Unlocking Learning: A Review of Cognitive Load Theory

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Abstract:

The book titled 'Cognitive Load Theory' is one of the important literatures written by John Sweller, Paul Ayres and Slava Kalyuga, Professors of the School of Education, University of South Wales, NSW, Australia. This book is the Part of the book series: "Explorations in the Learning Sciences, Instructional Systems and Performance Technologies" (LSIS, volume 1). The series editors of the book are J. Michael Spector, University of Georgia, Athens, GA, USA and Susanne P. Lajoie, Mc Gill University, Montreal, Quebec, Canada. The book looks very convenient and the cover page is intriguing. The silky red colour with yellow lines give a good attracting impression for the curious readers of learning & teaching ecosystem. The preliminary information of the book are as follows as a reference for the readers:

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Introduction:

'Cognitive Load Theory' is all about the definitive declaration of innovative instructional process and distinctive cognitive architecture. The widely accepted and globally recognised Cognitive Load Theory (CLT) has been empirically supported by a large number of studies. This book includes the most thorough and all encompassing analysis of the research on cognitive load theory. Cognitive architecture is a presumption about the fixed structures that make sense in both natural and artificial cognitive systems working together. Cognitive architecture integrates several facets of human cognition to give a cohesive explanation of cognition. Architecture builds with knowledge and skills to yield comprehensive behavior towards different complex environment. The conceptual framework explains the fundamental mechanisms and structures of the human mind that underpin intelligent behaviour is known as cognitive architecture. It is a computer program that mimics human thought processes, including perception, learning, memory, attention, and decision-making. Cognitive load theory is a unique instructional design theory based on human brain processing and storing information. Therefore, it is very important for the teachers, educators, stakeholders and researchers to make an appropriate instructional system for betterment of learner's knowledge

acquisition in present time. This book has been designed for exploring new instructional technique and their related cognitive effects. This book has interrelated five parts and each part is divided into one or more chapters. It's a blueprint for understanding how we process information, perceive, think, learn, and make decisions. .

Critical Assessment of the Content:

The theme under the Part-I is “Preliminaries to Cognitive Load Theory”. This section has only one chapter, Categories of Knowledge: An Evolutionary Approach'. Writers focused on Biologically Primary and Secondary knowledge and associated instructional consequences. Biologically Primary Knowledge (BPK) is the recognition or differentiate of faces and speech. It also related to use of general problem-solving strategies. It refers to the information and skills that humans naturally possess that have evolved to be necessary for survival and environmental adaptability. These skills included folk physics, folk psychology, and folk biology, which were deemed "primary" due to their inherent nature, evolutionary adaptation, and cross-cultural universality. Originating in evolutionary psychology and cognitive science, this idea emphasised the significance of comprehending human learning and cognition within the framework of biology and evolution. Biologically Secondary Knowledge (BSK) requires instruction (such as Reading and Writing. Instructional design is mostly connected with secondary knowledge. BPK does not need any distinctive abilities of human cognition of intelligent behaviour. On the other hand, BSK needs effort and consciousness due to cultural reasons. It describes the kind of information that is culturally distinctive, obtained through formal education or explicit instruction, and expands on the fundamental knowledge of biology. Reading, writing, and math are examples of secondary biological knowledge that must be mastered by practice and explicit instruction. It frequently involves domain-specific tasks and calls for the use of core skills in new circumstances. Common cognitive skills including thinking, planning and decision making are applied as instructional consequences into BPK.

On the basis of evidences, researchers conclude that mean-end analysis is suitable for novice learners and domain-specific strategy is applicable for expert learners. Instructional procedure of BSK may effective when withholding information from learners is more used in constructive and discovery learning than the use of explicit instruction. Relevant concepts and procedures to construct secondary knowledge should be more important than merely knowledge acquisition.

Part-II addresses the theme of "Human Cognitive Architecture". This section has three chapters - Chapter 2, "Amassing Information: The information store principle", Chapter 3, "Acquiring Information: The Borrowing and Recognizing principle and the Randomness as Genesis principle" and Chapter 4, "Interacting with the external environment: The narrow limits of change principle and the environmental organizing and linking principle". Under these section writers have discussed both working and long term memory as a component of human cognition and use of five basic principles of information processing for secondary information. Two essential parts of the human memory system are working memory and long-term memory. Working memory, also referred to as Short-term memory briefly stores and manipulates information for cognitive functions like learning, problem-solving, and decision-making. In contrast, Large volumes of information are stored in long-term memory over a long time span, frequently years or a lifetime (Atkinson & Shiffrin, 1968). Consolidation is the process by which information moves from working memory to long-term memory and includes significant processing, rehearsal, and repetition. Principles of Borrowing and Reorganising are the primary notion to cognitive load theory. The capacity of working memory (time or duration limit) depends on novel or familiar information but long-term memory enables to store both biologically primary and secondary knowledge. Instruction leads to positive change in long term memory is called Learning.

