

Writing c
as a pro
seven c

- plan
- draf
- sha
- eva
- revi
- edit
- pub

Effective
number
to suppo
compon
writing p
should le
and why
strategy
pupils' p
be impro
the strat
gradually
as pupil
increasi
prior kno

The strat
describe
before p
them wi
Support
be gradu
as pupil
increasi

EVIDENCE STRENGTH
VERY E
EXTEN
MODE
LIMITE
VERY L

5 Develop pupils' transcription and sentence construction skills through extensive practice

A fluent writing style supports composition

6 Target teaching and support by accurately assessing pupil needs

High-quality assessment and diagnosis should be

7 Use high-quality structured interventions to help pupils who are struggling with their literacy

Schools should focus first on developing core

Box 10: Shared reading tips

Tip 1: Ask questions about the book.

Parents can support their child by asking a range of questions about the book they are reading together.

- The **'five Ws'**—**who**, **what**, **where**, **when**, and **why**—can provide useful question stems for parents.
- Parents should use a mixture of **closed questions** (which can be answered with a single word, or a small number of words) and **open questions** (which require a fuller response).
- Children might also be asked to **summarise** what has happened in the book or story so far, and to **predict** what will happen next.

Tip 2: Link reading to the real world.

- By talking about links between the book and real life, parents can make the story more interesting and help children develop their understanding of ideas in the book. For example, while reading about Cinderella going to the ball, a parent might discuss the similarities between a ball and a birthday party.

IMPROVING MATHEMATICS IN KEY STAGES TWO AND THREE
A self-assessment guide

RECOMMENDATION 1
Use assessment to build on pupils' existing knowledge and understanding

INEFFECTIVE

Assessments are often set without careful consideration of their intended purpose.

Teachers collect summative data but rarely use assessment to collect information about pupils' mathematical strengths and weaknesses. Teaching does not respond to pupils' developing understanding.

Many teachers are not knowledgeable of the common misconceptions in mathematics. This has not been a focus of CPD.

When planning future lessons, teachers do not consider the misconceptions that are likely to arise.

Teachers' feedback is not specific, accurate or clear. It is often limited to empty praise.

Feedback is inefficient and creates a large workload for teachers. Teachers spend a large amount of time marking work. This is potentially distracting teachers from more beneficial activities.

IMPROVING

Assessments are sometimes set with consideration of their purpose, but this is inconsistent. Not all teachers are confident users of assessment for different purposes.

Teachers are able to achieve a good understanding of pupils' strengths and weaknesses, using a variety of data sources, but they do not adapt their teaching in response.

Teachers' knowledge of common misconceptions is patchy. Some teachers need support to improve their knowledge.

Some teachers plan to address likely misconceptions but this practice is not consistent throughout the school.

Some teachers can confidently and consistently provide effective feedback, but others do not.

There is a recognition that marking workload is a problem, but there is still work to be done to minimise the burden of marking.

EXEMPLARY

Careful consideration is given to how the results of an assessment will be used before an appropriate assessment is selected.

Teachers use a variety of types of assessment, as appropriate, to collect information about strengths and weaknesses. They adapt their teaching in response and use assessment information to inform planning.

Teachers have a good knowledge of the common misconceptions in maths and why they arise. They use this knowledge to inform their assessment.

Teachers use their knowledge of common misconceptions to plan future lessons.

