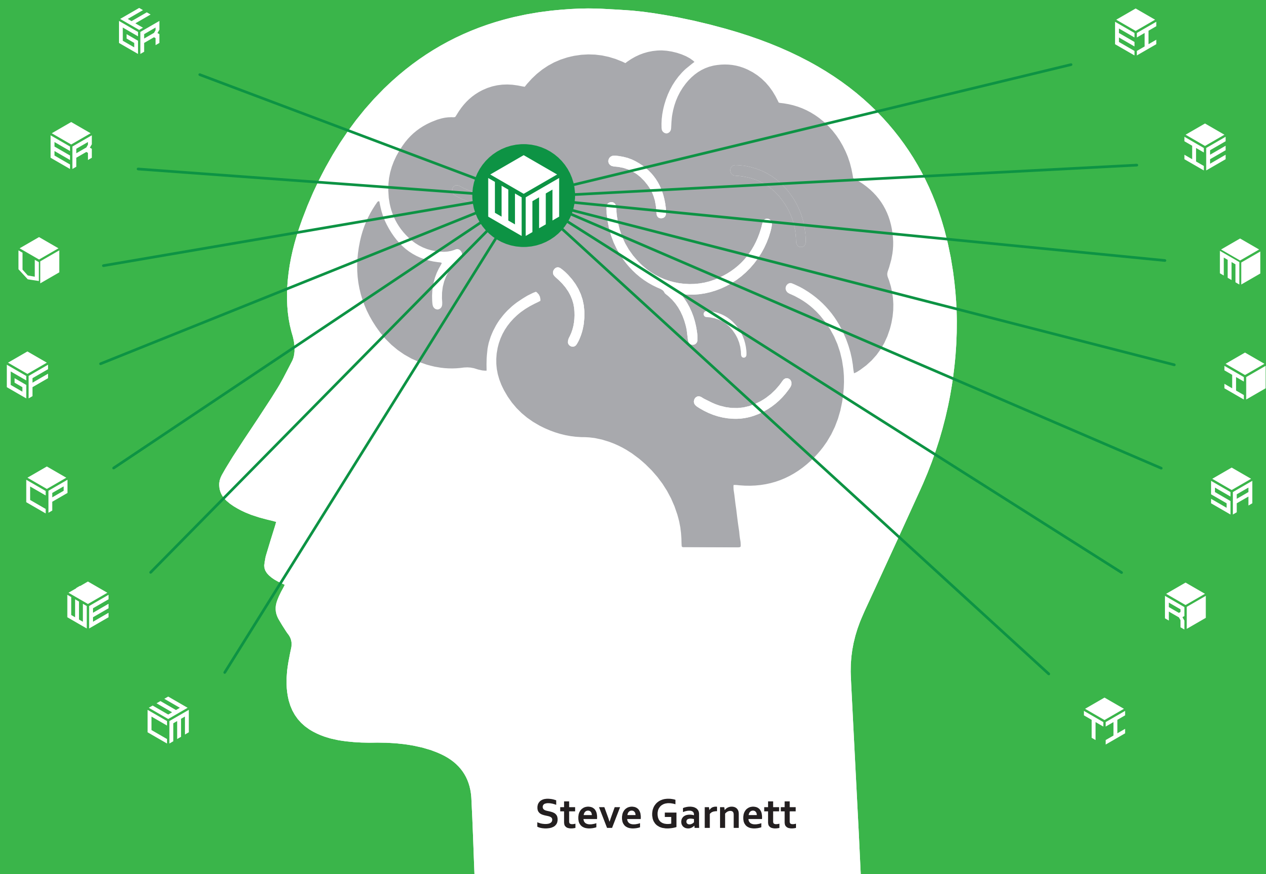
# Cognitive Load Theory

## A handbook for teachers



**Steve Garnett**

# Praise for *Cognitive Load Theory*

Teaching is one of the most important activities associated with the continuity of civilisation. An enormous amount of research relevant to teachers is produced each year, with the vast bulk of it appearing in research journals intended for a researcher rather than practitioner readership. Translating those technical research findings into a form that is accessible to teachers is a rare skill. It is a skill that Steve Garnett has in copious abundance, and in *Cognitive Load Theory: A Handbook for Teachers* he provides a brilliant exposition of instructional design principles. The book has a consistent clarity of purpose and coherence that justifies a prominent place on every teacher's bookshelf. I recommend it in the strongest possible terms.

**John Sweller, Emeritus Professor of Educational Psychology, School of Education, University of New South Wales**

I think it's safe to say that Steve Garnett's *Cognitive Load Theory: A Handbook for Teachers* is the book that educators have been waiting for. It is a much-needed, timely resource that puts common sense and cognitive science, rather than hunches and fashions, at the heart of the profession.

There are numerous books which now exist which demonstrate how teachers can take back control and strip away the ineffective nonsense, which of course make liberal reference to cognitive load theory. However, this book, dedicated entirely to the idea that working memory is limited, seeks to delve deeper into this theory. Garnett breaks cognitive load theory down into 14 different effects which impact on a range of stages of students' learning. Each of these are explained using clear, illustrated examples. Crucially, guidance is given that allows the teacher to consider how to adjust his or her lessons in light of these effects in order to maximise students' understanding and learning.

With input from cognitive load theory's main proponent, John Sweller, this book is a must-read for any educator seeking to improve their practice in line with the most up-to-date research.

**Sarah Larsen, geography teacher, blogger and speaker**

Cognitive load theory is a hot topic in education at the moment – but, as with so much that gets introduced to teachers, there is a risk of it being misunderstood and then mutating into something it was never meant to be.

Steve Garnett's book should ensure that cognitive load theory is fully understood by busy teachers. It brings a great deal of clarity to a complex area of research and shows how it can be applied in the classroom to help teachers make informed decisions about the way they design their lessons.

