An Introduction to Structural Learning

Version 1.1

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Memory, Comprehension and Structural Learning

Every day, in our schools, learners are bombarded with new information. We sometimes assume that this information will fit together into well-organised mental packages inside the child's head, deeply understood and ready for recall. Memory and cognition do not work like this, thinking is hard work and sometimes we need an extra bit of support.

In a world of information overload where our working memory is struggling to keep up with the demand placed upon it's finite capacity, we sometimes need our cognitions to be scaffolded. Learning is an active process of organising information, making connections and forming ideas. If our cognitive bandwidth is exceeded it becomes very difficult for our learners to grapple with complex classroom tasks.

Why is Structural Learning Learning Important for Understanding New Concepts?

- Structural Learning is a cognitive teaching strategy that uses building bricks to help students process information and construct knowledge.
- The strategy promotes creative thinking by emphasising the important connections that exist in every subject.
- Structural Learning promotes conceptual understanding that strengthens memory.
- The strategy uncomplicates abstract ideas by using visual representations and guided classroom talk.

Our assumptions about the Learning Process:

1. Knowledge is acquired through Learning.
2. Learning involves thinking about the lesson content.
3. Thinking consists of a repertoire of cognitive processes that are reflected by ways of talking.
4. These cognitive processes have their foundations in connection making.
5. These connections help generate meaning (we understand something in the context of something else).
6. The meaning that is made leads to better comprehension and memory.
7. Comprehension and Memory are fundamental for academic success.
Structural Learning in a Nutshell

What is it?
Structural Learning is a new way to enhance critical and creative thinking. The process helps students form an idea of something abstract in their mind (in a playful way).

Why Bricks?
Cognitive building bricks are used to help students organise their thoughts and construct meaningful knowledge. The strategy promotes creativity and critical thinking by engaging pupils in connection making exercises. This new methodology can be used to enhance knowledge acquisition and writing skills.

When Do You Use It?
When you want your learners to make connections and really 'think through' an important concept before committing pen to paper. It is best deployed when you want to hand over the cognitive work and you see a need for students to participate in meaningful learning conversations.

How do learning conversations help the learning process?
As learners engage in verbal reasoning they justify their ideas to one another. This generates discussion and debate giving participants opportunities to share and clarify their understanding.

How does Structural Learning Enhance Comprehension?
All knowledge has a structure. These structures are made up of connected ideas that form concepts. Timelines, Hierarchies and Causational Relationships are easier to understand if we can reduce complex text into important key words. If we visualise, connect and elaborate on the key points we are in a good position to understand 'The Big Picture'.

How can Structural Learning be used to Enhance Writing?
Exposing children to the underlying patterns of language significantly helps them grasp critical writing concepts. From blending Morphemes to organising ideas, the classroom kits can be used to make the process of writing productive and engaging for all learners.

Are there implications for SEND?
The Structural Learning concept has a particular significance for certain learning needs including; dyslexia, dyspraxia and general working memory problems. Most classrooms have learners who could really do with some extra scaffolding.
Learning by Building

Why do we love building? It's in our nature to be playful and look for connections. The essence of creativity is in connection making, that's the space where ideas collide. When we do this with others we generate cognitive sparks. This is the catalyst for new thoughts and different perspectives.

Building is a collaborative exercise by nature and when facilitated effectively, it elicits insightful learning conversations. Structural Learning requires learners to collaborate and engage in problem-solving discourse. This brings with it the development of essential skills such as tenacity, teamwork and self-regulation.

The visual nature of Structural Learning gives teachers better access to what their children are thinking. A quick look around the room reveals a lot about what is going on in your students heads. Spotting misconceptions early provides a real opportunity to deliver timely feedback.

The colour-coded nature of the bricks helps students code (and recode) information. Information placed on the bricks can be re-categorised multiple times. The brick structures are not permanent. Students can easily edit their constructions leaving learners free to try out ideas without fear of failure.

The physical connections between the bricks make abstract connections more concrete. Every time a new connection is made students justify their ideas and engage in higher order thinking. The horizontal and vertical connections also allow information to be ‘chunked’ together.

“To learn structure in short, is to learn how things are related.”
Jerome Bruner
Which *Evidence-Informed* Principles is Structural Learning Based Upon?

### Dialogic Teaching
The building of knowledge structures acts as a catalyst for learning conversations.

### Intellectual Character
The strategy also develops the non-cognitive capacities associated with academic success.

### Metacognition
Students use the bricks to order their ideas and review their understanding.

### Questioning
The brick structures and colours act as a 'Spring-Board' for higher-order questioning.

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**Concrete Models:** Understanding the underlying structure of a body of knowledge is important for grasping abstract ideas. Building concrete representations of abstract ideas will reinforce conceptual understanding.