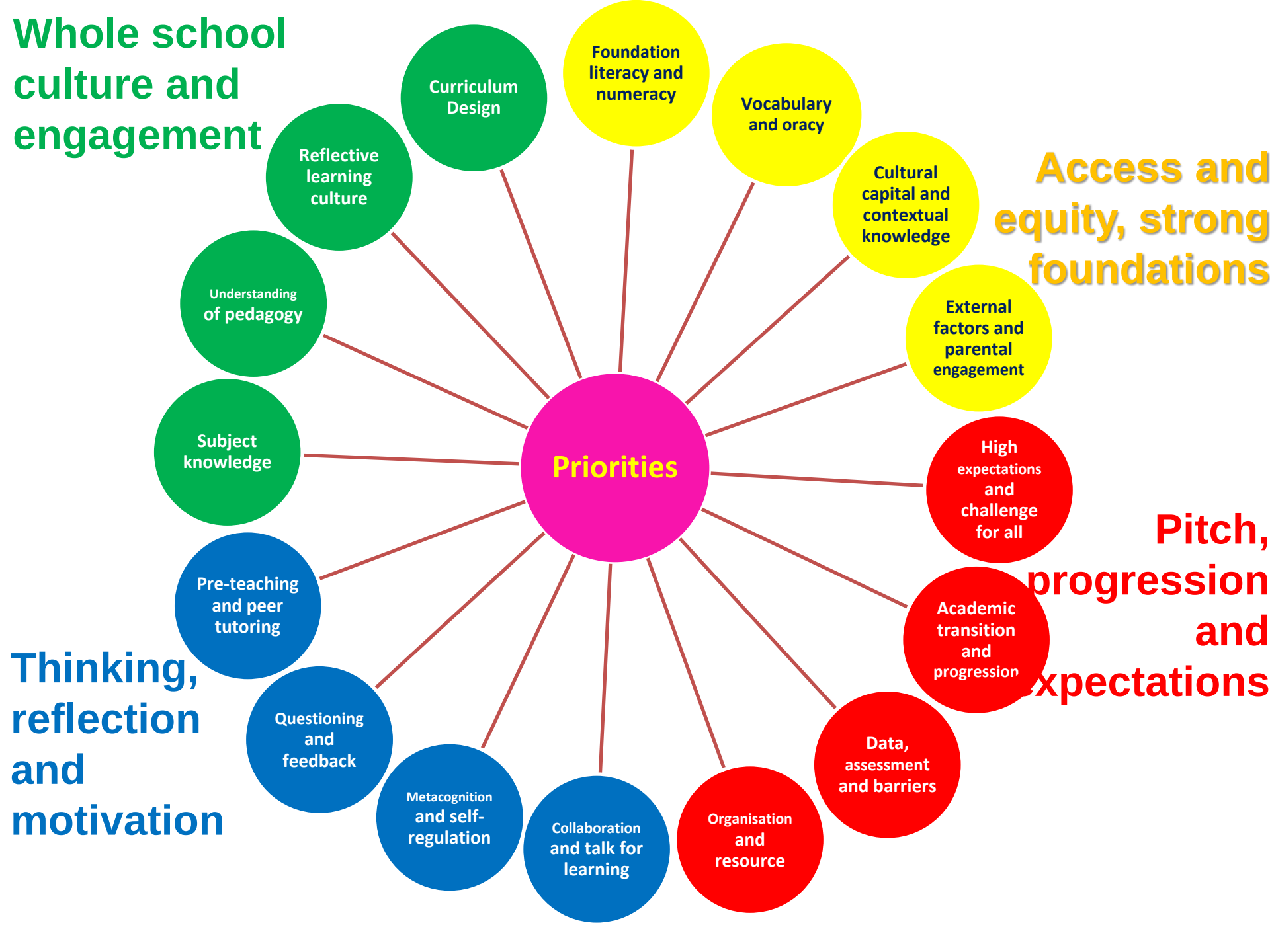
Feedback is effective and generally resembles the principles outlined in the guidance.

Feedback is efficient and does not create a large workload for teachers. There is a healthy balance between oral and written feedback.

What the Research Says: Successful Principles Vs Hindering Principles

The research team identified the following building blocks for success:

1. **Whole-school ethos of attainment for all**
2. **Addressing behaviour and attendance**
3. **High quality teaching first**
4. **Meeting individual learning needs**
5. **Deploying staff effectively**
6. **Data driven and responding to evidence**
7. **Clear, responsive leadership**


Whole school culture and engagement
Curriculum Design
Foundation literacy and numeracy
Vocabulary and oracy
Cultural capital and contextual knowledge
Access and equity, strong foundations
External factors and parental engagement
Reflective learning culture
Understanding of pedagogy
Subject knowledge
Priorities
High expectations and challenge for all
Pitch, progression and expectations
Academic transition and progression
Pre-teaching and peer tutoring
Thinking, reflection and motivation
Questioning and feedback
Data, assessment and barriers
Metacognition and self-regulation
Collaboration and talk for learning
Organisation and resource

2

Explicitly teach pupils metacognitive strategies, including how to plan, monitor, and evaluate their learning knowledge

- Explicit instruction in cognitive and metacognitive strategies can improve pupils' learning.
- While concepts like 'plan, monitor, evaluate' can be introduced generically, the strategies are mostly applied in relation to specific content and tasks, and are therefore best taught this way.
- A series of steps—beginning with **activating prior knowledge** and leading to **independent practice** before ending in **structured reflection**—can be applied to different subjects, ages and contents.

