



The Learning Theory Podcast

Episode 7

Sweller's - Cognitive Load

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Original Broadcast Date: 04/12/08

Introduction

Welcome to episode 7 of the Learning Theory Podcast. When I started this podcast series, I did not have a plan beyond the first three episodes. I figured that after the first three I would first of all see if I wanted to keep doing this, and second a plan would come together. Well the surprisingly large number of listeners answered the first question; yes I do want to do this. I would like to take a moment here to thank each of you. I am thrilled that so many of you find this podcast worthy of eight minutes of your time. As for my plan going forward; well no plan yet, but fortunately the topic is so broad that something always seems to catch my interest. These last couple of weeks I seem to be stumbling across numerous discussions about cognitive load.

Background

Cognitive load theory, formalized by John Sweller at Australia's University of New South Wales in 1988, provides a framework for considering cognitive processes when designing instruction (Paas, Renkle, & Sweller, 2003). These cognitive processes are working memory, long-term memory, the schema by which knowledge is stored in long-term memory, and the degree to which the schema can be automated (Sweller, Merriembore, & Paas, 1998).

Working Memory

One assumption of cognitive load theory is based on research by George Miller who found limitations in the number of elements that can be simultaneously contained in working memory (Tuovinen & Sweller, 1999). According to Miller, working memory, also referred to as short-term memory, can only hold seven, plus or minus two, chunks of information (Miller, 1956). This could help explain why we have so much trouble with the Ten Commandments.

While working memory can hold five to nine chunks of information, cognitive load theory assumes that working memory can only operate on two to four pieces of information at a

time and that the information is lost after approximately 20 seconds, unless it is refreshed by rehearsal (Merriembore & Sweller, 2005). It is important to understand however, that this assumption only applies to novel or new information which is being processed through sensory input (Merriembore & Sweller). When dealing with information retrieved from long-term memory, cognitive load theory assumes working memory limitations do not apply. So when standing before the pearly gates citing Miller's research in your defense is not recommended.

Long Term Memory

The cognitive load theory assumptions surrounding working memory are fairly straight forward. When we start to look at long-term memory however, the theory gets complicated. The theory assumes effectively unlimited long-term memory, comprised of multiple schemas with varying degrees of automation (Tuovinen & Sweller, 1999). It is difficult to describe these as individual elements as they all integral parts of each other within the frame work of the theory, so for simplicity let's just assume long-term memory, being unlimited, contains all one has ever learned. How one is able to use that prior learning however will depend on the schema, or pattern, in which it is stored in long-term memory.

Schemas

An understanding of schemas is critical to the understanding of cognitive load theory. In effect, schemas are the synthesis of multiple items into complex patterns. These patterns are stored in long-term memory but can be called into working memory when needed to processes new information arriving in working memory through sensory input. A prime example of a schema is the ability to read. In order to read one must know the alphabet, recognize the patterns by which letters come together to form words, have acquired a vocabulary which assigns meaning to the words, understand the rules of grammar and punctuation which control the flow

of the words (which of course may also affect meaning), and perhaps even call on other schemas related to context of what one is reading. Most of us formed this very complex schema called reading by learning one letter, one word, and one rule at a time. When you reflect on it, it is really quite remarkable.

Schemas reduce the load on working memory (Sweller, et. al). As previously mentioned, schemas are brought into working memory in order to process new information. The more complex the schema the more information it can process which in turn reduces the cognitive load. Staying with the reading schema, a poor reader may have difficulty comprehending the message of a passage because working memory is loaded with the task of just recognizing the words on the page; where as an accomplished reader's schema relieves working memory of the word recognition task thus enhancing reading comprehension. This is where the theory gets exciting. A schema brought forth into working memory is considered to be a single element within working memory; however, there is no limitation to schema complexity (Sweller, et. al).

Schema Automation

Another aspect of schemas is automation. Information can be processed either consciously or automatically (Sweller et. al, 1998, citing Schneider & Shiffrin, 1977 and Shiffrin & Schneider, 1977). Schemas can fall into either of these categories or somewhere along an undefined line between the two. Where on that line a schema falls is a matter of practice. Once again we can look at reading as an example. When we initially learn our alphabet, rules of phonics or whole language patterns, we have in effect created a reading schema and we do obtain some level of comprehension from our reading. But this schema is not fully automated yet so we are still conscience of the act of reading and this conscience effort places a load on working memory. With repeated practice however, our reading becomes an automatic process and the act

of reading, with all of its symbols and rules, becomes a single complex schema which we bring forward into working memory to help us process new information.

Application

In applying cognitive load theory, the instructional designer should look for techniques to reduce the load on working memory in order to facilitate long-term memory schema acquisition and automation (Soloman, n.d.). To do this, Sweller recommend that instructional designers minimize the load on working memory in the following ways: avoid means-ends approaches with the use of goal-free problems or worked examples, avoid making learners integrate several sources of information, and avoid unnecessary redundant information (Soloman). Additionally, Sweller suggested that working memory capacity can be increased by dual-coding with auditory and visual information that is both essential to understanding, but not redundant (Soloman).

This list of Sweller's recommendations has likely generated more questions than answers for you. For more detail regarding the specifics of Sweller's recommendations I would highly recommend an article by Dr. Graham Cooper (1998) entitled *Research into Cognitive Load Theory and Instructional Design at UNSW*. The link to this article can be found in the reference list for the transcript of this episode.

Wrap up

I hope you have found this episode interesting and enlightening. If you would like to provide feedback please visit me at www.dancampbell.us where you can find the transcript for this and other episodes, as well as links to other learning theory resources. Thank you for listening! I'll be back in two weeks. Until then, go out and learn something new everyday.

References

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