Shotton Hall
Research School

# 5 MINUTES ON...

# SCHEMAS

# What are schemas?

**Schemas are structures that organise knowledge in the long-term memory; they help us to make sense of the world around us. They are networks of connected information sometimes called mental models, scripts or frames.**

They contain sensory and emotional information as well as factual details.

Our brains automatically connect new information with existing knowledge. Learning is the process of building and reshaping schemas.

Knowledge builds on knowledge. The more you know, the more you can know. New memories are not free floating; they are connected to things we already know.

The more sophisticated your prior knowledge is, and the more elaborate your schema, the easier it is for you to assimilate new information and make it stick.

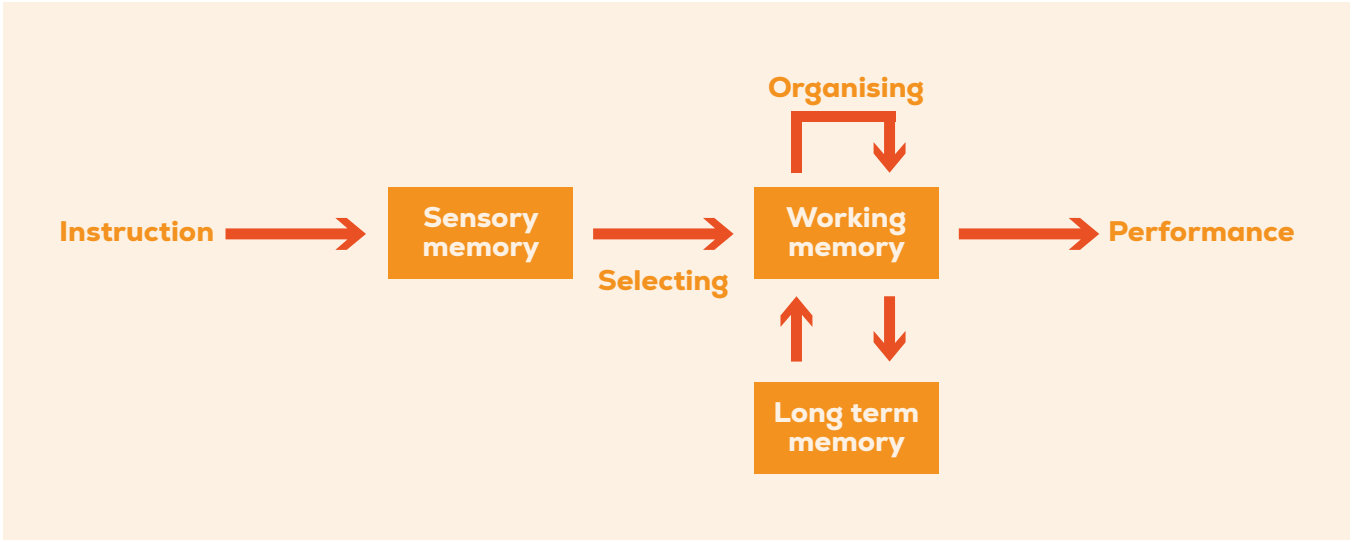
We aim for connected bodies of knowledge, not disconnected islands. (S. Cottingham 2023, p. 19)

Meaningful learning happens when we build connections with what we already know. The more connections we forge, the deeper our understanding.

Schemas develop through either:

- assimilation (new experiences are incorporated in an existing schema) or
- accommodation (the schema is changed / reorganised to fit the new experience).

## Mayer's SOI Model of memory




**S** **Selection**
The mind has to decide which parts of the incoming sensory information to pay attention to.

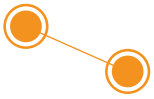
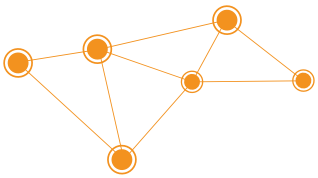
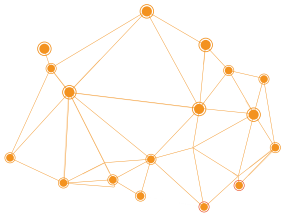
**O** **Organisation**
The mind then has to place this information into context to make sense of it.