Page 14

3

Model your own thinking to help pupils develop their metacognitive and cognitive skills

- Modelling by the teacher is a cornerstone of effective teaching; revealing the thought processes of an expert learner helps to develop pupils' metacognitive skills.
- Teachers should verbalise their metacognitive thinking *('What do I know about problems like this? What ways of solving them have I used before?')* as they approach and work through a task.
- Scaffolded tasks, like worked examples, allow pupils to develop their metacognitive and cognitive skills without placing too many demands on their mental resources.

Page 18

4

Set an appropriate level of challenge to develop pupils' self-regulation and metacognition

- Challenge is crucial to allow pupils to develop and progress their knowledge of tasks, strategies, and of themselves as learners.
- However, challenge needs to be at an appropriate level.
- Pupils must have the motivation to accept the challenge.
- Tasks should not overload pupils' cognitive processes, particularly when they are expected to apply new strategies.

Page 20

EEF Guidance: Metacognition & Self Regulation

Modelling reading strategies for maths

- Pupils should be introduced to a range of strategies that support comprehension.
- Whether you are focused on the ability to summarise information, make inferences or ask relevant questions about a text, teacher modelling is an essential part of the learning process.
- Effective modelling fosters meta-cognition. Pupils see reading processes that may be automatic for a mature reader made visible.

- Using a ‘think aloud’ approach to modelling is a great way to make reading and maths strategies and skills visible.
- Allow pupils the opportunity to apply these modelled approaches during reading lessons.
- Although modelling can occur at any stage, it is particularly useful when introducing or returning to a strategy.

Designing a Think-Aloud

Process
1. Name the strategy, skill, or task you wish to model.
2. State the purpose of the strategy, skill, or task.
3. Explain when the strategy or skill is used.
4. Use analogies to link prior knowledge to new learning.
5. Demonstrate how the skill, strategy, or task is completed.
6. Alert learners to errors to avoid.
7. Assess the use of the skill.

Adapted from Fisher, Frey, Hattie, *Teaching Literacy in the Visible Learning Classroom*, 2017

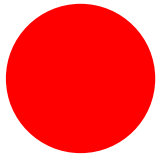
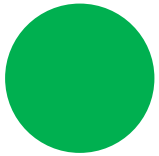
Linking text marking to a maths strategy or domain

- Being able to effectively model a strategy should improve pupils' understanding as they imitate and internalise your modelling.
- Pupils can practise the strategy by text-marking.
- By linking our text-making to a particular domain or strategy we can focus our work with pupils.

Using graphic organisers to structure pupil thinking in accessing mathematical texts and vocabulary

- Alongside text-marking opportunities, graphic organisers can allow pupils to apply strategies, and provide a bridge to more formal recorded outcomes.

Vocabulary collector

		
Words I don't know yet	Words I am unsure of	Words I know

Questioning leading to rich discussion

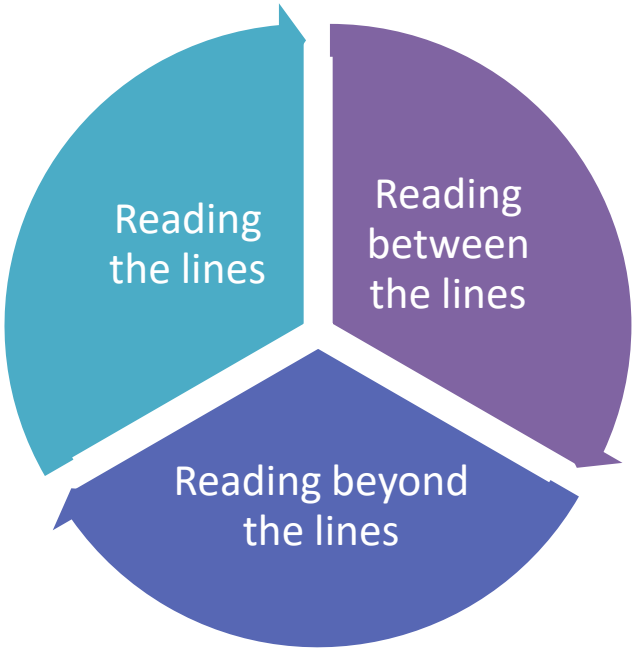
Questioning is “the most crucial strategy for developing inference-making.”

