j-pita
Journal of Pedagogical Insights & Technological Advancements
Volume 1, Issue 2, January 2025
ISSN: 3049-0685

Optimizing Learning: The role of Cognitive Load Theory in Instructional Design

Shainy Mole P.T.
Assistant Professor
Mores College of Arts and Science, Chembra.

Abstract

Cognitive Load Theory pioneered by John Sweller, aims highlights how the cognitive load impacts the learning and to process new information and to create long term memories. By understanding the principles behind cognitive load theory, teachers can optimize the way they present novel ideas to students to make them easier for their audience to understand. Applying Cognitive Load theory in education ensures that instructional methods align with cognitive capacities, leading to improved learning outcomes. This paper examines and explores the fundamental principles of Cognitive Load Theory, the types of cognitive load and explore the classroom implications of cognitive load theory.

Keywords: Cognitive load theory, intrinsic load, extraneous load, germane load, instructional design, working memory

Introduction

Cognitive load theory was propagated by John Sweller, in 1988 According to Sweller, Ayres, and Kalyuga (2011), cognitive load theory is an educational theory that draws from our understanding of human cognition. Since its conception in the 1980s, the theory has produced experimental, educational outcomes by utilising elements of human cognitive architecture (e.g., Sweller, 1988). When new teaching methods are contrasted with more conventional methods in a controlled, randomised study, these impacts are shown. A new effect that is influenced by our understanding of human cognition may have been demonstrated if the unique approach aids in

learning, as indicated by test results. Teachers and other relevant professionals, including instructional designers, are interested in the new instructional processes that result from the effect.

The cognitive approach to learning focuses on how attention, memory, and information processing contribute to knowledge acquisition. Cognitive learning theory explores how the thinking process itself can affect learning. That means it also explores different factors influencing our thinking, such as internal and external factors. According to cognitive theorists, to define learning internal thoughts or insights are equally important along with observable modified behaviour of learners. Cognitive Load Theory (CLT) provides a framework for instructional design, which explains how the brain processes and retains information by managing the limitations of working memory. Cognitive Load Theory elaborates on the concept of a limited short-term memory by defining three types of "load" that need to be considered by instructors and instructional designers.

Objectives

- To examine the fundamental principles of Cognitive Load Theory.
- To identify types of cognitive load and their impact on learning.
- To explore the classroom implications of cognitive load theory.

Cognitive Load Theory

The concept of cognitive load was first coined by Sweller (1988), Cognitive Load Theory states that working memory and cognitive capacity for processing new information or ideas of all individuals have a limited capacity. Cognitive load theory (CLT) suggests that there are three types of cognitive loads we process when engaged in learning something new:

Intrinsic Cognitive Load: Intrinsic cognitive load is the inherent level of difficulty associated with a specific instructional topic. Depend on the complexity and schema, the inherent

Volume 1, Issue 2, January 2025
ISSN: 3049-0685

difficulty of the material being learned may vary. The instructor might not be able to alter this difficulty.

Extraneous Cognitive Load: Extraneous cognitive load is the load, which imposes from some extraneous source. This is completely based on the manner in which information is presented to learners. Here the instructional designers have a great role in altering the difficulty.

Germane Cognitive Load: Germane load stem from the learner's characteristics. The cognitive effort paid by the learner in constructing and organizing schemas enhances a meaningful learning and long-term retention. it is influenced by the relationship between intrinsic and extraneous load.

The theory is predicated on our understanding of the structure and functions of the human mind, or human cognitive architecture, which aids in our comprehension of how we learn, think, and solve problems. It is thought to be a natural information processing system that produces a variety of processes intended to enhance the acquisition of biologically secondary knowledge stored in long-term memory and lessen cognitive load.

Biologically Primary and Biologically Secondary Knowledge

Biologically primary and biologically secondary knowledge are two basic categories of knowledge,

Biologically primary knowledge: The information that humans have evolved to acquire over thousands of generations is known as biologically primary knowledge, and it is acquired unconsciously and without instruction because it is essential to human survival and the survival of their societies. Examples of biologically primary knowledge include general problem-solving and thinking skills, such as learning to speak and listen in a native language at a young age, generalising, transferring, and performing basic social skills like face recognition. Since we have evolved to acquire such information automatically, it does not require instruction, and because it is easy to learn, it does not place a significant cognitive load on our minds.

Biologically secondary knowledge: The term "biologically secondary knowledge" refers to information that must be explicitly taught and not left up to students' discovery; it requires conscious effort, and the majority of subjects taught in formal education fall into this category. Examples of biologically secondary knowledge include reading, writing, mathematics, history, science, and other subjects that are typically taught in schools and universities. Because acquiring biologically secondary information is not simple.

Principles of Cognitive Load Theory

In order to maximise learning, there are a number of fundamental principles associated with cognitive load theory. Lowering needless mental strain and enhancing retention of information these fundamental concepts support the instructional designers.

The working memory principle

Human working memory has a limited capacity, which cannot hold an excessive amount of information at a time. Learners may experience cognitive overload when too much information is presented at once.

The schema construction principle

A schema is a mental framework that organizes information and how we respond to situations. New information is organized into schemas and this defines the effectiveness of learning. Instructional designs and strategies promotes the development of schemas.

The modality principle

The modality principle suggests Instructional designs which include modals, diagrams or graphics will give more result than that of traditional methods. This helps the learner or user focus on the most important points, reducing cognitive load and increasing germane load.

The redundancy principle

The redundancy principle promotes a planned or simplified combination of text,

Volume 1, Issue 2, January 2025
ISSN: 3049-0685

narration, and images to reduce extraneous cognitive load. This allows the learner to concentrate on the problem and devote more effort to devising strategies for solving it.

