Understanding cognitive load: How mental effort impacts learning and performance.

Yoshinori Ozaki*

Department of Neurophysiology, Institute of Biological Research, Uruguay

Introduction

Cognitive load refers to the mental effort required to process and understand information. It plays a crucial role in how well we learn new material, solve problems, and perform tasks. The concept, first introduced by John Sweller in the 1980s through Cognitive Load Theory (CLT), has become a foundational idea in educational psychology. By understanding cognitive load, educators, instructional designers, and even individuals can optimize learning environments, improve performance, and prevent cognitive overload. This article explores what cognitive load is, how it affects learning, and practical strategies to manage it [1].

Cognitive load significantly influences how effectively we learn. When cognitive load exceeds the brain's capacity to process information, learning can become inefficient or even detrimental. This is because our working memory has limited capacity. If too much information is presented at once or the material is too complex, learners may experience cognitive overload, resulting in reduced attention, frustration, and poor retention [2].

For instance, if students are asked to solve a complex math problem while simultaneously trying to understand a lengthy set of instructions or navigate a poorly designed interface, they may struggle to manage all the elements involved. This overwhelming mental effort can lead to disengagement and frustration, making the learning experience ineffective [3].

Conversely, managing cognitive load effectively can optimize learning. By aligning the complexity of tasks with the learner's skill level and presenting information in a clear, organized manner, educators and instructional designers can reduce unnecessary cognitive effort, allowing learners to focus on mastering new material [4].

Working memory, the brain's temporary storage system for information that we are currently processing, plays a crucial role in cognitive load. It has a limited capacity—usually around 7±2 pieces of information at once. When too much information is presented simultaneously or when information is too complex, working memory becomes overloaded [5].

For example, when learning a new language, trying to memorize both vocabulary and grammar rules at the same time can overwhelm working memory, leading to poor retention. By focusing on one aspect at a time (e.g., first learning vocabulary, then grammar), we can more effectively manage cognitive load and improve retention [6].

This is where techniques like chunking—grouping related pieces of information into larger, more manageable units—become helpful. In the language-learning example, grouping words into categories (e.g., food items, transportation) can reduce the cognitive load, making the information easier to remember and retrieve [7].

In the context of performance, cognitive load can significantly impact how well we perform tasks, particularly those that require problem-solving or decision-making. Tasks that are too mentally demanding can lead to fatigue, errors, and lower performance. This is particularly relevant in high-pressure environments like surgery, air traffic control, or even sports, where the consequences of poor decision-making are high [8].

Take sports as an example. An athlete who is mentally overloaded may struggle to execute complex plays, make quick decisions, or respond to opponents effectively. On the other hand, when cognitive load is appropriately managed, athletes can stay focused, think strategically, and perform at their best [9].

Similarly, in professional settings, employees who are burdened with extraneous cognitive load—such as an overwhelming amount of irrelevant information or unnecessary tasks—may experience decreased productivity and performance. Reducing cognitive load in work environments can help individuals focus on key tasks and improve outcomes [10].

Conclusion

Understanding cognitive load is essential for optimizing learning and performance. By recognizing the different types of cognitive load—intrinsic, extraneous, and germane—and how they interact, we can create environments that promote efficient learning and reduce unnecessary mental strain. Whether in the classroom, the workplace, or daily life, managing cognitive load helps individuals focus on what matters most, improving their ability to absorb information, perform tasks, and reach their full potential. As research continues to advance, the concept of cognitive load will undoubtedly remain central to designing more effective educational and performance-enhancing strategies.

***Correspondence to:** Yoshinori Ozaki, Department of Neurophysiology, Institute of Biological Research, Uruguay, E mail: y.ozaki@fcien.edu.uy

***Received:** 1-Apr-2025, Manuscript No. aacnj-25-163734; **Editor assigned:** 3-Apr-2025, PreQC No. aacnj-25-163734 (PQ); **Reviewed:** 15-Apr-2025, QC No. aacnj-25-163734; **Revised**: 22-Apr-2025, Manuscript No. aacnj-25-163734 (R); **Published**: 31-Apr-2025, DOI:10.35841/aacnj-8.2.258.*

***Citation:** Ozaki Y. Understanding cognitive load: How mental effort impacts learning and performance. J Cogn Neurosci. 2025;8(2):258.*

References

1. Haji FA, Rojas D, Childs R, et al. Measuring cognitive load: Performance, mental effort and simulation task complexity. Med Educ. 2015;49(8):815-27.
2. Gieshoff AC, Heeb AH. Cognitive load and cognitive effort: Probing the psychological reality of a conceptual difference. Transl Cogn Behav. 2023;6(1):3-28.
3. Feldon DF, Callan G, Juth S, et al. Cognitive load as motivational cost. Educ Psychol Rev. 2019;31:319-37.
4. Kirschner PA. Cognitive load theory: Implications of cognitive load theory on the design of learning. Learn Instr. 2002;12(1):1-0.
5. David L, Biwer F, Baars M, et al. The relation between perceived mental effort, monitoring judgments, and learning outcomes: A meta-analysis. Educ Psychol Rev. 2024;36(3):66.
6. Grund A, Fries S, Nückles M, et al. When is learning "effortful"? Scrutinizing the concept of mental effort in cognitively oriented research from a motivational perspective. Educ Psychol Rev. 2024;36(1):11.
7. Schnotz W, Kürschner C. A reconsideration of cognitive load theory. Educ Psychol Rev. 2007;19:469-508.
8. Huang X. Example-based learning: Effects of different types of examples on student performance, cognitive load and self-efficacy in a statistical learning task. Interact Learn Environ. 2017;25(3):283-94.
9. Wang T, Lajoie SP. How does cognitive load interact with self-regulated learning? A dynamic and integrative model. Educ Psychol Rev. 2023;35(3):69.
10. Kuldas S, Satyen L, Ismail HN, et al. Greater cognitive effort for better learning: Tailoring an instructional design for learners with different levels of knowledge and motivation. Psychol Belg. 2014;54(4):350.

Citation: *Ozaki Y. Understanding cognitive load: How mental effort impacts learning and performance. J Cogn Neurosci. 2025;8(2):258.*