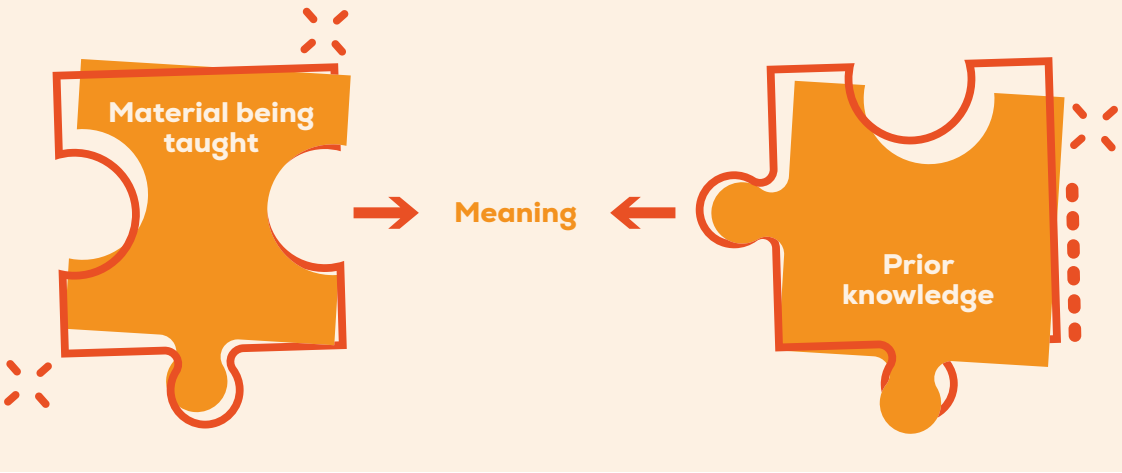
**I** **Integration**
The information is linked to the learner's prior knowledge and is assimilated into the schema, or the schema is altered to accommodate something that contradicts what was already known.

**"The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly."**

David Ausubel

# Learning is the acquisition of schema

| Stages of learning | Novice | Developing | Expert |
|---|---|---|---|
| |  |  |  |
| **When presented with new information** | The pupils struggle to connect the content with existing knowledge: they can't refer it to anything. | There are more connections and some reliance on existing knowledge can be made | Multiple connections. Pupils fluently refer to and recalls existing knowledge |
| **Consequences for learning** | Working memory used exclusively. Strong scaffolding required. | Some automaticity relieves pressure on working memory. Faded examples are effective. | Working memory freed. Deeper exploration of content. Self-directed investigations possible. |




# So... what does this mean for teachers?

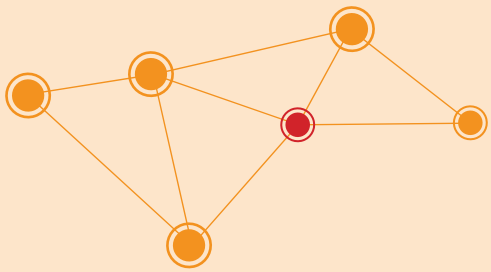
- Teachers must recognise that **every pupil's schema is different**; shaped by each individual's prior learning and lived experiences.
- Consider **pupils' prior knowledge** and how this might influence their organisation of new knowledge.
- Schema development requires **rehearsal and evaluation** so that what is being stored is complete and accurate; we must consider how we're engaging all pupils as much of the time as possible.
- This needs to happen before engaging in retrieval activities. Knowledge must make sense first at a basic level, connected to existing knowledge in a meaningful way.
- Remember- pupils don't see what the teacher sees; they are more novice. The expert has more complex schema.

# Tip 1 Ascertain and retrieve prior knowledge

- Forging connections to prior knowledge increases pupils' likelihood of remembering information.
- All pupils have different prior knowledge. A class of 30 pupils contains 30 different schema-forming brains. Each pupil comes into our classroom with their own unique existing schemas.
- It is our role as teacher to aim to create **shared meaning**.
- Prior knowledge must be activated deliberately. Before introducing new ideas, spend time revisiting the foundational knowledge to which new ideas will connect.
- Teaching processes should engage all pupils in tasks that allow them all to think about what they already know. The teacher needs to gauge the range in the class so they can adapt accordingly.
- A **wide representative sample** of prior knowledge is vital (e.g. cold calling and mini whiteboards).
- **Retrieval practice** provides a cognitive scaffold for pupils to link new learning to old.
- Never assume what prior knowledge your pupils have. Check, check, check!

