Using Cognitive Loads for Practical uses to Adjust the Task Arrangement in High School Students

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ABSTRACT
The focus of this review is on how cognitive load theory can be applied to manage teachers' teaching programs and learners' learning programs. The purpose of this paper is to provide some assistance to confused teachers and learners by using the aforementioned knowledge from social psychology. The method used in the development of the lesson plan is known as "instructional design". Through the use of avoiding visual clutter, building on existing mental models, and offloading tasks, this approach can be of much help to teachers. In the self-study section, this paper refers to a cognitive approach called 'multitasking', which focuses on creating a relatively low cognitive load environment and ensuring that one's attention and learning efficiency only tends to increase. In this case, productivity can be greatly increased. This paper is of great importance in the study of particular approaches to time management. The use of cognitive load theory in the field of education will be a key point to focus on in future research.

Keywords: *cognitive load, study efficiency, task arrangement, multitask.*

1. INTRODUCTION

1.1. Broad introduction to thesis topic

The cognitive load theory holds a crucial status in behavior science and cognitive psychology, as it is related closely to the daily life of individuals. The cognitive theory is a relatively novel conception, which was brought up by John Sweller in 1988 initially.

1.2. The current review

It refers to the used amount of working memory resources, which brings negative effects to the concentration and task completion of individuals under a heavy cognitive load circumstance. After this theory was raised, numerous psychologists keep studying and further refined and modified the content of this notion. First, about proving the existence of cognitive load. Scientists created a method that measures combining psychological load and task performance, and allow one to obtain information about the relative efficiency of teaching conditions [1]. Due to this method, the scientists could prove the level of "mental effort", which is what people called "cognitive load", actually does exist, and it appears differently in different circumstances on the same individual. Also, the exact adverse effects caused by heavy cognitive load have been studied. According to scientists, the heavy cognitive load may cause individuals to hold stereotyped opinions, even if they seem quite objective.

1.3. Research questions

The fact is, the majority of scientists keep focusing on the precision of the cognitive load theory, and then some factors that may cause effects the level of cognitive load of individuals. Although some researchers did mention the cognitive load theory could be used in selective attention, those predictions and theories seem somehow abstract. Students who suffered from distractions that cannot be immuned during study time will definitely appreciate some specific methods that may keep their concentration. Those methods, such as test arrangement, can help them to manage their work and time. The thing is, the initial purpose that made Sweller study and put forward this theory is intended of inventing a new instructional design, which is able to decrease the cognitive load that appears in an individual to a great extent. Now there is the question: could the cognitive load theory be used in self-study and the education system? In other words, how to use the cognitive theory to make an efficient study plan?

2. DEFINITION AND DIAGNOSIS

2.1. Definition of cognitive load

Cognitive load theory (CLT) is a task-based theory of cognitive structure and the individual learner. CLT focuses on complicated cognitive tasks learned by people in which the learner is usually overwhelmed because of a huge number of interacting information elements that take simultaneous processing to start meaningful learning. CLT describes the process of addressing as including three significant components: working memory, sensory memory, and long-term memory [2]. Since then, plentiful researchers have increased their understanding of the concept of CLT, while the basic model has kept the same. Often, people are bombarded with sensory information, and sensory memory processes most of the data, but the most critical parts leave an impression long enough to be passed on to working memory. These are the basic ways in which cognitive load operates. Load is considered "intrinsic" to a task, determined by the number of information elements in the task and their interactions. The more elements a task contains, the higher its intrinsic cognitive load and the more interaction between them." Irrelevant" or "relevant" cognitive load is generated by the way in which information is presented to the learner and the load generated by the learning activities required by the learner. Contextual load is driven by the information and facilitated activities of the learning process; the extrinsic load is caused by information and activities that do not directly influence and contribute to learning. When learning occured the overall load must not exceed the learner's appropriate working memory resources. Intrinsic, extrinsic, and related cognitive loads are therefore seen as adding up as a whole.

More efficient task allocation may release the capacity to increase the relevant load by reducing the extra load: if learning is improved by reducing the task allocation of the external cognitive load, this improvement may be due to the fact that the extra working memory (WM) capacity released by reducing the external cognitive load is allocated to the relevant cognitive load. At the same time, the acquired new cognitive schema leads to a reduction in intrinsic load. The reduced intrinsic load frees up the capacity to process information by reducing the overall cognitive load. These increased cognitive schema abilities give the learner the ability to use the newly learned material, i.e., the newly acquired cognitive schema, to acquire a higher level of learning schema. Thus, a new cycle begins that allows people to acquire very advanced skills as well as knowledge in many processes.

