Archives of Surgical Research | Invited Comment

Managing Cognitive Retention of Surgical Graduate with Improved Techniques: Lessons from Cognitive Psychology

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IMPORTANCE As the base of scientific knowledge expands, it is becoming harder for the today's medical student to have a lasting grip on it. It is timely and very much the need of hour to incorporate modern learning techniques in our lessons and educate medical students about them so that they can remember most of material, manage the cognitive load more effectively and enhance their germane loads to compete the pace of ever-increasing body of medical knowledge. It remains imperative to understand the process of information processing and cognition, the problems associated with it before embarking on identifying and suggesting the strategies to overcome associated issues. This article would focus on first, the process of information processing and memorizing and in the later half would focus on identifying associated problems and the strategies in light of modern theories and recommendations to rectify them.

KEYWORDS Cognitive retention; Techniques; Surgical education

HOW TO CITE Arif S, Asad T. Managing Cognitive Retention of Surgical Graduate with Improved Techniques: Lessons from Cognitive Psychology. *Archives of Surgical Research*. 2020;1(3):35-38. https://doi.org/10.48111/2020.03.08

Invited Comment

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https://doi.org/10.48111/2020.03.08

Many of the students find it difficult to learn and retain long and lengthy material to secure good grades in exam [1]. Though we need to work on many areas to improve educational outcomes such as student counseling, remedial classes, teacher training to use advanced techniques and minimizing the number of students to facilitate individual attention; however, this article specifically pertains to understanding the reasons for lower cognitive retention and strategies to deal with them. Fortunately, there are thoroughly investigated strategies that have been developed by cognitive and educational psychologists that are helpful for student dealing with lengthy learning materials [2,3]. These techniques are easy to use and generalizable to great set of students. In this assignment we will first analyze the problem of the index student, then would define the reasons for his lower cognitive retention and then learn techniques to handle cognitive load and cognitive retention.

STATEMENT OF PROBLEM

A final year student in your medical college has complained that it is difficult for him to remember what he studies. He has asked for advice from you so that he can grasp long reading material and learn it to pass the exam. Suggest strategies on the basis of the principles and approaches of cognitive psychology, how he can remember most of information.

ANALYSIS OF THE PROBLEM

The problem of low cognitive retention and forgetfulness faced by the student can be at either at the end of the teacher or the student himself. For example the poor teaching techniques used by the teacher would certainly reflect on the students in form of lower achievement of the educational goals[3]. Interference, retroactive inhibition, proactive facilitation, differential resistance to interference and lack of enactment and automaticity are the most important factors which a teacher has to control to impart lesson effectively with better cognitive retention[3]. The details regarding these factors can be found elsewhere[3]. Apart from role of the teachers and quality of lessons, learning environment, emotional stability of the student, low self-esteem and level of motivation play significant role in cognitive retention.

On the student side there can be many problems but the most common problem that students often face is to manage the cognitive retention effectively. There are many techniques that are quite popular among the students for remembering the lengthy materials but they are not effective enough and hence the students eventually suffer[4].

As a medical educationist it is our primary responsibility to teach our students these techniques for better handling of the long reading materials. Dunlosky et al have extensively worked on defining roles of these strategies[4]. Table 1 here gives a list of few commonly used techniques:

Technique	Description
1. Elaborative interrogation	Generating an explanation for why an explicitly stated fact or concept is true
2. Self-explanation	Explaining how new information is related to known information, or explaining steps taken during problem solving
3. Summarization	Writing summaries (of various lengths) of to-be-learned texts
4. Highlighting/underlining	Marking potentially important portions of to-be-learned materials while reading
5. Keyword mnemonic	Using keywords and mental imagery to associate verbal materials
6. Imagery for text	Attempting to form mental images of text materials while reading or listening
7. Rereading	Restudying text material again after an initial reading
8. Practice testing	Self-testing or taking practice tests over to-be-learned material
9. Distributed practice	Implementing a schedule of practice that spreads out study activities over time
10. Interleaved practice	Implementing a schedule of practice that mixes different kinds of problems, or a schedule of study that mixes different kinds of material, within a single study session

Table 1: Learning Techniques (Courtesy: John Dunlosky 2013)

The traditional techniques such as highlighting, re-reading and summarization have been frequently used in past by the students with some benefit. However, newer techniques have emerged recently which are far more effective and can enhance cognitive retention massively. Here at this juncture it has become to understand these new techniques for better cognitive retention and to teach to our students for optimal educational outcomes.

Modern Learning Techniques:

The selection of appropriate technique for learning by the student is of utmost importance. Dunlosky et al have extensively worked to map the beneficial role of various learning techniques and have divided the techniques into high, moderate and low utility technique[4]. The most commonly used techniques by the students include re-reading, highlighting, note taking, summarization, writing to learn etc have all been interestingly estimated to be low utility techniques. Others popular newer techniques such as concept mapping, PQ4R method, keyword mnemonics, imagery and elaborative interrogation have been found to be moderately effective. In stark contrast, practice testing, distributed and interleaved practice have been found to be highly effective techniques with exceptional overall educational outcomes in terms of cognitive retention and reproduction.

Here we evaluate the differential usefulness of the techniques and we stress for the student to adopt the technique according to the type of educational content and goals. Appropriate selection and right use of these techniques would produce quite effective results.

