What is cognitive load theory and how should we be mindful of it in our everyday classroom practice?

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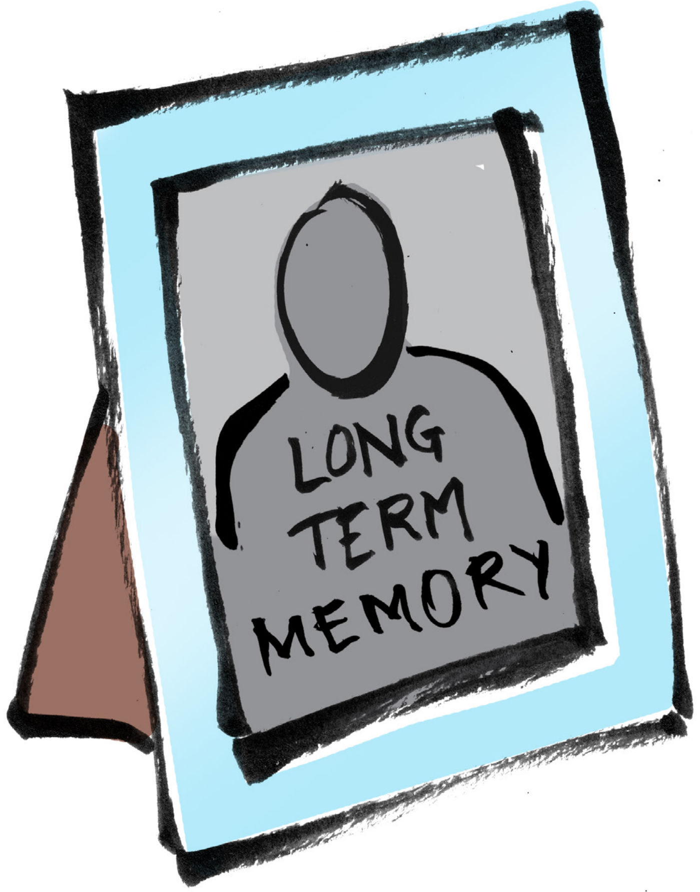
Cognitive Science (CogSci) surrounds how the brain encodes and stores information, transferring it from working to long-term memory as working memory is limited in capacity and duration, whilst long-term memory is infinite (Fletcher-Wood et al., 2019). CogSci principles like Cognitive Load Theory (CLT) focus on boosting long-term memory and improving information recall. According to Weinstein et al. (2018) 'few teacher training textbooks cover' CogSci principles, though there has been an 'increased interest in the potential of cognitive science...to inform classroom practice' (Scutt, 2019) in recent years, especially as teaching becomes a more evidence-informed profession. In a 2017 Tweet Wiliam asserted that CLT is the 'single most important thing for teachers to know' (Enser, 2019a), but just how should we be mindful of it in our everyday practice?

CLT (devised by Sweller in the 1980s) covers potential for working memory overload and what methods of teaching are best to minimise this so students can learn complex ideas (Enser, 2019a) by efficiently transferring information to long-term memory, from where it can subsequently be recalled. The aim is for recall to reach levels of automation, as this will reduce the burden on working memory, enabling it to feed new information into long-term memory more easily (CESE, 2017). Working memory is affected by different loads:

- Intrinsic load is affected by task complexity (difficult or unfamiliar material equals a higher load [Tharby, 2019]).
- Extraneous load involves thinking that hinders learning, e.g. classroom distractions and over-complex slide design (Enser, 2019a).
- Germane load is the desirable load that contributes to learning (Tharby, 2019) by developing schemas (brain networks which help us organise and interpret information [Smith, 2020]).

Whilst extraneous load should be reduced, intrinsic load should be managed, 'but not necessarily reduced' as 'memory is the residue of thought' according to Wiliam (Young, 2014) as you remember more of what you actively think hard about (McCrea, 2019). Reducing extraneous load and managing intrinsic load will benefit germane load and lead to better learning.