**Elaboration:** The learners mental models can be used as a launch-pad for ‘How’ and ‘Why’ questions. This will help develop a greater depth of knowledge and act as a gateway to higher-order thinking. This produces robust gains in both factual and inference learning.

**Dual Coding:** Combining words and visuals in creative ways helps information to be understood and later remembered. The brick structures are a great way of showing relationships and add meaning to any topic.
How many times do we see pupils not fully engaging in tasks because they do not know where to start or how to progress? Spending time clarifying our ideas and thinking about how we should learn has repeatedly been shown to enhance educational outcomes. Mind-maps and graphic organisers are tried and tested tools that have helped guide students thinking for decades. Structural Learning builds on these ideas but goes further by adding cognitive precision to the learning task. The methodology comprises of planning tools and a Cognitive Matrix that helps teachers (and learners) design their own activities utilising manageable cognitive processes. These ‘cognitive stepping stones’ ensure that everyone knows how to move forward and no student gets left behind.

As much attention must be paid to the organisation of knowledge as to its content. When trying to convey a body of knowledge, teachers should attempt to develop explicity, and then gradually expand, a well-organised knowledge structure that students can actively use.

Frederick Reif
Surface level comprehension: Learners lack ‘depth of knowledge’.

Deficient Written work: Often unstructured and muddled, the learner has difficulty putting their thoughts on paper.

Poor Recall: Students have difficulty remembering key facts and unscrambling ideas.

Anxious when Presenting: Pupils are uncomfortable articulating their ideas verbally.

Organise information visually and spatially.

Break down complex tasks into ‘bite-size’ chunks and manageable cognitive processes.

Create connections that promote critical and creative thinking.

Develop the habits of a self-regulated learner.

Talk through their reasoning and listen to other points of view.

Engage in academic tasks with increased cognitive and emotional investment.

Clarity of Thought: Information is processed effectively and knowledge is organised schematically.

Deeper Meaning Making: Learners see curriculum content as a system of connected ideas.

Improved Memory: Knowledge is embedded into long-term memory resulting in effective retrieval.

Better Writing: Learners have the conceptual understanding and the correct linguistic expression to write with purpose and effect.
Conceptual Understanding Across the Curriculum

How can Structural Learning be used to build Lasting Knowledge?

Organise and Describe: Connections between items.
- Sorting Exercises
- Creating Hierarchies
- Concept Maps

Sequence: Chronological and Causal Connections.
- Creating Timelines
- Building Life Cycles
- Connecting Causes of Events

What Happens and Why?

Compare: Comparative Connections.
- Comparing Two Things
- Ranking items by a value
- Connecting Concepts

What is it Like?

How is it Similar or Different?

Big Picture Thinking: Comprehension of new ideas

Semantic Concepts

Word Level
- Morphology
- Prefixes and Suffixes
- Segmenting and Blending

Sentence Level
- Joining Sentences
- Expanding Sentences
- Making Grammatical Decisions

Writing Concepts

Text Level
- Planning Ideas for better:
  - Stories
  - Reports
  - Recounts

Numerical Concepts
- Place Value
- Order of Operations
- Fraction Walls
- Bar Modelling
- Counting Sticks
- Cuisenaire Methods

Maths Concepts
This map highlights the subject areas where Structural Learning could be used to enhance outcomes. As a general rule of thumb, the classroom kits should be used when you need your learners to grasp a critical concept that has a structure to it.

**English**
- Developing the Big Idea
  - What is it like?
    - Character Descriptions
    - Categorise Key Features
  - What happens and why?
    - Story Maps
    - Identify causation
  - How is it similar or different?
    - Compare the two characters
    - Rank the adjectives

**Science**
- Developing the Big Idea
  - What is it like?
    - Group the rocks together
    - Categorise the animals
  - What happens and why?
    - Create the water cycle
    - Explain evolution
  - How is it similar or different?
    - Rank the metals according to...
    - Compare the materials

**History**
- Developing the Big Idea
  - What is it like?
    - Describe the monarchs
    - Group the countries together
  - What happens and why?
    - Explain the impacts of global warming
    - How has punishment changed
  - How is it similar or different?
    - Compare historical figures
    - Rank the effects of...