(Tennent et al, Guiding Readers, 2016)

Engaging learners in rich discussion and dialogue through focused questioning will improve inference and wider comprehension of subject specific vocabulary and mathematical texts.

This rich discussion could take also place in the maths learning journey.

Three Levels of Comprehension (Guppy and Hughes 1999)



The three levels of questioning

Exposition – literal questioning
(looking questions)

Exploration – inference/deduction based on the text.
(clue questions)

Expansion – evaluative/opinion questions, often linked to experience of the wider world.
(thinking questions)

Adapted from Tennent et al, 2016

Dialogic talk stems

- Talk stems can allow stundets to develop a wider repertoire of dialogic strategies. The stems below are examples; there are many more possibilities.

In my opinion…	*I agree and would like to add that…*	*Could you explain…?*
Building on what __ said…	*Is there evidence that…?*	*I can make a link to…*
Another point of view could be…	*I disagree because…*	*Have you considered…?*
Do you think that…?	*Is that similar to….?*	*What if…?*

Facilitate and guide the discussion

- **Marking conversation:** “That’s an important point.”
- **Keeping the channels open**: “Did everyone hear what she just said?"
- **Keeping everyone together:** “Who can repeat . . . ?"
- **Challenging students:** “That’s a great question, Rebecca. What do the rest of you think?”
- **Revoicing:** “So are you saying that . . . ?”
- **Asking students to explain or restate:** “Who disagrees or agrees, and why?"
- **Linking contributions:** “Who can add on to what he said?”
- **Pressing for accuracy:** “Where can we find that?”
- **Building on prior knowledge:** “How does this connect . . . ?”
- **Pressing for reasoning:** “Why do you think that?”
- **Expanding reasoning:** "Take your time. Say more.”
- **Recapping:** “What have we discovered?”

MODELLING THINKING IN MATHS-PROBLEM SOLVING

Principles

- Beware of working memory limitations
- New problem= easier and familiar content
- More familiar problems= more challenging calculation and content.
- Pupils need to be explicitly taught problem solving skills

What do students find difficult about problem solving?

- Understanding where to start
- Language
- Keeping track and changing
- Evaluating
- No life experiences of context

Access to Problem Solving

As teachers we can support this process in the following ways :

- Through our choice of task
- Through structuring the stages of the problem-solving process
- Through explicitly and repeatedly providing children with opportunities to develop key problem solving skills
- By developing a classroom culture for problem solving.

Helping pupils to understand tasks

Students…

- Should acquire as much experience of independent work as possible
- Should be encouraged to repeat the statement/problems in their own words.
- They should be able to pick out key points, facts/data, unknown, restrictions/conditions.

Teachers…

- Need to carefully choose problems that are not too difficult, not too easy
- Should support through questions to identify the principle parts of problems.

George Polya's 4 stages to problem solving

1. Understand the problem
2. Try to use experience from related problems to plan an attack.
3. Carry out the attack
4. Ask yourself whether you really believe the answer you have got

Understand

- Can you state the problem in your own words?
- Will a picture, diagram or acting it out help you to understand?
- What are you trying to find or do?
- What are the unknowns?
- What information do you obtain from the problem?
- What information, if any, is missing or not needed?

Plan an attack
Heuristics

- Look for a pattern.
- Examine related problems, and determine if the same technique can be applied. (analogy)
- Examine a simpler or special case of the problem to gain insight into the solution of the original problem.
- Make a table.
- Make a diagram.
- Use a formula
- Use a model
- Write an equation.
- Use guess and check.- trial and improvement
- Work backward.
- Identify a sub-goal.