The split attention principle

The Split Attention Effect is when students are given opportunity to constantly switch between the different formats of information in the same platform. Same information can be given in multiple formats simultaneously to refer. Attention got split when diagrams and explanations should be placed together rather than in separate locations.

The worked example principle

Worked examples are a very beneficial tool to use when students are relatively new to a topic. Usually, all their attention goes into solving a problem which might leave little room in their working memory to remember what steps they took to solve this problem. Providing step by step worked examples reduces cognitive load for beginners and helps them learn problem solving strategies.

The expertise reversal effect

The effectiveness of instructional strategies changes as learners gain expertise. New learners benefit from guided instruction, while advanced learners require less guidance and more independent problem solving.

Relevance of CLT

CLT is highly relevant in modern education and instructional design as it provides a scientific framework for optimizing learning. Its significance can be understood through the following aspects.

- Enhance Learning Efficiency.
- Improving Instructional Designs.
- Supporting differentiated Learning.

- Promoting Long Term Knowledge Retention.
- Application in technology enhanced learning.
- Reducing Cognitive Overload in Classrooms.
- Practical implications for Educators and Trainers.

Educational Implications

CLT plays a significant role in education, as it provides guidelines for designing instructional materials and teaching strategies that align with human cognitive processes. Educators can ensure student learning, improve retention, and reduce cognitive overload. Some of the amin educational implications are:

Designing Effective Instructional Material

By eliminating unnecessary information and distractions instructional designers and teachers could structure learning materials to reduce the extraneous load. Also clear, concise and well-organized content which helps students focus on essential concepts can be introduced. Already worked examples and step by step problem solving methods will provide great result.

Scaffolding Learning

Based on the schema of learner instruction should be adjusted. Responsibility of the instructors is to provide guidance and facilities to develop new schemas and organizing the information. Complex tasks can be break into smaller steps to ensure students are noe overloaded with information.

Optimizing the Use of Multimedia

As per the modality effect, combination of auditory and visual presentation of

information enhances learning in a more enthusiastic way. Instead of integrating text and images they can be present separately to improve comprehension.

Differentiated Instruction for Diverse Learners

Only after assessing the prior knowledge of the learners, teachers can adjust their instructional method to avoid complexities. Students might be different according to their schema and schema development capacity.

Reducing Cognitive Overload in Classrooms

To minimize distractions teachers should avoid redundant explanations and also has to simplify instructions. Breaking of information into smaller segments will enhances memory and recall in a better way.

Promoting Active Learning and Schema Construction

To promote deep learning teachers can encourage the learners to assimilate and accommodate new knowledge with existing schemas.

Application in E- learning and Digital Education

Varities of online platforms, which ensure interactive content that follows CLT principles, should be used in the learning process. Even though digital platforms are more attractive, it must be free from excessive animations, repetition of text, and unnecessary graphics to prevent extraneous cognitive load.

Enhancing Problem- solving and critical Thinking

To build problem solving skill among students, CLT suggests worked examples and guided practice. Learning through examples before attempting independent problem solving will

be effective.

Conclusion

To summarize, cognitive load theory is an important concept in education, as it is based on several key principles that guide instructional design to optimize learning, it assists educators in designing effective learning experiences that are compatible with the brain's cognitive limits. It applies to all learning venues, including classrooms and digital learning platforms. As CLT continues to inform educational practices, it holds the promise of contributing to the ongoing improvement of instructional design and educational effectiveness for years to come.

References

Cherry, K. (2022, December 12). *An overview of learning theories in psychology*. Verywell Mind. https://www.verywellmind.com/learning-theories-in-psychology-an-overview-2795082

Chohan, S. (2024, October 24). *Cognitive load theory: Types and principles for reduction*. Lemon Learning. https://lemonlearning.com/blog/cognitive-load-theory-types-and-principles-for-reduction

Clark, C., & Kimmons, R. (2023). *Cognitive load theory*. https://doi.org/10.59668/371.12980

Cognitive load theory - The Decision Lab. (2024). The Decision Lab. https://thedecisionlab.com/reference-guide/psychology/cognitive-load-theory

Likourezos, V. (2021, March 3). *An introduction to cognitive load theory*. The Education Hub. https://theeducationhub.org.nz/an-introduction-to-cognitive-load-theory/

Sweller, J. (2011). Cognitive load theory. In B. H. Ross (Ed.), *Psychology of learning and motivation* (Vol. 55, pp. 37–76). Academic Press. https://doi.org/10.1016/B978-0-12-387691-1.00002-8

Sweller, J. (2011). *Cognitive load theory - an overview*. ScienceDirect Topics. https://www.sciencedirect.com/topics/psychology/cognitive-load-theory

The 10 principles of cognitive load theory | InnerDrive. (2022, March 3). https://www.innerdrive.co.uk/blog/principles-cognitive-load-theory/

Thompson, P. (2019). 3.2 Cognitive theories of learning. In *Foundations of educational technology* (Ch. 3). Oklahoma State University. https://open.library.okstate.edu/foundationsofeducationaltechnology/chapter/3-cognitive-theories-of-learning/

Waude, A. (2017, January 17). *Cognitive load theory: How "cognitive load" affects memory*. Psychologist World. https://www.psychologistworld.com/memory/cognitive-load-theory

Wikipedia Contributors. (2019, June 3). *Cognitive load*. Wikipedia. https://en.wikipedia.org/wiki/Cognitive_load

Williams, J. (2023, February 22). *Cognitive load theory: How to optimize learning*. Let's Go Learn. https://www.letsgolearn.com/education-reform/cognitive-load-theory-how-to-optimize-learning/