# What is cognitive load?

by Connie Malamed (http://theelearningcoach.com/learning/what-is-cognitive-load/)

As far as I can tell, working memory (WM), the part of our brain that consciously processes information, dominates everything we do in terms of learning. Working memory can only hold 4-5 bits of information at one time and information in working memory lasts only around ten seconds.

The fact that our working memories have a small capacity and a short duration is worthy of headline news. It's what we're up against as humans and as learning experience designers.

Working memory is the equivalent of being online

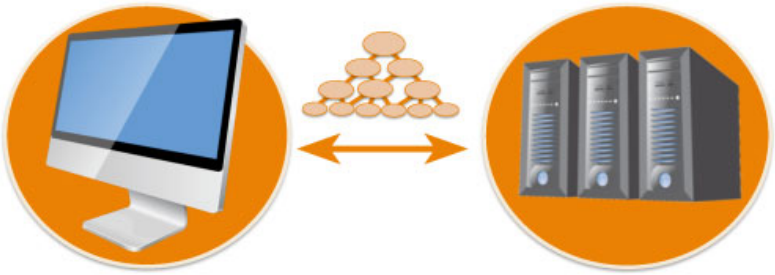
Long-term memory provides permanent storage

## Interactions Between WM and LTM

Unlike working memory, long-term memory appears to have an unlimited capacity. Information in long-term memory (LTM) is stored in schemas, which are mental structures we use to organize and structure knowledge. Schemas incorporate multiple elements of information into a single element with a specific function.

The interaction goes both ways. We construct new schemas in working memory so they can be integrated into existing knowledge in long-term memory. And existing knowledge

in LTM is brought into working memory to help us understand the world. Otherwise, everything would be new all the time!

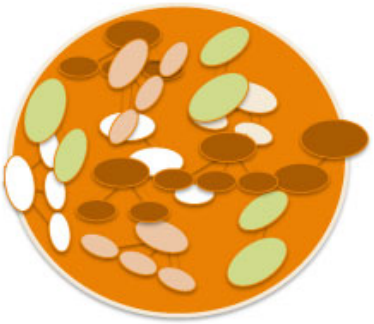


We build schemas in working memory and ingegrate them into existing schemas in long-term memory

We bring schemas from long-term memory into working memory to understand the world

## WM is Vulnerable to Overload

Sometimes learning involves great effort—even suffering (am I a drama queen?). That's because working memory is quite vulnerable to overload, which occurs as we study increasingly complex subjects and perform increasingly complex tasks. As learning experience designers, we have to watch out for *cognitive load,* which refers to the total amount of mental activity imposed on working memory in any one instant.

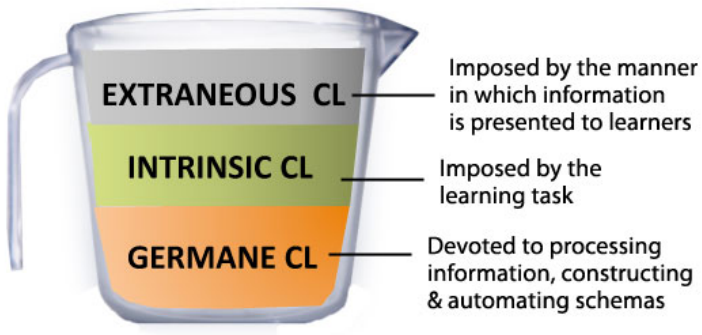


When WM has to process too much information, it leads to poor comprehension and it obstructs learning. (These are little schemas, not ameobas.)

What causes too much demand on working memory? One cause comes from an abundance of novel information. More information than the person can process. But high cognitive load is also strongly influenced by the number of elements in working memory that interact with each other. Often, complex learning is based on interacting elements that must be processed simultaneously. For example, learning to drive involves understanding how several elements simultaneously interact, such as considering the

pressure required to brake, the amount to turn the steering wheel and making adjustments for weather conditions and traffic.

## The Good, the Bad and the Ugly

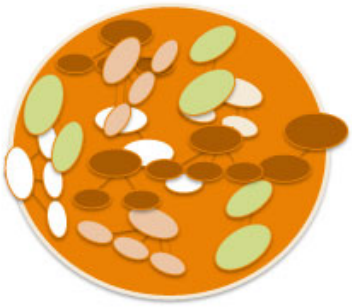



Not all cognitive load is bad. But a problem arises when the load exceeds the capacity of the person processing it. So for example, what overloads the mind of the novice may not overload the mind of the expert. If the load is imposed by constructing new schemas and automating them, it will have positive effects on learning. This is **germane cognitive load**.

If the load is imposed by the nature of what is to be learned, including the number of information elements and their interactivity, it is known as **intrinsic cognitive load**. Sometimes we can change the nature of the learning task, but not that often. People need to learn what they need to learn.

However, if the load is generated by the manner in which information is presented to learners, it is under the control of those who design learning experiences. Known as **extraneous cognitive load**, it is imposed by mental activities that can have a negative effect on learning if not designed appropriately. Extraneous load can interfere with the construction or automation of schemas.

## What We Can Do



Novices in a domain have small bits of information that are not yet formed into effective schemas.

Experts in a domain have constructed vast schemas and networks of knowledge over the years.

There are two things instructional designers can focus on to free working memory capacity: helping learners construct schemas and helping them automate schemas. Effective instructional design can help people combine elements of lower level schemas into higher-level schemas. This is how someone achieves expertise. When multiple elements of information are chunked as single elements, there is more working memory capacity available for solving problems and processing information.

In addition, schemas can get automated if they are repeatedly and successfully applied. Automated schemas directly steer behavior and are not consciously processed in working memory. They free working memory capacity for other activities. Some types of schemas that become automated are reading and driving a car.

As learners becomes increasingly familiar with content and skills, schemas change so that the information or task can be handled more efficiently by working memory. Our job is to facilitate this change in schemas, which ultimately, is what learning is all about.

*This article was taken from a presentation on cognitive load that I gave at the Learning Solutions Conference in Orlando, FL.*

**You may also want to read:**

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