# Tip 2 Anticipate and address misconceptions

- Accurate schemas are needed to provide solid foundations for future learning. Limited or faulty schema prevent pupils making sense of new information.
- **Efficient formative assessment** is vital, as we need to spot misconceptions and gaps in learning so we can adapt our teaching and correct them.
- If pupils develop a schema around a misconception, the **faulty schema must be unpicked**, or it can resurface later. We must 'rewire' the schema to make the correct version the default. (Tom Sherrington and Oliver Caviglioli, 2020 p. 86)
- Anticipate common misconceptions and **address them head-on**.
- Once you have addressed misconceptions, pupils must have opportunities to strengthen a correct schema through **practice**.



## Misconceptions

**The red dot in this schema represents a misconception. Everything connected to this will be fragile. Misconceptions can cause and reinforce further misconceptions.**

# Tip 3 Generative learning

- Generative learning involves 'making sense' of our experience by testing it against what we already know (Zoe and Mark Enser 2020 p. 7)
- The learner 'generates' information themself. This reinforces its connection to prior knowledge.
- The 'generation effect' is one of Robert Bjork's 'desirable difficulties' (Bjork and Bjork, 1994)
- Memories are strengthened when we generate information from our memory.
- This involves pupils retrieving their existing schema; exploring their own mental models consciously and making their own connections to new information.
- Pupils must be given opportunities to select and organise information, to search their schema for answers – rather than relying on external supports.

The table below contains various generative learning strategies. Each strategy requires teacher **modelling and scaffolding** and should involve **all pupils**. Each of these tasks force learners to **actively engage** with information. They are prompted to **think hard** about it, which means they are more likely to remember it. These strategies rely on the cognitive processes of selecting relevant information, organising it and then integrating it (**SOI model**).

| Generative Learning Strategy | How does it work? |
|---|---|
| **Concept mapping** | Organising key concepts or knowledge on maps or graphic organisers.<br>Pupils generate the links themselves (represented by the lines connecting the words).<br>Making schema visible helps pupils organise and extend their schema.<br>It encourages connections between related items of learning.<br>Teachers should consider why they are using mapping tasks and ensure pupils' attention is focused on the most useful components. |
| **Elaborative interrogation** | A higher order questioning strategy encouraging students to connect information,<br>Generating an explanation for why a fact or concept is true.<br>Pupils explore the links within their schema by asking questions such as: Why? How? What happens next?<br>A peer can ask the questions, or they can mentally interrogate themselves using these questions. |
| **Self-explanation** | Pupils explain how new information is related to their prior knowledge.<br>E.g. pupils read a text or diagram and then explain it to themselves<br>Allows teachers to assess whether the relevant connections have been made.<br>Mentally rehearsing a sequence of ideas or delivering an explanation to someone else, trying to link concepts, vocabulary and visual models together. |
| **Schema/concept comparison and cognitive conflict** | Activities that compare contrasting, complementary, or conflicting concepts or examples.<br>Supporting pupils to differentiate between items of learning (e.g. using a Venn diagram).<br>Compare and contrast knowledge from new and prior learning. |