1. **Practice Testing:** Practice testing enhances learning and retention [5]. Even Edward Thondike (1906) found that active recall of a fact from within is as a rule better than its impression from without [6]. The technique has brought generalizability. It enhances retention by triggering elaborative retrieval processes. The practice testing increases the likelihood that the related information is activated and encoded along with the target during learning process.
2. **Distributed Practice:** This popular cramming strategy is very effective that is helpful in learning overtime either in one session or across sessions [7]. Distributed practice offers beneficial long-term retention of the information being processed by the student. The term distributed practice encompasses both spacing effect (advantage of spaced over massed practice) and lag effect (advantage of spacing with longer lags, over spacing with shorter lags)[4]. Researchers have shown that technique has high utility and very effective in educational setting.
3. **Interleaved Practice:** This technique facilitates organizational processing and specific processing by comparing different kind of problems. For example, it gives the students opportunity to identify which solution method can be used for a given problem. It helps to discriminate between different kinds of problems so that the students can select and use specific method or strategy to solve each of them one by one (Dunlosky, Rawson, et al., 2013).

4. **Elaborative Interrogation:** Elaborative interrogation and explanatory questioning can be harnessed to promote learning. The students learn the material and complex concepts by asking questions and answering them [8]. In their earliest systematic studies of elaborative interrogation found that this technique enhances learning by supporting the integration of new information with the existing prior knowledge. Learners activate their schemata to organize new information that facilitates retrieval [9].
5. **Group Study:** This technique can be quite effective for better retention. Small groups running of the basis of PBL, CBL, communities of practice are good examples of group study where interaction plays an important role in improving cognitive retention.
6. **Self-Explanation:** It is effective in learning content material within task as well as across several task domains. As this technique requires little or no training so it can be easily practiced by the students. But they need teacher assistance to explain the task or give brief introduction to the learning material [10]. The quality of explaining the material affects directly on the learning outcome. It has broad applicability. For example, the students perform better when they were provided minimal explanation about problem solving than who were not.
7. **PQ4R Method:** This is the most popular strategy in which student preview, question, read, reflect, recite and review the information. The teacher during the lecture stops at various points and asks students to reflect their understanding of the concept, can ask short questions in order to engage the students in active learning instead of passive listening (Slavin, 2017).
8. **Outlining and Concept Mapping:** This is comparatively new strategy but can be very effective to learn large amount of information. Outlining is to identify the main points in hierarchical format [11]. In this way the long topic can be organized in few important points that would be easy to learn. Concept mapping is to identify the main ideas and diagram the connections between them [12]. Although the research is limited in this area but the technique can be very useful to learn lengthy materials.
9. **Summarization:** When students are required to learning huge amount of information, summarization can be very helpful learning strategy [13]. The teacher can ask the students to summarize the 40 minutes lecture in 10 minutes. This technique would improve the student ability identify the main ideas if the lengthy lecture and sum up it in few points. It is important to keep this in mind that summaries can be of single word, sentences, paragraphs are written or spoken whatever works for the students. The teacher can facilitate the technique by guiding students, how to write better summaries by emphasizing the main points [12].
10. **Imagery:** Imagery is to form mental images to remember. Researches show that it boosts comprehension and effect positively on learning abilities [14]. Imagery can be very helpful in memorizing complex scientific content. Visualizing and making mental images can enhance mental organization or integration of information in the text. However, this technique is limited to use where the content is imagery friendly.
11. **Keyword Mnemonics:** the use of mnemonics can enhance learning and comprehension for a wide variety of material and students with various abilities [15]. For example student in a literature class can grasp the motives of the main character by visualizing the whole scene in mind's eye [12]. Evaluation of class room application of mnemonics show mixed results and there are questions about long term retention of the material learned through techniques.
12. **Highlighting an Underlining:** This technique is frequently used by the students when they are going through text books and reading materials[2]. It is frequently used because it is easy to practice. This technique relies on cognitive phenomenon, isolation effect in which semantically or phonologically unique item or phrase is much better remembered than its less distinctive counterparts. Research shows that students are more likely to remember highlighted text [12].
13. **Note Taking:** Note taking is another commonly used technique. The students paraphrase the information focusing the main ideas. When the students dealing with lengthy materials, the teacher can provide them with some partial notes to direct student's note taking and avoiding unnecessary details.
14. **Writing to Learn:** This is a useful strategy in which the students read the material and then write it. It involves high level of information processing as the student thinks about the material and then paraphrases it. The student writes about the cardiac cycle and better retains it.

15. **Rereading:** students use this technique frequently than the other techniques as it is self-regulated and requires no assistance, so it is very popular among students. Dunlosky in 2012 conducted a survey where university students average SAT scores above 1400. The students reported that 84% of them used re-reading in their list of learning strategies [12].

COMMENT:

Learning strategies discussed in this assignment are not the only things that would facilitate learning and clearly motivation plays a central role in this process. The students need to differentially evaluate the learning material and

adopt the appropriate learning technique for prolonged and reusable retention. The students should rely on the high utility techniques instead of the low utility old but more popular techniques for better outcomes. Differential use of these learning techniques can be quite helpful for varying tasks; even blending of the techniques may work for certain tasks. The teacher has immense responsibility to ensure that students can differentially understand the utility of various techniques and their application in a comprehensive way.

ARTICLE INFORMATION Accepted for Publication: September 20, 2020. Published Online: September 30, 2020.
https://doi.org/10.48111/2020.03.08

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INTEREST DISCLOSURES: Author disclosed have no financial or personal relationships with individuals or organizations that could inappropriately influence (bias) their work.
Financial Support and Sponsorship: Nil.

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