Carry out the attack

- Implement the strategy or strategies in planning stage, and perform any necessary actions or computations.
- Students may go down wrong turns and need to revise plans.
- Check each step of the plan as you proceed. This may be intuitive checking or a formal proof of each step.
- Keep an accurate record of their work.

Believing the solution

- Check the results in the original problem. (In some cases this will require a proof.)
- Interpret the solution in terms of the original problem. Does your answer make sense? Is it reasonable?
- Determine whether there is another method of finding the solution.
- If possible, determine other related or more general problems for which the techniques will work. This may be contexts of interest.

The 4 stages

Observers discuss and feedback about when these elements were observed.

1. Understand the problem
2. Try to use experience from related problems to plan an attack.
3. Carry out the attack
4. Ask yourself whether you really believe the answer you have got

How could you model this process to students by ‘thinking aloud?’

Problem solve together

- In groups of 4-6 have a go at one of the collaborative problems.
- Half of the group should work at solving the problems.

Others in the group observe and make notes, thinking about:

- The difficult points
- What strategies were used throughout
- Language used

MODELLING METACOGNITION

Goal Free Problems to encourage mathematical observance

16 A book has some pages
Amina has read part of the book

What can you find out ?

16 A book has 276 pages.

Amina has read $\frac{1}{3}$ of the book.

How many pages are **left** for Amina to read?

Show your method

pages

2 marks

16 A book has 276 pages.

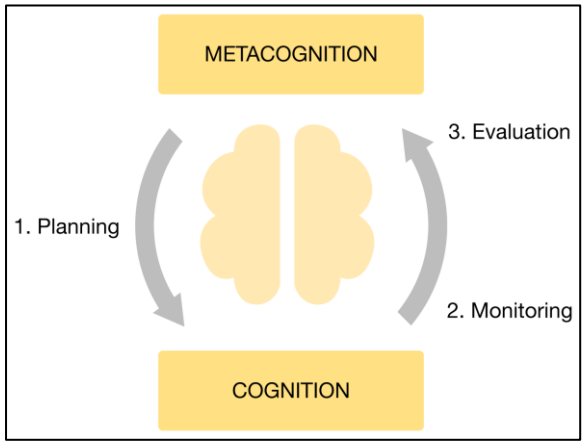
Amina has read $\frac{1}{3}$ of the book.

How many pages are **left** for Amina to read?

Show your method

pages

2 marks



Use the model to reflect on the thinking you are doing to solve this problem:

Metacognition:

- Have I solved a task/problem like this before?
- What strategies did I use/ could I use?
- How will I organise my thinking?

Cognition:

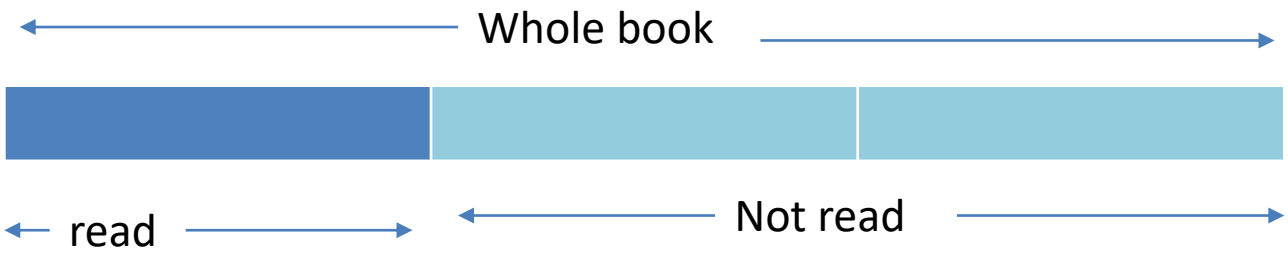
- What mathematics do I need?
- Can I work out the equation(s) needed?

Think about these 7 steps.
How might they apply to the process of solving this problem

7 step model.

1. **Activate prior knowledge** – remind pupils of what is already known
2. **Explicit strategy instruction** – explain how the strategy will solve the problem
3. **Modelling of learned strategy** – solve the problem using the strategy
4. **Memorisation of strategy** – discussion, sharing, questioning to check
5. **Guided practice** – another modelled example using the strategy
6. **Independent practice** – pupils complete a similar, linked example
7. **Structured reflection** – discussion on how effective the strategy was and how it might be used with similar problems.