**Mark Enser, Head of Geography and Research Lead, Heathfield Community College, and author of *Teach Like Nobody's Watching* and *Powerful Geography***

# Cognitive Load Theory

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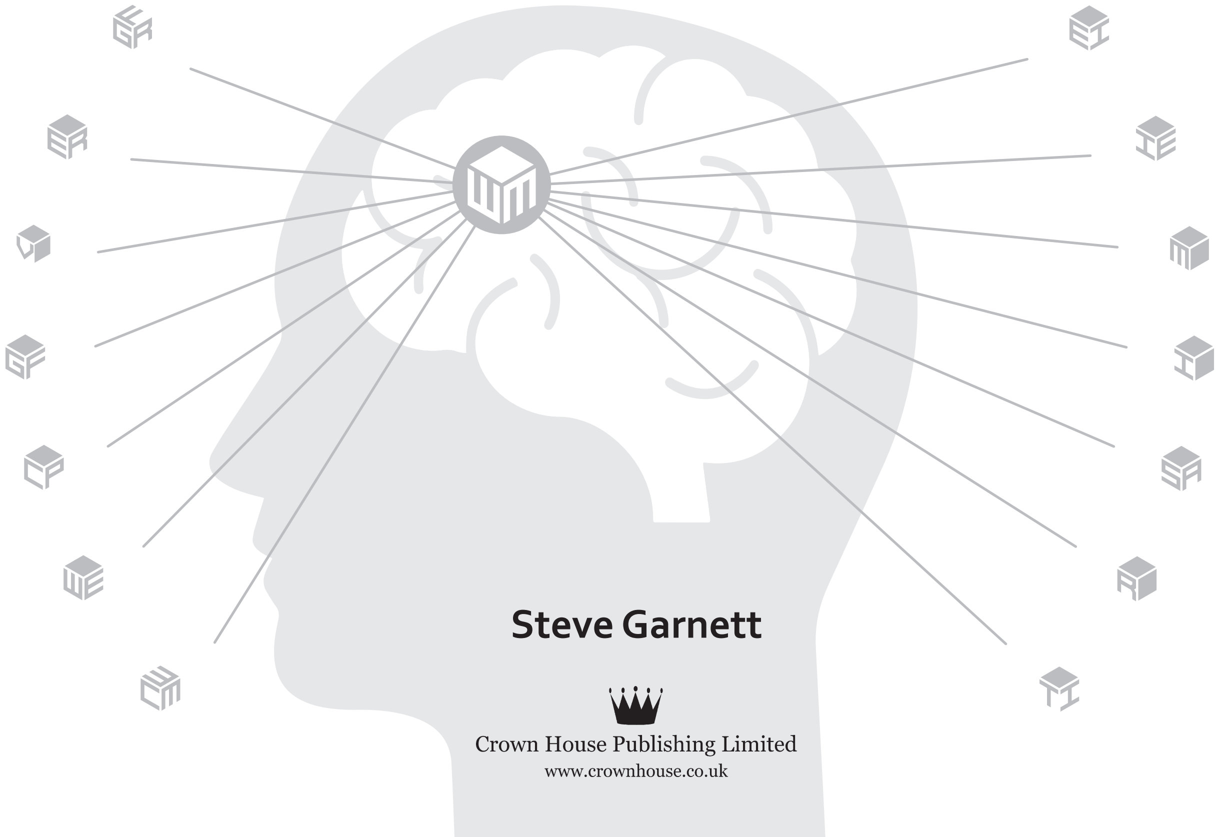

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# Preface

I have a picture in my mind of the intended readership of this book. It's the busy teacher, possibly teaching an overcrowded curriculum in an overcrowded classroom.

This book is for the teacher who doesn't have the time – or, indeed, perhaps the inclination – to access the original journals or research papers from which this book ultimately draws. Therefore, there is a deliberate approach to style and substance taken in this book, which is to make the theory accessible, practical and ready to be implemented almost immediately.

In short, it's meant to save time for teachers everywhere.

# Contents

# Introduction

I remember very clearly what I was thinking when I read a tweet that Professor Dylan Wiliam posted on 26 January 2017: a tweet that made a pretty emphatic claim.

> **I've come to the conclusion Sweller's Cognitive Load Theory is the single most important thing that teachers should know.**[1]

My thinking was quite simple: 'I have absolutely no idea what that is!'

I spend my professional life working with teachers to improve all aspects of the learning experience for their pupils. Over the last 12–15 years my work has extended to over 30 countries around the world, including extensive experience across the whole of the UK. When I count the number of workshops and whole-school or whole-staff professional development sessions I have run, the number of teachers I have delivered training to must extend to over 15,000 quite easily.

My point in telling you this is that, up until I saw the Dylan Wiliam tweet, the concept of cognitive load theory (CLT) had never, ever come up. It was never a question raised when training teachers, never came up within a wider, more general conversation related to aspects of pedagogy, nor was it ever requested as a focus for training.

In short, my view was that whilst I certainly had no idea about CLT, teachers – whether working in the primary or secondary sector, whether in state or independent schools, or international schools across the world – had no idea either.

So when a claim as emphatic as Wiliam's is made about something, I feel I should not only find out what

1 D. Wiliam, Twitter, 26 January 2017. Available at: https://twitter.com/dylanwiliam/status/824682504602943489.

it is all about (for my own sake!), but, more importantly, I need to put any new knowledge I gain together so that busy teachers can use these insights to improve their pupils' learning experiences.

What follows is an attempt to bridge the research base of this theory and show how to put it into practice by describing and demonstrating what should be happening in real classrooms with real pupils when the principles of CLT are embedded.

You might – as I did – have some preliminary questions about CLT, so we'll begin by exploring those.

## Where did CLT originate?

Emeritus Professor John Sweller, of the University of New South Wales, Australia, conceived of the theory of CLT and published a paper on it in April 1988.[2] Sweller himself says that after this his work was largely ignored for the next 20 years! Dylan Wiliam's tweet suggests that the theory had remained largely confined to narrow academic fields, and was certainly not at home in the pedagogical discourse with which normal classroom teachers were familiar.