The theme “Categories of Cognitive Load” under Part-III has two chapters: Chapter 5, “Intrinsic and Extraneous Cognitive Load” and Chapter 6, “Measuring Cognitive Load”. Instructional process of information associates with working memory. Load of working memory has two broad category mentioned above. Intrinsic cognitive load is related to ‘Germane resources’ and Extraneous Cognitive load is solely connected with the information of working memory resources which is imposed by instructional design. Intrinsic cognitive load, a core notion in Cognitive Load Theory (CLT), alludes to the intrinsic challenges of a learning task owing to its complexity and constituent involvement. Although CLT has influenced instructional design, some scholars contend that the idea of intrinsic load overgeneralises the intricate relationships that exist between prior knowledge, task difficulty, and learner characteristics. Cognitive loads are measured by several techniques which is based on the result of problem solving and learning experiment. Subjective scale of mental effort is the most effective, useful and unobtrusive technique of cognitive load measurement. But researchers have doubt about the use of alternative psychometric techniques as they are less successful to categorize cognitive load constructs for the learning of beginners. The book has highlighted the need for a more nuanced understanding of intrinsic load, particularly in relation to individual differences in learner expertise and topic interest. Furthermore, the measurement of intrinsic load remains a challenge, with ongoing debates about the most effective methods for assessing cognitive load.

Part-IV deals with the theme “Cognitive Load Effects”. This section has eleven chapters : Chapter 7, 'The Goal free Effect', Chapter 8, “The worked Example and Problem Completion Effects”, Chapter 9, “The Split Attention Effect”, Chapter 10, “The Modality Effect”, Chapter 11, “The Redundancy Effect”, Chapter 12, “The Expertise Reversal Effect”, Chapter 13, “The Guidance Fading Effect”, Chapter 14, “Facilitating Effective Mental Processes: The Imagination and Self-Explanation Effect”, Chapter 15, “The Element Interactivity Effect”,

Chapter 16, "Altering Element Interactivity and Intrinsic Cognitive load", Chapter 17, "Emerging Themes in Cognitive Load Theory: The Transient Information and the Collective Working Memory Effects". Writers analyze the condition and application of different types of cognitive load effects and their appropriate instructional implications in various learning processes, with some empirical evidence. Every instructional process is based on principles of cognitive load theory. It flows from cognitive load effects to facilitate learning and problem solving. The load effects analyze through two phases of experiment - **i) Learning phase** (apply conventional and modern methods) and **ii) Testing phase** (measurement of different learning outcomes). The Goal free effect is highly significant in search-based problem-solving strategies to improve learning outcomes in mathematics and Science subjects. The work example effect which is most widely investigated and relates with borrowing and Re-organizing principle, reduces extraneous cognitive load. Split Attention Effect connected with instructional strategies of integrated materials. Learners enable to separate multiple sources of information (spatial or temporal) with the specific requirement of attention. This effect works as horizontal or vertical format to demonstrate diagrams (learning vocabulary, computer aided design and manufacturing). The "Modality effect" is accessible when two sources of information are indiscernible in isolation. Instructional implications of this effect benefit for presenting information in audio-visual dual mode. Learners perform better and retain information better when provided in a mixed format that combines visual and aural aspects, as opposed to a single format. This phenomenon is known as the modality effect. This effect occurs as a dual-channel processing of visual and auditory information in multimedia learning which reduces cognitive overload and enhances working memory capacity. Multimedia presentations that combine visual and aural elements can enhance learning outcomes, boost retention, and facilitate knowledge transfer. The modality effect can be used by instructional designers to produce more efficient learning resources that accommodate various learning preferences and styles. "Redundancy effects" require independently understandable information sources that do not

require concurrently processing or logical integration. It helps learners to coordinate the simultaneous information (written or spoken form). When the same information is presented in different formats or channels, it might have the redundancy effect, which is when learning performance declines instead of increases. Cognitive Load Theory states that this impact occurs because redundant information might result in needless cognitive load, which confuses students and impairs their capacity to efficiently process pertinent information. Eliminating unnecessary information can enhance learning results by lowering cognitive load and enabling students to concentrate on key content. Instructional designers should be mindful of the redundancy effect and work to deliver information in a clear, non-redundant way to maximize the learning. Additional information is beneficial for novices but same information is excessive for the experts in "Expertise Reversal effect". "The Fading effect" is worked based on the premise of a decline or incline in guidance and expertise for problem solving strategies of learners. It needs dynamic instruction methods with the changing level of learner's expertise during learning session which helps to increase the capacity of working memory to deal with growing demands. Imagination effect and Self-Explanation effects are both related to each other. It involves with an imagination which helps learners to acquire adequate knowledge and skills in specific cognitive domain. These effects are mostly potent to computer based learning environment. The impact of Imagination effect is more beneficial for experienced learners than for novices. The Element Interactivity effects relate with the decrease of unnecessary cognitive load. Researchers have used altering component engagement to optimize intrinsic cognitive load of learners. The Transient Information effect occurs when learners require to retain preliminary information to combine with impending information. It is more effective in speech and animation field.

Lastly, Part-V "Conclusions" has one chapter, Chapter 18, "Cognitive Load Theory in Perspective". It describes overall concepts and content of all the parts & chapters thoroughly.

It showcases overall standpoint of the theory which is differ from other ostensible instructional procedures.

Conclusion:

Overall, this book explains various aspects of uniqueness about cognitive load theory and its related components. Different cognitive load effects and instructional implications have been tested and analyzed hypothesis under the randomized control experimentation. The overall presentation of the content is so much relevant in present time. The linguistic level is appropriate for the educators, instructional designers, researchers, curriculum developers and enthusiastic readers of Psychology and other educational fields. The content is written in easy language with simplified explanations and implications. But footnote is almost absent in the book. Each content of all the chapters is presented step by step, from simple to difficult level (Inductive approach). Structural flexibility is present in the book. Diagrams and graphs are used properly in appropriate places as per requirement of the content. Correct words are used throughout the book. At the end of the book a glossary is also present. Content related terminologies are used in correct place. This book would be fruitful for the research area of Educational Psychology, as well as for those who would like to implement the concept into classroom environment to know the instructional effectiveness in a new way.