In past research, scientists have found that cognitive load can be associated with different variables in different modalities. For example, cognitive load has an effect on distinguishing female faces (as shown in experiments with male candidates, descriptions and the adjective 'female'), cognitive load sometimes influences the learning principles that are prescribed in the learning process, cognitive load has an effect on the food people choose, and cognitive load influences children's judgments on specific issues that is a crucial role in the study of human psychology.

2.2. Cognitive Load Theories & Previous studies

Associated with learning achievement, expert research has identified several principles of how to manage the cognitive load during teaching and learning, such as the attention splitting effect, the working example effect, and the teaching fading effect. These features interact with each other, and the operation of one of these aspects has an impact on the whole system, which should always be considered as a system by the instructional designer. Research on CLT has shown that it is possible to overcome each individual's working memory limitations through collaboration [3]. A homogeneous and similar group of learners working together can be thought of as a system of individual information processing with many limited collections of working memory. This can help create a broader and more effective collective workspace [4]. The collective working memory effect thus created reflects the finding that when learners collaborate, they can benefit from the WM abilities of others in the learning process. The findings of these studies have implications for learning that relies on multimedia technology and for the design of instruction for teachers in general, for example, the principle of presenting information in an integrated form is known in CTML as temporal and spatial adjacency [5]. The use of AR-based technologies within the 4C/ID framework has also been used to provide just-in-time information and to segment learning sessions [6]. Cognitive load has an impact on working memory: a series of experiments [7] have demonstrated that cognitive control processes, and working memory, all involve the coordination of dual tasks, with the efficiency of distractor rejection playing an important role in selective visual attention tasks. There is now a lot of evidence that similar areas of the dorsolateral prefrontal cortex are activated for both task coordination and active maintenance of working memory [8]. Cognitive capacities of task coordination management and working memory are apparently included in the online management of current priority task performance. Physiological associations that determine the extent to which observers are distracted by irrelevant stimuli are related to cognitive management of dual-task coordination and working memory. Thus, loading either of these two functions leads to distraction from irrelevant, low-priority stimuli. In selective attention tasks involving irrelevant but potentially competing distractors, the key to successful performance lies in the cognitive control available to ensure that task manifestation is aligned with actual preference.

3. TO THE TEACHERS/STUDY ASSISTANTS

3.1. Use cognitive load theory to make teaching programs

Instructional design (instructional systems design, SD or ISD) refers to the practice to design, develop and deliver digital and physical teaching materials and experiences [9]. Cognitive load theory provides a framework with implications for instructional design that allows designers to control the learning conditions in the environment in most instructional materials. Moreover, it provides evidence-based guidelines to help instructional designers reduce the learning process's external cognitive load, thereby refocusing learners' attention on the relevant material. The theory divides cognitive load into three categories: extrinsic cognitive load, intrinsic cognitive load, and associative cognitive load.

Intrinsic cognitive load is related to the difficulty associated with a particular instructional topic. Chandler and his colleague Sweller stated that different instructions have different inherent difficulties in 1991. For example, the inherent difficulty of solving 1+1 is different compared to solving the matrix, and this inherent difficulty cannot be modified by the instructor. However, while the difficulty of the task cannot be amended, practices such as sequencing and chunking can help to reduce the cognitive load. Sequencing refers to reducing the intrinsic load by presenting parts of a concept in sequence [10]. Chunking refers to reducing the intrinsic cognitive load by break contents into smaller pieces. Meaningful contents should be kept when breaking the concept into units. In addition, this could help to reduce the Germane cognitive load as well.

Extraneous cognitive load is under the control of the instructional designer. The instructors present the information to learners with the design of the materials to help learners to learn. For example, learners are able to understand the concept of sphere by looking at the ball showed by the instructor instead of descriptions. Yeung and his colleagues [11] suggested that it is important to reduce distractions to reduce extraneous cognitive load. For example, students in the computer science lesson may be easily distracted to Facebook web pages. Schools and teachers can limit the accessible web pages to avoid this kind of split attention.

Germane load refers to the processing, and construction of schema. A schema organizes a variety of information and the relationships between them and it is usually used to describe a pattern of thought or behavior. For example, a student would be more efficient to understand a concept if he can devote more memory. However, de Jong [12] suggested that the germane load requires needs careful implementation strategies as a different group of learners would experience opposing effects.

