COMMENTARY

LEARNING BASED ON PRINCIPLES OF COGNITIVISM

Muhammad Junaid Khan, Brekhna Jamil, Ahsan Sethi
Institute of Health Professions Education and Research, Khyber Medical University Peshawar-Pakistan

Sometimes, knowledge or information becomes difficult to understand and/or memorize. Cognitive load theory aids a learner to gain information effectively. It provides a scientific roadmap to the design of learning materials. Through a complex set of mental processes, information is acquiring, process, retain, and comprehend information. Applying mental effort for remembering is a very crucial phenomenon. The core of memory process is apprehending and saving of information into long term memory. Because of limited capacity of working memory, delivering or acquiring of information should not be overloaded with irrelevant materials. Based on cognitive load theory dozens of strategies can be intervened at different loci of cognitive process and every piece of information is easily remembered. Not only learners, but teachers can also get benefits from them. In this commentary, John Sweller ideology is further discussed and strategies are presented for better comprehension and memorization of difficult information.
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Cognitive load theory (CLT), presented by John Sweller, delineate how human brain acquires, process, retain, and comprehend information.[1] The inherent ability of brain to consciously process sensory input and communicate with Long term memory (LTM) is bridged by working memory (WM). This WM is limited and holds input for 7±2 seconds at a time. It processes the novel surge of information from sensory registers and helps in understanding.[2] Such understanding is obstructed when a complex and overloaded source of information is bombarded on WM. This phenomenon is called Cognitive Loads (CLs), which are mainly three types, intrinsic cognitive load (ICL), extraneous cognitive load (ECL) and Germane load (GL).[3] Therefore, CLT explains how a learner can improve the learning process by manipulating CLs and can successfully convert information into LTM.[4] By applying CLT principles, some strategies are derived to enhance the learning and memorization.

Starting a teaching session with accessing learners' previous knowledge, from simple to complex and initially added/explained with examples would be best for novice.[5–8] Using verbal and visual modalities (dual-coding theory)[9] and emphasizing upon deemed important contents (signalling principle), presenting the same concept with a single aid and one at a time (redundancy principle)[7] would have drawn more attention. Proper graphics illustration, i.e., words besides the visual aid (spatial contiguity)[10] and removing irrelevant images, layouts and environmental distractions (coherence principle), these all reduce the ECL and relive the working memory for interpretation[7]. Adding mind map, figures or charts would help in schema formation. The cognitive stress, however, focuses attention, yet it narrows working memory and hindered conversion of short-term memory into long term.[11] A well-planned session which helps students to process as well as focus on relevant contents and form schema maximizes the GL.

Memory is a complex process of human brain which takes in, process, store and retrieve information for future use. In other words, the reuse of past experiences to modify the behaviour or bring changes to a current situation is called memory. It is one's ability to acquire (encode), maintain (store) and recall (retrieve) information. Whereas, memorization is a process of learning by which one understands a concept, remember it permanently and is always able to recall when needed.[12]

In figure-1, (A) shows input (visual, acoustic, elaborative and/or semantic) information which is processed into STM or WM and then either encoded into LTM (E) or deleted (F). For reasonable but limited memorization, alertness, chunking and maintenance rehearsal e.g. rote is necessary (B).[13] However, for successful long-term retention of information, elaborative rehearsal, schema formation and techniques like guided questioning are very important (C).[14] Six cognitive domains (C1-C6) are accessed by questioning and higher thinking levels are stimulated which store information into permanent memory. Superficial thinking without paying much attention to the meaning of information (shallow processing) is temporarily stored whereas deep thinking with sufficient attention to comprehend the meaning of information (deep processing) helps in long term retention.[15] Information in LTM is stored in the form of cues-the building blocks of cognition. These cues are decoded for interpretation or decision making. The recognition tasks, recall methods and re-learning retrieve stored knowledge/cues (D).[16] Unlikely, idle cues disintegrate with passage of time. Therefore, based on forgetting curve, relearning at specific interval (F), and practicing various concepts of retrieval keep the cues intact and maintain the long-term memory.[17]

Moreover, below are some memory processing strategies for long reading material which is difficult to remember and require deeper understanding. Anyone can memorize or convert STM into LTM by using these:

Miller's principle of chunking: Breaking contents into pieces, enhances STM capacity and reduces CLs.[13]

Atkinson and Shiffrin Principle: Repeating contents in audio form.[18]

Recalling previous knowledge: At the completion of a topic, summarizing the whole content or preparing for assessment encourages learners to recall previous contents and able them to apply it in practical life.[19]

Interference theory: Emphasizing upon most important contents at beginning (primacy effect) and reviewing the session at the end (recency effect).[20]

Serial position effect: Either at the beginning or ending of teaching, drawing attention towards a difficult topic and emphasizing for understanding the concept.[21]

Reading Aloud: Forrin *et al.* suggested that during self-reading (or teaching other), reading out loud improves retention of information.[22]