Sweller's theory was used to generate hypotheses that were investigated by teams of researchers around the world and tested using randomised controlled trials. The efficacy of CLT rests on a base of hundreds of these randomised controlled trials, testing many thousands of primary and secondary schoolchildren as well as adults.

CLT can be described as something of a 'moving target' in the sense that Sweller has been constantly evolving and updating the theory since that first publication in the late 1980s, as we'll see on the timeline of major developments on pages 18–19. It has also been influenced by new thinking and studies by other researchers. One such example of external influence was as a result of David Geary's work on

2 J. Sweller, Cognitive Load During Problem Solving: Effects on Learning, *Cognitive Science: A Multidisciplinary Journal*, 12(2) (1988): 257–285.

evolutionary educational psychology.[3] Briefly, Geary made a distinction in terms of how the brain processes and organises information, dividing it into two spheres:

1. **That which can only be learnt.**

   The first aspect Geary terms 'biologically primary knowledge'. This relates to all the things the brain does which cannot be formally taught. Essentially things like how to communicate in our first language and how to recognise faces. These things, he says, are just learnt and cannot be formally taught. It's an evolutionary thing.

2. **That which can only be taught.**

   The second is termed 'biologically secondary knowledge'. This is all the things we need to learn in order to function successfully as human beings in society. Examples can include everything from learning how to count or read, to learning how to ride a bike or change a plug.

3 D. C. Geary, *Origin of Mind: Evolution of Brain, Cognition, and General Intelligence* (Washington, DC: American Psychological Association, 2005).

This is where schools come in. They are tasked with the purpose of passing on 'biologically secondary' skills to pupils. Sweller describes the differences beautifully when he says that (broadly) reading and writing can only be taught, whilst speaking and listening can only be learnt.

Sweller adds a slight adjustment in recognising that, across the curriculum, what needs to be learnt in maths is clearly different to what needs to be learnt in English, so he introduces the phrase 'domain-specific biologically secondary knowledge'.[4] This type of knowledge needs to be taught formally and explicitly to pupils – expressed through the phrase 'explicit instruction'.

In this model, the pupil is the 'novice' and the teacher is the 'expert', so passing knowledge from the expert to the novice can be seen as the role of the teacher.

4 J. Sweller, Cognitive Load Theory, without an Understanding of Human Cognitive Architecture, Instruction is Blind, talk given at researchED Melbourne (3 July 2017). Available at: https://www.youtube.com/watch?v=gOLPfi9Ls-w.

Geary's model made total sense to Sweller. It revealed the reason for the struggles that we have when trying to learn biologically secondary knowledge. It's because we are not (in evolutionary terms) designed to learn this knowledge naturally: so we must be taught it.

## What does this cognitive science mean for teachers?

Sweller's big idea is that the brain has a very specific way of processing the learning of *new* or *novel* domain-specific biologically secondary knowledge. Once a teacher understands how this system works, they can improve the quality of instruction that a pupil receives. If the teacher doesn't understand the system that the brain uses to process this type of new learning, then the quality of learning is hampered.

This is why Sweller describes CLT as an 'instructional theory': by understanding it, teachers will be better able to deliver quality instruction.

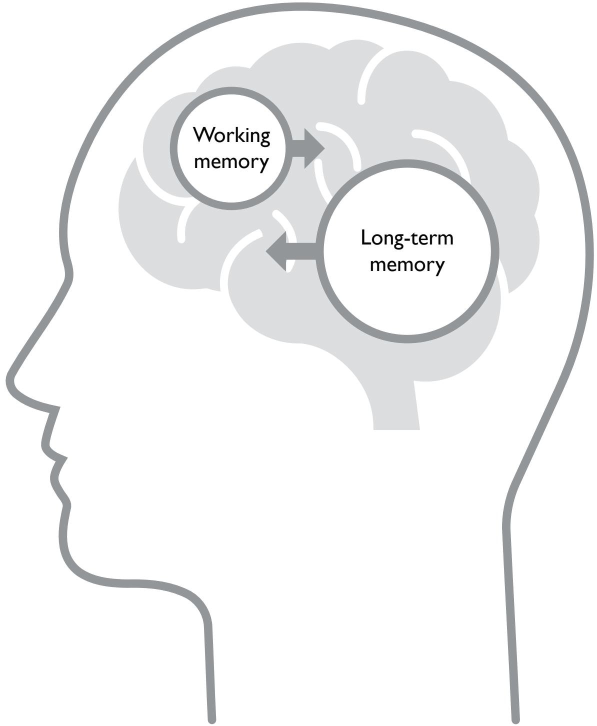



Figure I.1: The two major components of Sweller's information processing system

The information processing system Sweller describes has two major components, as shown in Figure I.1. Figure I.2 then reveals a little more about how working memory and long-term memory function.

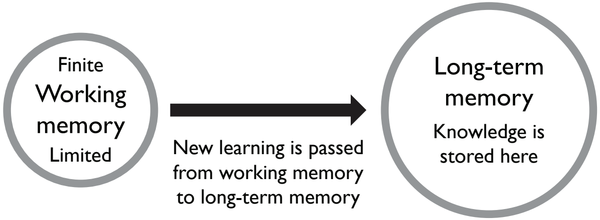



Figure I.2: Sweller's information processing system for new, domain-specific biologically secondary knowledge

## Working memory

Figure I.3 (see page 6) locates the position of working memory, towards the front of the brain. In neurological terms it's in the central executive part of the prefrontal cortex. It's smaller in size than the part of the brain that stores long-term memories (further back in the brain the hippocampus acts as the trigger for long-term memories).

Working memory is the part of the brain that processes what we are currently doing and thinking. If that is completely new or novel, then we can only deal with a *finite* amount of information at one time.