**Computing**
- Developing Skills
  - Decomposition
  - Pattern Recognition
  - Abstraction
  - Algorithms

**Maths**
- Developing Skills
  - Order of Operations
  - Fractions
  - Algebra
  - Number and Place Value

**Writing and Language Concepts**
- Word Level
  - Phonics
  - CVC Words
- Morphology
- Digraphs and Trigraphs
- Root Words, Prefixes and Suffixes

- Sentence Level
  - Sentence Structure
  - From Simple to Complex
  - Conjunctions/Connectives
  - From Singular to Plural
  - Punctuation
  - From Past to Present Tense

- Text Level
  - Fiction
  - Story Creation
  - Poetry
  - Non Fiction
  - Instructions
  - Balanced arguments
  - Persuasive texts
  - Newspaper reports
  - Information texts
Classroom Implementation of **Structural Learning**

Thinking carefully (about your students thinking) will ensure that the classroom kits are used with a clear educational purpose. This simple implementation guide will help you form an outline for a clear classroom strategy.

1. **For what purpose** will you use Structural Learning?
   - **Comprehension Exercise:** Learners use the bricks to generate a ‘Knowledge Model’ that helps them understand a particular topic.
   - **Planning for Writing:** Create structures that order the key points for a piece of writing.
   - **Revision:** Using the strategy to produce an engaging revision activity, ‘Build What You Know’.
   - **Assessment Activity:** Provide an enriching and playful formative assessment experience.

2. **What inputs** will we use?
   - Prior Knowledge
   - Pre-prepared List
   - Presentation
   - Video
   - Talk Partners
   - Read from a Book

3. **What outputs** are we focused on?

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**Conceptual Understanding**

**Planning for Thinking**
Writing

Structural Learning enhances a student's ability to think and talk about the process of writing. This approach helps pupils understand and explore written language.

“Learning requires the construction of knowledge. Construction is not facilitated by withholding information from students.”

Paul Kirschner
Building **Words, Sentences and Plans**

Structural Learning can be used to develop writing on a word, sentence or text level. The different coloured bricks can be used to highlight different types of words or sounds and help draw attention to the patterns that exist in language.

### Word Formation

- Un + kind + ness
- Un + willing + ness
- Un + help + ful

### Sentence Structure

- Agile
- Nimble
- Speedy
- Florence
  - practices
  - plays
  - football

**Boldly.**
**Skillfully.**
**Intelligently.**

### Split Digraphs

- L + i + k + e
- Sl + i + m + e
- B + i + k + e

### Planning Extended Writing

- 1st Point Keyword
- Evidence
- Explanation
- 2nd Point Keyword
- Evidence
- Explanation
- 3rd Point Keyword
- Evidence
- Explanation

**Conclusion 1**
**Conclusion 2**
Structural Learning and Literacy

Structural learning is a foundation for thinking and speaking. The applications for literacy are vast and these three broad categories will be a good starting point for classroom application. Use the bricks to help your learners explore the important connections that exist within every subject. The EEF Literacy reports published in April 2017 provide an excellent summary of evidence-informed strategies. We have linked these principles to the use of Structural Learning.

**Thinking and Speaking**

- **Thinking and Speaking**
  - Articulating ideas before writing means pupils are not hindered by handwriting and spelling skills.
  - Encourage lower achieving pupils to talk and articulate their thinking in collaborative tasks.
  - Building well organised background knowledge to promote comprehension and memory.

**Writing Composition**

- **Planning**
  - Generating ideas before pupils begin writing.
- **Drafting**
  - Pupils set out their key ideas in a logical order.
- **Revising**
  - Making changes to the content of writing in light of feedback and self-evaluation.

**Sentence Construction**

- **Sentence construction and sentence combining**
- **Spelling**
  - Focus on prefixes, suffixes and root words to learn common rules.
- **Learn to construct increasingly sophisticated sentences, for meaning and effect.**

**Implications for Writing**

- **Thinking like a Writer**
  - Thinking activities that extend pupils conceptual understanding and expressive vocabulary.
  - Planning and drafting techniques that promote balanced and structured writing.
  - Using the bricks on a grammatical level for sentence construction and word building.
**Building CVC and CVCC Words**

**Topic:** Word Recognition and Spelling Patterns

**Objective:** To facilitate the progression from reading simple consonant-vowel-consonant (CVC) words such as 'cat' and 'bus' to longer CCVC words such as 'clap' and 'stop', and CVCC words like 'fast' and 'milk'. To develop greater fluency, Consonants can eventually be 'chunked' together e.g. 'Ch'. The colour of the bricks could also be used to identify 'bouncy' or 'stretchy' sounds.