Draw a picture to help **understand** the problem

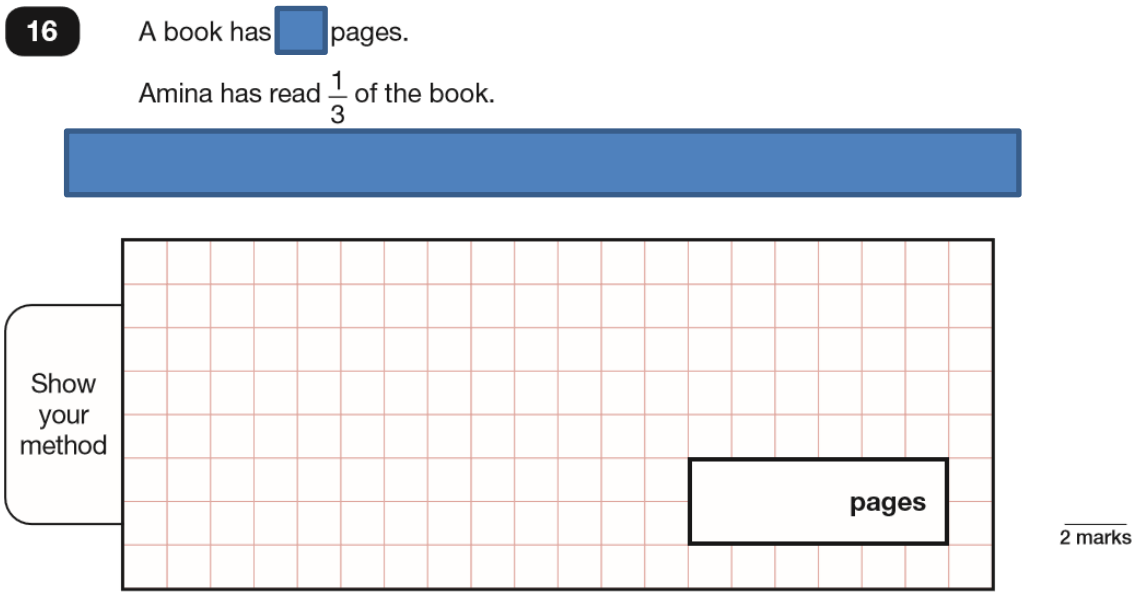


Activate prior knowledge
What do we know about…

- Fractions?
- Percentages?

- How many different ways can you find $\frac{1}{5}$ of 420?
- How many different ways can you find 75% of 200?

Explicit Instruction and modelling to decode the problem and find heuristics suitable to problem



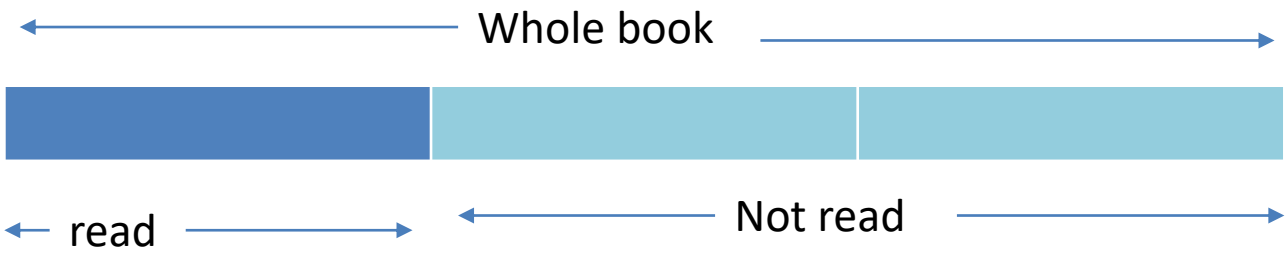
Now what do you know?

What do you not know/wonder?

She has read….. of the book

She has not read….. of the book

Draw a picture



Whole ÷ 3 = $\frac{1}{3}$

$\frac{1}{3}$ x 2 = $\frac{2}{3}$ (not read)

What other stories can you make up that may use this model?