How much is a finite amount? Let's take this example: you make a mental list of 20 items that you need to buy at the supermarket. Sweller agrees with what cognitive psychologist George A. Miller coined as the 'Magical Number Seven'. Miller's paper of that name was published in 1956, but the figure still seems to hold true.[5] In other words, most people would only recall around seven items from the shopping list. Some might recall as few as five but others as many as nine – hence the full title of this oft-cited paper: 'The Magical Number Seven, Plus or Minus Two'.

5 G. A. Miller, The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information, *Psychological Review*, 63(2) (1956): 81–97.

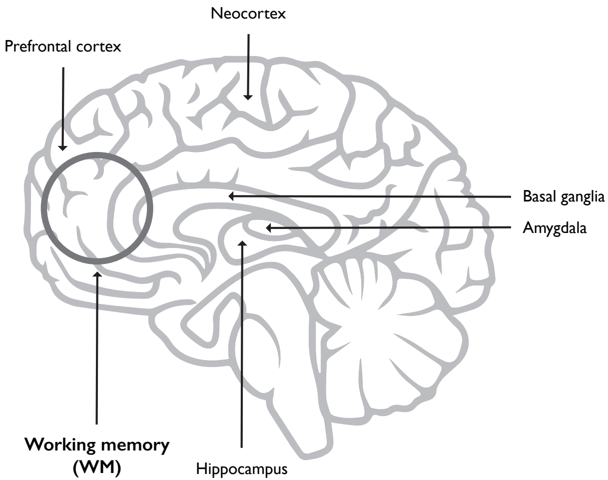



Figure 1.3: Location of working memory within the brain

The other 13 items in the shopping list you would likely have forgotten about around 20 seconds after thinking about them. In other words, that memory is *limited* in duration.

However, Sweller goes on to say that if what you are trying to hold in your working memory has what he calls 'element interactivity' – or, in other words, the pieces of novel information are interconnected or linked in some way that is a bit more complicated and involved – then working memory has even less capacity to remember, so the number would drop to three or four items.

Essentially, working memory acts as a 'gatekeeper' to new learning.

The implications for the classroom teacher are clear. When teaching a class of pupils a new topic or skill, the teacher must be aware of both the limitations of the working memory and how it functions, because it is this part of the brain that will be attending to all the new learning.

Sweller is really clear on the implications of the limitations on working memory:

> **The implications of working memory limitations on instructional design can hardly be overestimated. [...] Anything beyond the simplest cognitive activities appear to overwhelm working memory. Prima facie, any instructional design that flouts or merely ignores working memory limitations inevitably is deficient.**[6]

6 J. Sweller, J. J. G. van Merrienboer and F. G. W. C. Paas, Cognitive Architecture and Instructional Design, *Educational Psychology Review*, 10(3) (1998): 251–296 at 252–253.

## Long-term memory

In contrast, the long-term memory is described by Sweller as 'indescribably large' and something that 'nobody's measured'.[7] He argues that the main objective behind teachers understanding and using CLT in their practice is for pupils to have, ultimately, a greater store of knowledge in their long-term memory. In order to form a memory, the brain must store any new information so that it can be accessed again later, which it does through a process called 'encoding'. There are broadly three ways in which new learning transitions from working memory to long-term memory: acoustic, visual and semantic.

Here is a simple example.

**Acoustic encoding:** Imagine that you are introduced to someone for the first time and you don't know their name. Their first name is Jane. Once they are introduced as Jane that information would transition

7 J. Sweller, Cognitive Load Theory, without an Understanding of Human Cognitive Architecture, Instruction is Blind.

from working memory to long-term memory through the process of hearing it said.

The way to ensure that you would then keep that person's first name in your long-term memory would be through rehearsal. Repeat the name frequently to make it 'stick'.

**Visual encoding:** Cognitive scientists would explain this as the process of converting things that you see into mental images. Similarly, when you see something new or novel, it means that you are likely to remember it. The maxim 'I never forget a face' probably holds true as it would be an example of visual encoding (Perhaps this is quite obvious, but nonetheless it is how encoding works.)

**Semantic encoding:** Again, cognitive scientists suggest that if new sensory information can be linked to existing knowledge or understanding then it is better remembered. When you make sense of something and see how it functions or operates then this allows semantic encoding to take place. So the word 'polygon' with no context will be difficult for a novice learner to remember but if an association is made to it, in this case a drawing of a polygon, then the chances of it being remembered are higher.

The goal of learning should not be to acquire a whole lot of unrelated facts or items of knowledge, but rather a collection of these facts and items of knowledge. They then should be interconnected and relatable to each other in order to build greater coherence and depth of understanding.

Encoding places this new learning in long-term memory. As pupils acquire new learning and then relate it to existing knowledge, then it can be said that the process of schema acquisition has begun.

The ultimate ambition is to develop well-constructed, coherent and detailed schema within our pupils' minds. Well-thought-out teaching ultimately guides pupils to building schemas.

## Schemas

A schema organises elements of information according to how they will be used and can be relatively simple or complex.

Examples of possible schemas include:

Alphabet.

Number line.

Mathematical/scientific formula.

Dictionary.

Encyclopaedia.

Chapters in a book.

Instructions on how to build a bookcase.

Dance routine.

Mark scheme.

Bus timetable.

Musical notation.

A tactical plan.

Knowing how to drive a car.

Solving number problems.

Labelled diagram.

Graphic organiser.

Knowledge and understanding are interconnected because knowledge is the collection of different concepts, ideas and facts, whilst understanding is the connections made between them.

Schemas are crucial to pupils' understanding because of the importance of these connections.