1. **Begin with CVC Words**

2. **Introduce second Consonants**
Topic: Writing a Recount
Objective: This learning sequence will help children write a sophisticated recount of an event. As with all the learning sequences, stages can be substituted and adapted to suit the lesson. This sequence breaks the process of writing into manageable stages that will decrease the load on the learners working memory. As pupils talk their way through their structures they will inevitably stumble across inventive linguistic solutions that can be accommodated into the timelines. To scaffold the sequence even further, target vocabulary can be prepared in advance of this lesson.

1. List important events

Guidance
Individually, in pairs or small groups, children list all of the things that happened on the miniature whiteboards. They do not need to order these events to begin with.

2. Order events sequentially

Guidance
The events can now be ordered sequentially. The colours of the bricks can be used to categorise the events if this helps.
3 Add Connectives

Guidance
The events can be linked together with suitable connectives.

First After that Monkey All of a sudden eventually Bus

4 Add Adjectives

The events can be described with adjectives.

First After that Monkey All of a sudden eventually Bus
Graceful Funny Delicious Scary Bumpy
We can describe what was happening in each of those events by adding a verb.

We can now add more meaning to the verbs by modifying them.
Topic: Sentence Construction

Objective: Using the classroom kits for exploring grammatical rules helps learners get creative with sentence construction. This type of strategy is often described as Colourful Semantics.

Instructions

1. Start the process with the construction of a simple sentence.
   - Florence is playing football

2. Introduce interesting adjectives and adverbs.
   - Speedy Florence is playing football skillfully

3. Start the sentence with the adverb.
   - Skillfully, speedy Florence plays football
4. Speedy and competitive football she plays is because she is competitive.

5. Because she is competitive, speedy Florence plays football.

6. Competitive and brave, Florence battles her way to victory.
**Key Stage:** Two  
**Topic:** Digestive system  
**Lesson Objective:** This learning sequence will help children write a comprehensive explanation of how our digestive system works. It can be applied to other scientific ideas with the complexity being incrementally increased as the pupil progresses through the sequence.

1. **Guidance**  
   Children identify all of the parts of the digestive system.

2. The digestive events can now be ordered sequentially.

3. Provide any extra features of the organs that are important.

4. Once the features have been added we can then explain the function of these organs.
Add Analogies

Guidance
The analogies will help the children explain and understand the system by comparing the digestive features to something that is familiar.
Think like a Scientist

Guidance
The events can be linked together with suitable connectives.

To begin with

Grind food

after a few seconds

transport

long tube

Oesophagus

Train Tunnel

until

Stomach

Juices

mixes juices

Washing Machine

eventually

Rectum

Excrete

Exit Door
**Topic:** Planning Extended Writing

**Objective:** Ordering ideas into logical and balanced writing plans.
Comprehension

Structural Learning helps develop the ‘expert-like’ thinking and talking that leads to deeper conceptual understanding.

*Understanding is memory in disguise.*

Daniel Willingham
Exploring Critical Concepts

Structural Learning promotes the organisation and development of students' thinking. It helps learners see patterns and relationships in information that might not have otherwise been visible. By systematically developing schemas, we can enhance the comprehension of new ideas for all learners. As well as improving the acquisition of secure knowledge, you should also observe an intellectual playfulness as pupils question one another's understanding.

Big Picture Thinking:
- **Chunk**: Join together related items
- **Connect**: Create causal links between items
- **Sequence**: Order by time or logic
- **Rank**: Order by an agreed value
- **Compare**: Identify similarities and differences
- **Understanding**: new ideas by exploring relationships and making inferences

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"Academic Subjects generate their own ways of talking and reasoning."

Neil Mercer
Big Picture Thinking

The construction of mental models helps learners to create lasting conceptual understanding across all subject domains. The models help students make sense of the world around them. This happens as the learner ‘uncomplicates’ abstract ideas and begins visualising the ‘connectedness’ that exists in all bodies of knowledge. These examples of knowledge structures can be used to engage learners in the creative construction of critical concepts.

1. What is it like?

Describing and Categorising
The ability to identify, describe and categorise is fundamental to human learning; it’s a constructive way to start thinking about any new topic.

- Mind Maps
- Sorting Tasks

2. What happens and why?

Connecting: Sequencing and Causation
Helping learners to recognise that actions and events have reasons and consequences. The analysis of causal relationships can be seen as the backbone of deeper knowledge creation.