At the start of a topic intrinsic load is high as students are novices and have few prior schemas to draw from in their long-term memory. They will benefit from simple to complex sequencing of taught material to reduce cognitive load. Therefore, carefully sequenced helix curriculum design is important for students to 'hook' new knowledge onto existing schemata to optimise learning (Deans for Impact, 2015). Within lessons, tasks should be delivered using a fading scaffolding continuum from 'worked-out examples to completion assignments (where a partial solution is given and they have to complete it themselves)' to independent answers (Shibli & West, 2018). For example, a model answer could be provided by the teacher, then a partially completed writing frame done together, before students have a go at independently answering a question. Faded scaffolding is more applicable in some subjects than others – it is easier to achieve in Science and Maths, for example, than in subjects like Geography, where it initially appears this principle might only apply to the likes of completing past paper questions. However, faded scaffolding does not have to be as concrete as types of task design – it can also apply to providing analogies and examples for abstract concepts, so its use is nuanced and multifaceted.



With scaffolding, care must be taken to avoid the 'expertise reversal effect' though (Kalyuga et al., 2003), as if worked examples are provided to students with greater expertise, they could just become a distraction and increase extraneous load at the detriment of germane load (Watson, 2020). Additionally, as Reif (2010, referenced in Shibli & West, 2018) states, caution is also needed to avoid oversimplifying material as 'the entire learning process would consist of too many small steps – and would thus become unduly fragmented and long'; oversimplification should be avoided, and differentiation is key.

CLT provides support for explicit models of instruction (CESE, 2017) and challenges the myth that 'students learn best by discovering things for themselves' (Enser, 2019a) and therefore contends inquiry learning. Independent research tasks and inquiry learning take up valuable space in working memory (Wiliam, 2018) as students may be overloaded by simply working out what to research (Kirschener & Hendrick, 2020). Whilst research tasks have merit if the aim is to explicitly teach research skills, if a research task is merely a method of content delivery it is important to ensure it is correctly scaffolded. Care is needed though, as Watson (2020) outlines how CLT can encourage an 'overemphasis on teacher-led instructions' as opposed to student-led learning.

Tharby (2019) recommends reducing extraneous load by: ensuring diagrams and associated information are near (the 'multiple-modalities approach' (Deans for Impact, 2015) to avoid the 'split-attention effect'; that processes are revealed stage-by-stage on the same slide so students can be prompted of earlier stages; and that teachers do not read text that is on a slide to avoid the 'redundancy effect' (Jones, 2018) as students cannot process listening and reading at the same time. These are all things teachers can frequently be observed doing and therefore should work on to ensure students are not cognitively overloaded.

By being mindful of CLT through utilising the above aspects in our everyday practice we can ensure that we know the most effective methods of teaching to see a persistent change in knowledge in student's long-term memory leading to successful learning. Before being useful to everyday practice though, its principles need embedding into long-term curriculum planning with the creation of helix curriculums, and then explicit instruction principles can be used in everyday practice. Additionally, its usefulness to everyday practice appears dependent on teacher expertise and engagement with research, amongst other factors. As Enser (2019a) states, CLT just supports how 'excellent teachers have always taught', providing a rationale for why strategies they have adopted work, and as such it is just 'common sense'. However, it is incredibly useful to early career teachers who have not reached expertise level to 'leapfrog' the trial-and-error stage (Enser, 2019b) by gaining a proper understanding of CLT as 'it can improve teacher instruction' (Shibli & West, 2018) and ensures teaching is 'at the appropriate level of challenge' (Watson, 2020). Moreover, even experienced teachers will benefit from learning about CLT and other CogSci principles, as if you 'know and understand the theories behind your practice' you can 'optimise your teaching' (Kirschner & Hendrick, 2020). That said, CogSci is such a broad discipline with many different facets, that without dedicated CPD time to learn about, and more importantly, implement, other aspects of CogSci in everyday practice (such as retrieval practice, spaced practice, and dual coding), teachers may only have superficial knowledge of concepts. As Scutt (2020) mentions, 'cognitive science does not provide a recipe for what teachers should do, but rather should inform their repertoire of approaches.'