The goal of the teacher is, firstly, to help pupils to construct schemas, both by initially instructing pupils (presenting the knowledge) and then by building up the complexity of the schema (securing the pupils' understanding). This way pupils are not just remembering a series of unrelated statements, facts or skills. Given that a schema can take a variety of forms such as a number line or alphabet or formula or essay plan, the role of the teacher in part is to teach the schema (e.g. numbers 1–10) in the correct order. The next job of the teacher is to assist pupils in getting these schemas automated (recalled without hesitation) so that they can be readily, easily and quickly retrieved and applied.

There are definitely some schools of thought which assume that transferring knowledge into long-term memory requires nothing other than 'rote learning' or 'drilling' – potentially a pejorative term, meaning that nothing is understood, just recalled. In other words, we end up with the unthinking pupil who can remember something but not understand it.

An example of this might be a pupil who can recall that the chemical symbol for iron is Fe. In fact, they can do this for most of the elements in the periodic table.

Sweller completely sees the value of storing knowledge – in fact, as much knowledge as possible – in the long-term memory. Providing, of course, that the knowledge is attached to a useful schema.

So, in this example, Sweller would prefer to see not only the ability to recall the correct chemical symbol for iron and the rest of the elements, but also that the pupil knows where each element is located in the periodic table, and why, based on its mass or whether or not it's a metal. Understanding the periodic table in this way is an example of having a schema.

Pupils' ability to automate detailed recall of such schemas is, Sweller argues, the real 'prize'. Indeed, he describes it as transformational. The key point is this:

**Ultimately the route to genuine competency in anything that needs to be learnt is via secure recall of the appropriate schema, located in long-term memory.**

Sweller points to research done on chess grandmasters, comparing their game play with that of a 'weekend player'. He asks what separates the two groups in terms of their competence as chess players.

The obvious conclusion might be that the grandmaster has an incredible intellect which is used to work out the best moves and strategy to beat their opponent.

The real answer turns out to be something of the opposite!

Grandmasters' success is simply down to the fact that they have a powerful memory of the different configurations possible on a chess board (this is, essentially, their schema). Once they recognise the configuration in front of them, they know the best moves to make in order to win. In short, it is their recall of configurations that singles them out and nothing else.

So this would be why Daniel T. Willingham, professor of psychology at the University of Virginia, said 'understanding is remembering in disguise'.[8]

This is a brilliant quote that should hopefully persuade those who might believe that knowledge recall is just a low-end cognitive challenge.

Analogies can often be useful devices to help communicate concepts. What follows is one that sprung to my mind to help get across the structure of the brain's information processing system as described by Sweller. It is based on a bookshelf and a library.

**Imagine putting up a new – very small – bookshelf in the entrance hallway of a house, by the front door (this mirrors the idea that working memory lies at the front of the brain and is where the brain first processes 'new' knowledge). This bookshelf can only hold three to five books (depending on their thickness). Trying to put more books on the shelf will mean that some of them will fall off because the bookshelf is too small to hold anymore (mirroring the problem of limited working memory capacity).**

8 D. T. Willingham, *Why Don't Students Like School? A Cognitive Scientist Answers Questions About How the Mind Works and What It Means for the Classroom* (San Francisco, CA: Jossey-Bass, 2009), p. 88.

Let's now develop the analogy further so that it links to the notion of knowledge transfer from working memory to long-term memory.

**Imagine that you have decided to build a library in one of the rooms at the back of the house. Once the books on the hallway shelf have been read, they can then be put in the library for the long term, ready to be accessed at any point in the future. The library in this analogy, of course, being long-term memory. (This movement of the books from the shelf at the front of the house to the library at the back of the house, for long-term storage and to be accessible at any future point, mirrors the idea of the transference of new knowledge from working memory to long-term memory.)**

Sweller argues that being competent or lacking competence in something depends entirely on how secure the retrieval of knowledge held in the schema is.

## What types of cognitive load can be placed on working memory?

It is now generally accepted that there are two types of cognitive load: intrinsic and extrinsic. Sweller effectively disregarded what had previously been considered a third type – germane load – in 2010, so as a result no further reference will be made to it in this book. As he says:

> **Unlike intrinsic and extraneous cognitive load, germane cognitive load does not constitute an independent source of cognitive load. It merely refers to the**

> **working memory resources available to deal with the element interactivity associated with intrinsic cognitive load.**[9]

## Intrinsic load

Intrinsic cognitive load relates to the inherent difficulty of the material itself. Sweller developed this concept when trying to understand why some of his experiments worked and some didn't, even though they were testing the same thing. It was the result of a variance in the complexity of what was being processed.

So if the new content to be learnt is inherently detailed and complex, with lots of 'moving parts', then it stands to reason that pupils can quickly be overwhelmed by this, thus exceeding their working memory capacity. Sweller is clear that if something is new but easy to remember (such as the sum 2 + 2 = 4) then there will be low intrinsic load. However, learning something like a quadratic equation – which has more elements to it that need to be held in working memory simultaneously – will result in a higher intrinsic load.

In other words, more complex content with lots of element interactivity will place a high cognitive load on pupils. This type of load is sometimes described as 'good' load, because the teacher would not want to make content too easy at the expense of exposing pupils to higher value, more complex content. Ultimately, we want our pupils to be able to learn that which is complex and detailed. The challenge is to make it challenging enough but not so challenging that it becomes too much.

Therefore we are aiming for *high load* but still within working memory limits so as not to cause overload.

9 J. Sweller, Element Interactivity and Intrinsic, Extraneous, and Germane Cognitive Load, *Educational Psychology Review*, 22(2), Cognitive Load Theory: New Conceptualizations, Specifications, and Integrated Research Perspectives (2010): 123–138 at 126.

# Extraneous load

Extraneous cognitive load is the load generated *by the way in which* the material is presented and relates to anything which does not aid learning. Originally Sweller saw all overload as extraneous load. Learning materials can be unintentionally delivered and presented in such a way that it actually exceeds pupils' working memory capacity because there is too much badly designed information and it is hard for pupils to deal with and filter out the relevant parts.