- Timelines and Causal Relationships
- Cycles

3. How is it similar or different?

Comparing: Similarities and Differences
An essential aspect of understanding is how we draw boundaries between different ideas. Distinctions are used to challenge definitions and labels.

- Comparing Two Things
- ‘Bridge’ two ideas together
- Ranking Exercises

Purpose
- Start thinking about a topic
- Organise content
- Identify themes
- See the relationship between the parts
- Stimulate the generation of ideas
- Reveal the hierarchy of ideas in a topic

Purpose
- Represent the sequence of events
- Plot historical episodes
- Explain cycles in the natural world
- Storyboarding
- Identify the causes and effects of events
- Examine multi-causal relationships

Purpose
- Identify the similarities between two topics
- Rank items to create new meaning
- Develop New perspectives
- Make evaluations against a criteria
- Encourage learners to justify their judgements
Think like a **Scientist**

**What is it like?**

**Describing and Categorising**
The ability to observe, identify, describe and categorise is fundamental to human learning within and across all disciplines.

- **Mind Maps**
- **Sorting Tasks**

**What happens and why?**

**Connecting: Sequencing and Causation**
Helping learners to recognise that actions and events have reasons and consequences.

- **Sequences**
- **Cycles**

**How is it similar or different?**

**Comparing: Similarities and Differences**
An essential aspect of understanding is how we draw boundaries between different ideas.

- **Comparisons**
- **Ranking**

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**KS1**

- Describe a variety of animals
  - Identify physical properties of materials
- Categorise different insects
- Sort plastic, glass and metal objects
- Categorise different food types
- Observe changes across the seasons
- Describe the effects of exercise
- Build a food chain

**KS2**

- Identify and describe the functions of a plant
  - Identify the contents of soil
  - Gather and organise scientific evidence
- Group together different types of rock
- Categorise magnetic and non-magnetic metals
- Categorise solids, liquids and gases
- Describe the effects of nutrition
- Describe how fossils are formed
- Plan an experiment
- Sequence the effects of natural disasters
- Sequence the changes of state in different materials
- Sequence the digestive system
- Construct a variety of food chains
- Describe how humans change as they get old
- Use models to explain scientific ideas
- Sequence a circuit diagram
- Compare two different planets
- Make a comparison of the different needs of plants
- Compare the lifecycle of a mammal to an insect
- Rank the needs of humans
- Rank the ‘usefulness’ of different materials
- Rank the effects of sun damage
- Rank the materials by weight
- Judge which environmental event is most hazardous
- Order materials based on their hardness or solubility
Describing and Categorising

The ability to identify, describe and categorise is fundamental to human learning, it’s a constructive way to start thinking about any new topic. Once the curriculum content has been categorised it can easily be manipulated into other meaningful structures such as hierarchies, sequences or ranks.

Categorising Information
Start to think about a topic by organising content and identify themes.

What continent are these countries in?

What type of food is this?

Do these creatures have a backbone?
This type of exercise involves both critical and creative thinking. Pupils will apply logical reasoning as they define their associations and engage in analysis as they break whole things up into component parts or attributes. An essential aspect of understanding is how we draw boundaries between different ideas. Distinctions are used to challenge definitions and labels.

**Making Judgements**
Ranking items to create meaning and develop new perspectives.

**Comparing Two Things**
Systematically comparing the attributes of two items.

1. **What are the most important human traits?**
2. **How are Tigers and Lions Similar?**
Examining Causal Relationships

These type of mental models help learners to recognise that actions and events have reasons and consequences. The analysis of causal relationships can be seen as the backbone of deeper knowledge creation. These examples aim to help learners understand the abstract concepts of war and natural disasters. As with all the constructions, these simplified representations can form the foundation of a writing plan with the gradual integration of target vocabulary.

1 What happens when a Tsunami strikes?
Utilising the kits to show how the effects of a natural disaster are linked together.

2 Why did the 2nd World War happen?
Examining how historical events unfold.
Sequencing Ideas into a Logical Order

Identifying the sequence of events or actions is an important way of establishing what happened or what will happen. This process has useful applications for writing instructions, unpicking historical events or deconstructing a chapter of a book. The white boards can be used to symbolise the important points with key words or pictures. As learners connect the bricks into a logical order they might also start to explore causational relationships.

Understanding Sequences and Change
Using the bricks to explore chronological concepts.

What happens and why?
1. What happens in the water cycle?
Utilising the kits to show a natural cycle.

2. Create an algorithm for making breakfast.
Break complex processes down into component parts (decomposition).