Moreover, these theories can be applied to minimize the cognitive load by applying three common strategies, including avoiding visual clutter, building on existing mental models, and offloading tasks. Avoiding visual clutter can be done by avoiding unnecessary actions for users and students to reduce irrelevant distractions. Building on existing mental models refers to helping users and students to understand the contexts based on their past experiences. Finally, offload tasks suggests that complex designs can be avoided as they may add to the cognitive burden, it is easy for students and users to understand by delivering the contexts straight forward.

3.2. The problems

Despite applying cognitive load theory in instructional design, the past study has shown that performing two tasks at once can result in lower performance. According to the dual-task study conducted by Strayer and Johnston [13], participants were disrupted when using phones when driving because phones can divert attention to other cognitive contexts. The distraction of high cognitive load is always an obstacle to study efficiency.

4. TO THE LEARNERS

4.1. Use cognitive load for self-study

As long as students can focus on one or more affairs to the maximum extent without exceeding their cognitive load, their task arrangement skill is undoubtedly excellent [14]. With the experiments mentioned above, individuals would turn to know that the cognitive load theory can be used in task arrangement. The research shows that experts who have quite abundant knowledge or experience with regard to a specific task could reduce the cognitive load associated with the task; nevertheless, novices who do not have those experience would thus fall into a higher cognitive load [15]. Age would often be decisive in the amount of experience one has in studying. According to research, although older people are more advanced in studying, young people could be trained to improve their working memory [16], and the cognitive load theory could completely explain it.

4.2. Further studies: multitask

This paper will also discuss using cognitive load to enhance individuals' ability to manage their work. According to the Cambridge dictionary, multitask learning (MLT), which was a relatively new learning style, means doing several meaningful jobs at the same time. Also, Multi-task learning is an inductive transfer method that makes full use of domain-specific information hidden in training signals of multiple related tasks. In the backward propagation process, multitasking learning allows the features specific to one task in the shared hidden layer to be used by other tasks. Multi-task learning will learn features that can be applied to several different tasks, which are not easy to learn in single-task learning networks [17].

First, to focus on the "ineffective multi-task learning". The research illustrates that the ineffective multi-task is constantly aggrandized nowadays. For example, researchers have observed the domiciliary study states of 263 high-school and university students. 15 minutes were randomly selected for sampling, and the result is, that their average complete focus time was not even more than 6 minutes [18]. This means that those students were kept checking their phones or other electronic devices, which can be a serious high cognitive load that causes this ineffective muti-task. In conclusion, even though multi-task learning can be helpful for improving one's study effectiveness, it would turn out to disturb one's focus under high cognitive load circumstances. Therefore, our group is realizing that if a relatively low cognitive load ambient could be created, which ensures that one's concentration and learning effectiveness is only on an increasing trend, the working efficiency maybe improves a lot.

In the previous studies, Marentakis and Brewster conducted a study on the pointing efficiency of indicating spatial audio display, and found that increasing cognitive load leads to a decrease in pointing efficiency. Based on these findings, researchers presented a comparative study of spatial audio techniques evaluated in a divided-and selective-attention task. To attend this research, music has been something included in the examination. Since classical peaceful music would add relatively less cognitive load to individuals, the researchers decided to use it and test participants' feelings and the "User-activated spatial minimization" [19]. As expected, participants did not like to be subjected to cognitive load. Study participants reported higher cognitive load and longer task times in the distracted group. At the same time, listening to concurrent audio increased the load effect, and in the selective attention group, the preference result was significantly reversed under interference and minimization conditions. These results show that most people avoid doing several things at once and avoid external distractions.

Cognitive load can be relatively low in specific circumstances, while it cannot ensure doing multi-task learning in those circumstances is a good choice. This is because the learner can hardly know if there was a latent distraction that cause an impact on his or her cognitive load, and therefore cannot ensure whether doing multi-task learning is effective in that circumstance [20].

5. CONCLUSIONS

This paper focuses on how cognitive load theory is able to be used to help manage learners' study plans. Content includes an explanation of the main relationships between cognitive load and task scheduling and particular uses such as teaching and self-study. This

The study is specific in nature as it not only develops a plan but also suggests issues that should be taken into account. The research significance of this text mainly lies in the extension of more practical methods based on cognitive load theory and can provide help to the majority of students and professors. In the design of the teaching program, we focus on the use of avoiding visual clutter and unloading tasks based on existing mental models. In addition, in order to help one to manage one's self-study better, the study turns out to consider the method of "multi-task", which differentiates the effectiveness of learning to a different extent. However, at the same time, there is not yet a solution to the uncertainty of the cognitive load faced by individuals, which makes this paper a long way from the truth. In future research, scientists may look at the practical uses of cognitive load, including its improvement in teaching programs as well as learning methods.

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