For teachers, 90% of the story behind reducing cognitive load on working memory revolves around addressing issues related to extraneous load.

We need low extraneous load so that space can be freed up for higher intrinsic load (as shown in Figure I.4).

This analogy should help conceptualise the point. Imagine the perfect cup of takeaway cappuccino. It would contain a small amount of espresso coffee (extraneous load in this analogy) and the rest of the drink would be frothy milk (intrinsic load). Thus, this describes the optimum mixture for the amount of load the novice learner can process (i.e. low extraneous load but the optimum intrinsic load – we don't want the cup to overflow, of course).

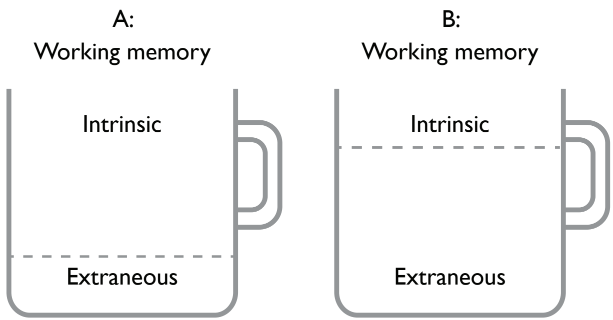



Figure I.4: Desirable and undesirable load

If our cup is already very full of strong coffee, we will have no room for the milk and our drink will be too bitter and hard to swallow for the untrained palate (novice learner). Desirable cognitive load is achieved by keeping any extraneous load to a minimum. This involves taking care with the instructional design of learning materials and the teacher exposition, thus keeping extraneous load as low as possible.

The right amount of challenge and complexity is achieved through careful attention to how difficult you make the acquisition of schemas, thus having a 'good' amount of intrinsic load.

This positive weighting in the balance between different types of load is summarised nicely by Paul A. Kirschner, professor of educational psychology at the Open University in the Netherlands, who suggested to:

> **Maximise useful load, minimise irrelevant load.**[10]

10 P. A. Kirschner, The Ideal Learning Environment: Evidence-Informed Strategies for EEE-Learning, presentation delivered at researchED National Conference (8 September 2018), quote on slide 15. Available at: https://researched.org.uk/wp-content/uploads/delightful-downloads/2018/09/Paul-Kirschner-rED18-The-Ideal-Learning-Environment.pdf.

## How do I ensure that pupils experience the right amount of cognitive load when learning something new?

The teacher needs to essentially balance cognitive load in favour of the desirable at the expense of the undesirable.

This involves careful attention in terms of thinking about the complexity of your content and how you can make it accessible without oversimplifying it. Care will be needed regarding the design of worksheets and slides that deliver learning materials.

The teacher will also need to carefully consider how much support pupils receive. Knowing when to gradually remove any scaffolding will be important.

Lastly the teacher will need to reflect on the auditory dimension of the lesson. Specifically, the timing of teacher talk and the amount of it is crucial to understanding some aspects of undesirable load, expressed through different CLT effects.

They will then need to attempt to pitch the lesson content so that there is the right amount of intrinsic load.

## What are CLT effects and how do they relate to cognitive load specifically?

Since the early 1980s, Sweller himself has directly researched, or overseen research into, a number of 'instructional techniques' or influences that affect instruction and, ultimately, cognitive load.

These have all been tested using randomised controlled trials and are expressed as 'effects'. This book focuses on 14 of them: some of which relate to intrinsic load and some to extraneous.

Figure I.5 lists them in date order (see pages 18–19).

## CLT effects linked to intrinsic load

The element interactivity effect is the one that led to the notion of intrinsic load. Teachers might be familiar with this term if they have searched online to find out more about CLT, as it is discussed in a lot of the literature. Intrinsic load relates to the inherent complexity of a subject or the content that a pupil needs to process. If element interactivity is too high, then working memory cannot process the necessary, most relevant information efficiently. The quest for the teacher is to get element interactivity just right. This is no easy feat!

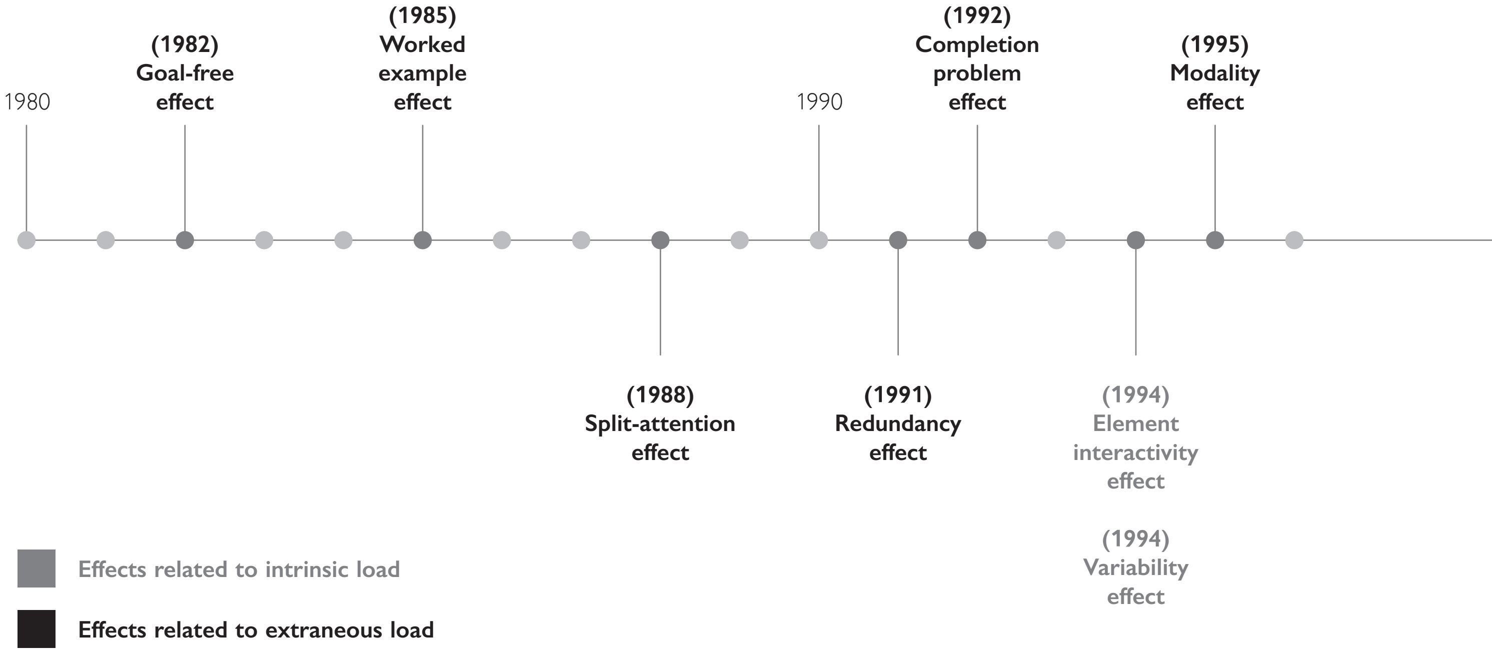
## CLT effects linked to extraneous load