A similar model with a slight change/variation?

4. Memorisation of strategy;
(provide time for me to practise and embed learning)
5. Guided practice;
(support according to need, reducing the scaffold, learning together)
6. Independent practice;
(apply learning)

1. Emily makes a 150ml milkshake.
   50% was fruit. The rest was milk. How much milk was there?

2. Emily makes 200g of snack mixture.
   20% was nuts. How much was other ingredients?

3. Sam did a 1km race. He walked 35% of the way and ran the rest. How far did he run?

4. The next year, Sam did a 1km race again. He walked 25% of the way and ran the rest
   far did he walk?

250 000 people visited a theme park in one year.

15% of the people visited in April and

40% of the people visited in August.

How many people visited the park in the rest of the year?

6 [2014]

200 children went on holiday.

10% of the children went to Wales.

25% of the children went to Scotland.

How many **more** children went to Scotland than went to Wales?

MODELLING VARIATION
AND
INTELLIGENT PRACTICE

Why use it in our teaching?

Variation (sometimes called intelligent practice) is a term used to describe learning activities that :

- integrate the development of fluency with the deepening of conceptual understanding.
- draw attention to the mathematical structures and relationships to assist in the **deepening of conceptual understanding**
- develop fluency through practice.

Variation

- Is the careful choice of examples that require thinking not just repetition
- The relationship between examples is as important (if not more so) than the examples on their own.
- It enables pupils to make links so they can work with greater independence.
- Scaffolds ideas and can extend thinking.

Key questions

Procedural variation/ intelligent practice

- What is the same? What has changed?

Conceptual variation

- What is the same? What is different?

What if…

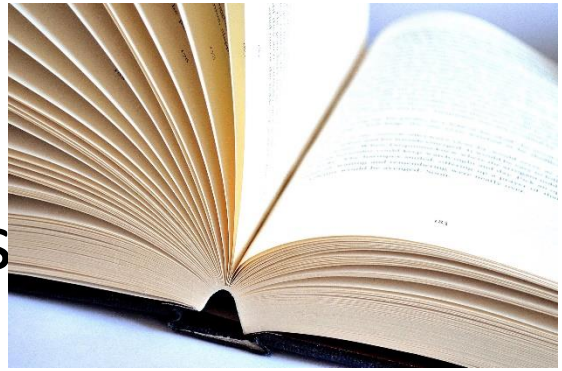
Amina read another book with 120 pages.
She read 10% of the book Monday and 35% on Tuesday.

How many pages did she have left to read?

What is the same? What is different between this question and the first one?

Vary the problem

How many pages did Amina have left to read on Wednesday?



- Draw it together on your tables

- Remember to label the information you have.

An example of intelligent practice sequences following some teaching on how to find $\frac{5}{7}$ of 175

Note the connections between each example

$\frac{3}{7}$ of 175 =

$\frac{3}{7}$ of 350 =

$\frac{3}{7}$ of 700 =

$\frac{3}{7}$ of 70 =

$\frac{3}{7}$ of 35 =

$\frac{3}{7}$ of 17.5 =

$\frac{5}{7}$ of 175 = 125

$\frac{5}{7}$ of 350 = 250

$\frac{5}{14}$ of 175 =

$\frac{5}{14}$ of 350 =

$\frac{5}{7}$ of 35 =

$\frac{5}{14}$ of 17.5 =

Reflect

What will your department do differently to support those with educational disadvantage ?

How might your approaches to access and success for all develop ?

How will you incorporate access to language and text into lessons?

How will you develop task design and variation ?

Hampshire Services
HIAS SCHOOL IMPROVEMENT

HIAS Maths Team

Jo.Lees@Hants.Gov.uk

For further details on the full range of services available please contact us using the following email:

htlcdev@hants.gov.uk

Hampshire Services
HIAS SCHOOL IMPROVEMENT

Upcoming courses

Keep up-to-date with our learning opportunities for each subject through our Upcoming Course pages linked below. To browse the full catalogue of learning offers, visit our new Learning Zone. Full details of how to access the site to make a booking are provided here.

- English
- Maths
- Science
- Geography
- RE
- History
- Leadership
- Computing
- Art
- D&T
- Assessment
- Support Staff
- SEN