Structuring and organizing contents: Based on the concept of "organized information (clusters) in memory centre", structuring or organizing information, making outliers etc. help in memorization.[23]

Zone of proximal development: Seeking assistance from expert until and unless one becomes an expert of task.[24]

Gestalt's principle: Based on Gestalt's principles of similarity, and proximity, visual working memory can be improved and used for encoding of information into long term memory.[25,26]

Word length effect: Short words are easier to remember than long (Baddeley's model of working memory).[27,28]

Sound Sleep: Katkov M *et al.* found a relation of consolidation with sufficient random-eye-movement sleep. So, study preceded by good and sound sleep is always awarding.[29]

RIP toolbox for memory: Using the strategies of repetition, imaginary and patterns, helps in retaining more information.[30]

Spacing effect: Instead of cramming, chunking the contents of a subject and learning them over a few days/weeks (micro/macro spacing) is effective and helpful in prolong learning[31].

Meta-memory: Accurate monitoring of one's own study (memory monitor) and outlining intellectual strategies for best decision (control) gives a promising improvement in study habits.[31]

Repeating differently: When the same content is repeated over different foci of time with different mode of delivery, this aids in converting information from STM to LTM.[31]

Limiting phonological similarity effect: This can enhance the learner's attention and prevent from getting confused. E.g. replacing words like "can, man, hen" with "can, person, chicken" etc.[32]

Rehearsal strategies (Mnemonic Devices): Rote or reading repeatedly (low-level rehearsal) or using concept map, charts, diagrams (high-level rehearsal).[14]

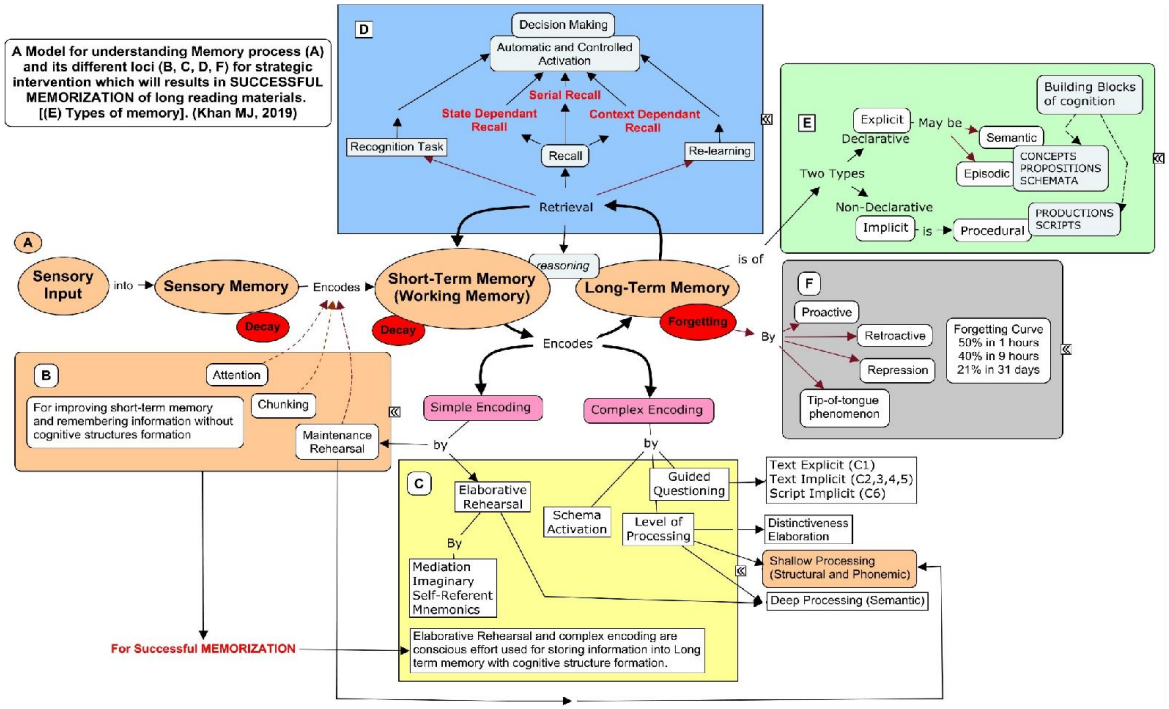

Figure-1: Khan MJ's Model of Understanding Memory Process and identifying loci of interest for memorizing long term reading material.

CONCLUSION

In a nutshell, while learning a topic, instead of overloaded and random reading from multiple sources, spending enough time for rehearsing the information, minimizing unattended speech effect and background noises, gaining information in both, visual and verbal format, visualizing the contents and making mind map of own, other strategies like, semantic or concept map, figures, pedigree and charts all these are proven to help in memorizing difficult concepts and prepare a learner for examination purpose.

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Address for Correspondence:

Dr. Muhammad Junaid Khan, Department of Community Medicine, Ayub Medical College, Abbottabad-Pakistan
Cell: +92 344 456 6444
Email: junaidkhan@ayubmed.edu.pk