Internet searches also reference extraneous load as a type of overload on working memory. The split-attention effect, redundancy effect, expertise reversal effect and transient information effect are all examples of effects that can 'clutter' working memory with unhelpful additional stimuli or 'noise', ultimately getting in the way of effective learning. Collectively these effects gave rise to the term 'extraneous load'.

Other effects, though, have been tested – and by understanding how best to utilise them in our teaching, we can avoid overloading working memory for our novice learners.

The 14 effects that Sweller and colleagues have studied are listed in the table on pages 20–21, with a brief description of each.

However, note that they are listed in the order in which we will encounter them in the remainder of the text.


1980
(1982) Goal-free effect
(1985) Worked example effect
(1988) Split-attention effect
1990
(1991) Redundancy effect
(1992) Completion problem effect
(1994) Element interactivity effect
(1994) Variability effect
(1995) Modality effect
Effects related to intrinsic load
Effects related to extraneous load

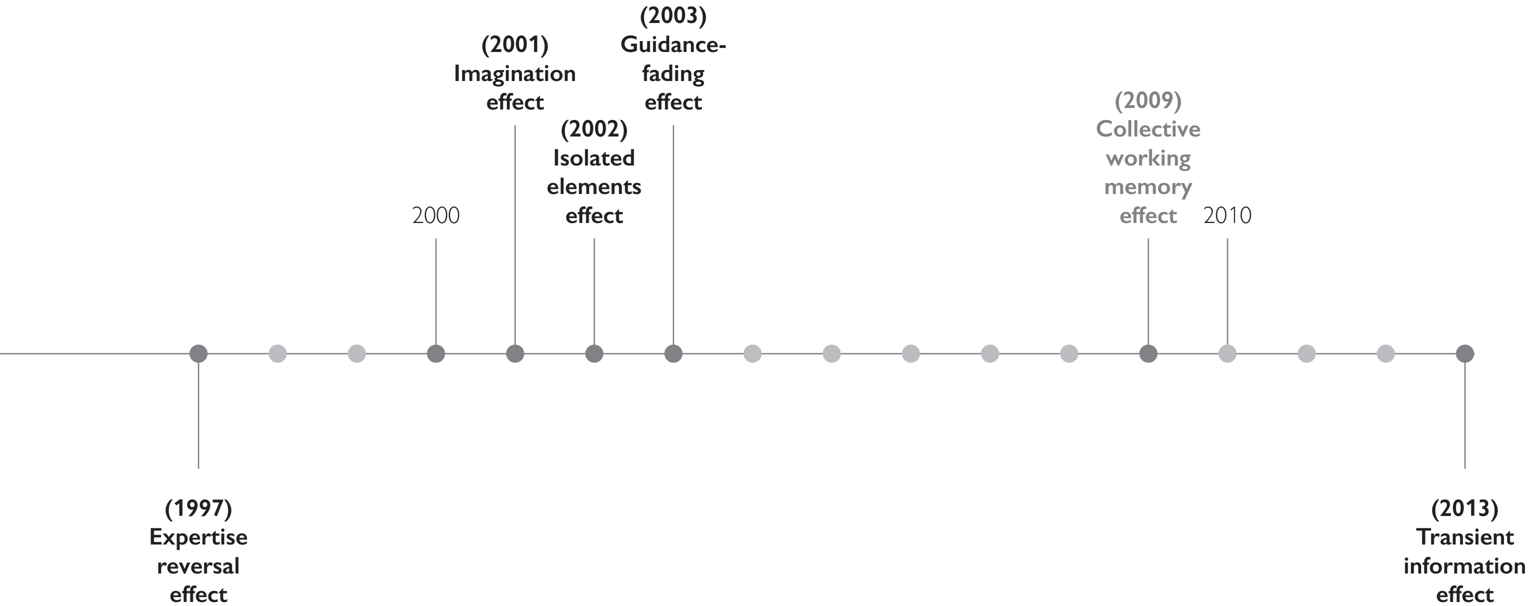



Figure I.5: Chronology of the development of CLT

## The 14 CLT effects

| CLT effect | Abbreviation | Brief description |
|---|---|---|
| **Element interactivity** | EI | Describes the level of complexity involved in learning something new. |
| **Isolated elements** | IE | The process of separating out the individual components involved when learning something. |
| **Modality** | M | The combination of spoken words together with relevant images to support the teaching of something new. |
| **Imagination** | I | The visualisation of concepts or procedures into mental images to assist with better recall. |
| **Split-attention** | SA | Occurs when the relevant stimuli are spread out all over a page and force constant change in focus and eye movement. |
| **Redundancy** | R | Occurs when extraneous or repeated information is provided on the same page/slide/worksheet. |
| **Transient information** | TI | The negative impact on learning when too much verbal exposition comes from the teacher. |