| | |
|---|---|
| **Summarising** | Requires students to collate and reorganise the main points from their learning.<br>Students must extract key information and make links with their prior knowledge.<br>Condensing a web of ideas into key points e.g.<br>"In your own words, summarise the story."<br>"Describe how to…."<br>"What are they key ideas about…?"<br>In the pupil's own words (generative)<br>Single sentence summaries<br>Using **Cornell notes** is a good strategy for summarising |
| **Imagining/ visualising** | Intentionally creating a mental image of what you're learning e.g. visualising food being broken down in the digestive system<br>Pupils organise new ideas into a coherent image in their minds.<br>They link that image to their prior knowledge in order to *integrate* it into their long-term memory.<br>Teacher can prompt pupils to create certain mental images.<br>Pupils can be asked to create static images, steps in a process or animated sequences. |
| **Prediction problems** | Pupils make predictions based on their prior knowledge<br>Pupils must apply their knowledge to a novel situation<br>E.g. "Given what you know about…, what do you think would happen if…?"<br>"What do you think the character will want to do as a result?" |
| **Drawing** | Drawing can be a generative activity when learners are asked to draw an image to represent the information being learned<br>E.g. drawing a diagram to show a process or a picture to represent a structure<br>Not simply drawing a picture, but showing how different aspects connect, interact, etc.<br>A benefit of drawing is that engagement is unavoidable. Translating textual or verbal information into a visual form requires thought.<br>This strategy also takes advantage of dual coding. |
| **Teaching others** | Pupils explain important concepts from their learning to their peers<br>Pupils must think carefully about which key aspects to pass on and how to explain them clearly. This involved checking that they have fully understood the material first.<br>3 phases: Preparation, explanation and then interaction between tutor and tutee e.g. questioning. |
| **Enacting** | Pupils make movements/gestures that are linked to what is being learned.<br>Enacting can also involve manipulating objects or using concrete models.<br>Makes the abstract more concrete in the pupils' minds. |

# Tip 4 Concrete examples and analogies

- Specific, relatable, real-life examples used to illustrate an idea. They help pupils to form more secure schema, particularly around abstract concepts.
- Analogies help pupils build conceptual bridges between what is familiar and what is new.
- Allow pupils to detect the resonance between what they know and the new learning.
- We can only learn new materials if it **makes sense in terms of what we already know.** Knowledge builds on knowledge.
- The main barrier to understanding is when new knowledge doesn't have sufficient grounding in existing knowledge. We must **plan connections to pupils' experience**.
- Without stable foundational knowledge, new learning isn't grasped at all.

# Tip 5 Teach the big picture

- It can help to form coherent schema if teachers **front-load** the process of introducing new ideas.
- Teachers must illustrate that specific ideas form part of a bigger picture. We can then compare and contrast related ideas to deepen pupil understanding.
- **Present a broad overview** of a topic before teaching the details e.g. using a timeline in history to understand the sequence of events before studying each one in depth.
- When focusing on specific elements, regularly make explicit connections back to the big picture.
- Tom Sherrington urges teachers to 'zoom in, zoom out.' (Tom Sherrington and Oliver Caviglioli, 2020 p. 74-75)

# Tip 6 A concept-led approach

- A concept-led approach can accelerate learning because the general concept acts as an 'anchor' for subsequent ideas, making the learning 'stickier'.
- Schemas can be a hierarchy. Sequence curricular ideas from the more general to the more specific.
- We can think of this hierarchy like a set of Russian dolls, with more detailed ideas nesting within more generalised ones (Sarah Cottingham, 2023).
- The important, more generalised concepts should be taught first to prepare pupils cognitively to learn the details in the most efficient and useful way.

# Resources and further reading on schemas:

**Teaching for understanding: Schema-building and generative learning**
Available at www.teacherhead.com. Click here to view.

**Schema-building: A blend of experiences and retrieval modes make for deep learning**
Available at www.teacherhead.com. Click here to view.

**Building Understanding: supporting students to assemble their own schema**
Available at www.teacherhead.com. Click here to view.

**Concrete not Sand – build on what they know!**
Available at www.teacherhead.com. Click here to view.

**Cognitive science approaches in the classroom**
Available at www.educationendowmentfoundation.org. Click here to view.

**From general to specific**
Available at www.snacks.pepsmccrea.com. Click here to view.

**An introduction to schemas and why your students can't have too much knowledge**
Available at www.my.chartered.college. Click here to view.

# References


Ausubel's Meaningful Learning in Action (Sarah Cottingham, John Catt Educational, 2023)

Making Things Hard on Yourself, But in a Good Way: Creating Desirable Difficulties to Enhance Learning (Elizabeth and Robert Bjork, 1994) CH05.qxp:FABBS_DESIGN_NE (ucla.edu)

Teaching Walkthrus: Five-step guides to instructional coaching (Tom Sherrington and Oliver Caviglioli, 2020)

Fiorella & Mayer's Generative Learning in Action (Zoe and Mark Enser, John Catt Educational, 2020)

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