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What is cognitive load theory?

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Statement of the problem

Instruction is often derived from theories that are not solidly grounded in research on how humans learn or are based on ideological considerations. Consequently, teaching practices are not always optimal. Understanding how people learn can inform and improve teaching practices.

Proposed solution

Cognitive load theory provides explanations of how learning occurs based on well-established principles related to the architecture of memory. Cognitive load theory has a range of direct implications for how teaching should be planned and delivered, particularly for novice learners.

The theoretical rationale – how does it work?

Cognitive load theory is based on two well-established principles related to memory. The first is that working memory, where short-term memory is stored and manipulated, is inherently limited. We can only hold a small number of pieces of information simultaneously and only for a short period. Thus, working memory can be easily overloaded, impacting negatively on learning. The second principle is that long-term memory is virtually unlimited. Information in long-term memory is often organised and integrated into schemas so it is readily and automatically retrievable in response to task demands, with relatively little effort from the learner. In effect, the capacity and duration limits of working memory disappear when dealing with familiar information from long-term memory. A key implication is that systematic and explicit instruction for novice learners minimises the load on working memory and facilitates the transfer of information to long-term memory, resulting in learning.

Rehearsal is important to consolidating schemas. The process of automation enables schemas to be more efficiently retrieved from long-term memory as an individual moves from novice to expert, freeing up working memory to engage with new information.

Research on cognitive load theory has produced a range of teaching principles that can improve learning outcomes. For example:

- **Worked example effect.** Worked examples involve the use of a problem that has already been solved, which is systematically and fully modelled to the student. This has been consistently found to be more effective for learning in novice learners than presenting students with conventional problems to solve.
- **Redundancy effect.** Presenting students with unnecessary information to the content being taught tends to needlessly load working memory and impairs learning. For example, redundancy occurs when the same information is presented in two different formats, when either one would be self-evident on its own. Another example is when non-essential graphics draw attention away from the key components of the task.
- **Expertise reversal effect.** While novice learners benefit from explicit instruction and worked examples, learners with more expertise may benefit from a greater emphasis on problem-solving. Awareness of the skill level of the students should guide the instructional approach.
- **Transient information effect.** Transient information that quickly disappears (such as spoken words) presents a greater challenge to working memory than non-transient information (such as written instructions), which can be reviewed as needed.

What does the research say? What is the evidence for its efficacy?

Cognitive load theory continues to be developed and refined, and some key questions remain to be answered. Nevertheless, an extensive body of replicated high-quality research has been published over 40 years supporting the basic tenets of the theory, as well as many of the specific effects described.

Conclusion

Many aspects of cognitive load theory are well validated by research and have direct implications for teaching practice. All teachers should have a working knowledge of cognitive load theory.

Key references

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