| CLT effect | Abbreviation | Brief description |
|---|---|---|
| **Collective working memory** | CWM | The process of asking pupils to pool their working memories rather than just draw on their own more limited ones. |
| **Worked example** | WE | Providing an example or model of a successful piece of work in order for pupils to devote more mental resources to creating their own. |
| **Completion problem** | CP | Created by giving pupils an incomplete worked example and then asking them to work out the rest for themselves. |
| **Guidance-fading** | GF | The process of gradually reducing the level of scaffolding and support a pupil receives. |
| **Variability** | V | Showing pupils a range of worked examples before they begin their own work. |
| **Expertise reversal** | ER | Avoiding spoon-feeding pupils too much, especially as their expertise grows. |
| **Goal-free** | GFr | Minimising the amount of instructions pupils receive when processing information. |

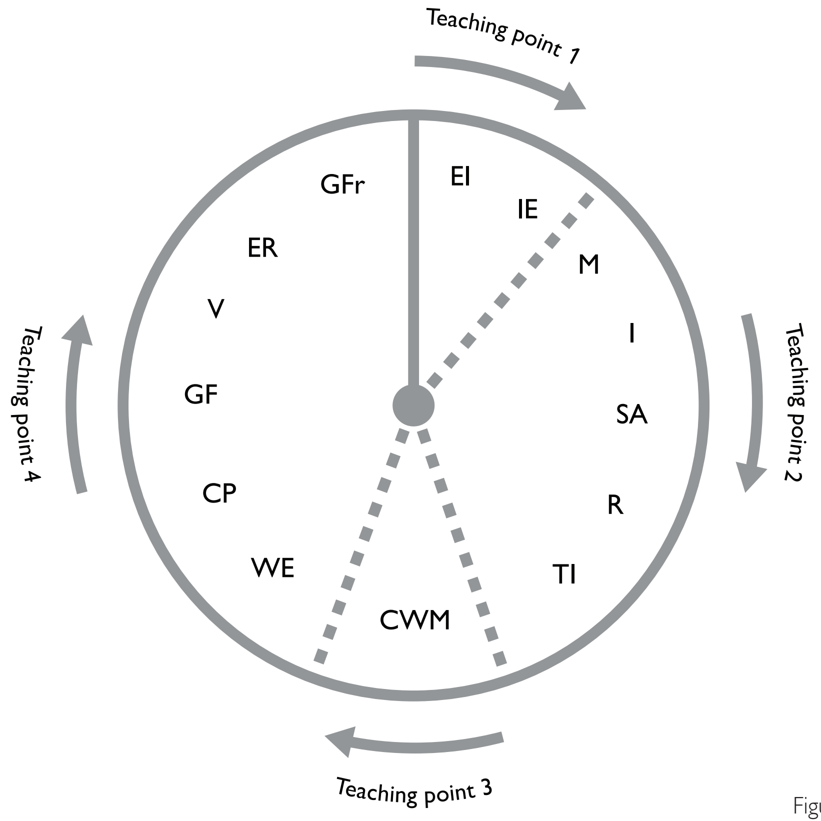



Figure 1.6: Full teaching cycle

# In the classroom

We will now consider when each of these 14 CLT effects might best be reflected upon when delivering a lesson or series of lessons.

Figure I.6 on page 22 promotes the idea that, when instructing the novice learner, it is helpful to break up the teaching process into a sequence of component parts.

Using the abbreviations from the table on pages 20–21, you can see when each of the 14 CLT effects might need to be considered within the four components of the lesson. Looking at the graphic, how easy do you find it to interpret this information? Can you recall what the abbreviations stand for? How many can you hold in your working memory? Do you need to look back at the list to make sense of this new information? Could I have presented this information differently? These are the kinds of questions we should be considering when designing learning materials and ways of presenting information.

The component parts of the lesson are described as 'teaching points', and there are four in total:

Teaching point 1: introducing a new topic.

Teaching point 2: teaching new knowledge/skills.

Teaching point 3: checking for recall and understanding.

Teaching point 4: pupils demonstrate understanding.

Broadly this involves an input phase (teaching points 1 and 2) in which formal instruction/teaching takes place. This is then followed by a crucial midway point at which the teacher can carry out some kind of informal assessment (teaching point 3) to gauge overall levels of understanding.

If the class has achieved a sufficiently high level of understanding (around 80%[11]), the teacher would then move into the final phase, in which pupils would be engaged in demonstrating their knowledge and

11 The notion of an optimal 80% success rate is taken from Barak Rosenshine's Principles of Instruction: Research-Based Strategies That Every Teacher Should Know, *American Educator* (Spring 2012): 12–19, 39 at 17. Available at: https://www.aft.org/sites/default/files/periodicals/Rosenshine.pdf.

understanding (teaching point 4). If levels of accurate understanding seem to be much lower than 80% – as indicated by the number of pupils answering questions incorrectly – then this would clearly signal to the teacher that there were significant omissions of knowledge and/or a lack of understanding. The teacher would therefore need to reteach the content delivered in teaching points 1 and 2.

Different CLT effects need to be considered at these various teaching points.

CLT is an instructional theory, so it follows that its structure supports a knowledge transmission model, at least in the early stages. The most effective learning for the novice occurs when the teacher acts as the expert and teaches the pupils directly.

There are, of course, other models – such as discovery learning or enquiry-based learning. Sweller is clear, though, that these models are most appropriate for pupils who are closer to the expert stage. Essentially, the expert does not experience the same working memory limitations as the novice does. The expert, therefore, has the necessary depth of knowledge stored in long-term memory to engage in independent learning.

CLT addresses the needs and perspective of the novice learner and so is an instructional model.

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