

# Integration of Technological and Pedagogical Knowledge: Need to Contemplate on the Cognitive Load of the Students

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## ABSTRACT

Nowadays, the education system at global level is embracing all those new innovations and technologies that can help the students to learn better. It is need of the hour to develop and apply new methods and technologies that can facilitate learning more effectively than conventional teaching methods. As technology facilitates the use of multiple senses, it reduces the efforts of an individual to understand the learning material and also enhances the retention ability. From the last few years, the development and use of E-content is emphasized more due to its positive effects on the academic achievement, engagement and motivation of the students. There are always some ways and directions to make maximum utilization of such technologies and E-contents and when we neglect those directions, it results in negative effects instead of helping the students. For instance, the use of such technologies and E-contents that are not developed or used according to some principles or guidelines such as linking of instructional matter with the previous knowledge of students, presenting the information in small segments or frames will definitely effect the intrinsic and extraneous cognitive load of students which in further, can harm the academic achievement and other psychological factors of the students to a greater extent. Therefore, this article will focus on Cognitive Load of students and some principles or guidelines which should be taken into consideration while developing or using the technologies or E-content in the class so that the cognitive load of the students can be minimized and achievement can be maximized.

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## 1. Introduction

The young generation of every country is the building block of its nation, therefore it matters a lot to provide quality education to them. Keeping this in mind, all current educational policies, reforms or programs are underlining the use of technology in classroom. Due to this development, the use of new technologies and E-content has been increasing swiftly and there is no need to prove that these technologies and E-contents facilitate the academic growth of students. Similarly, the use of e-content and other online information from the websites have an immense impact on the Cognitive load of the students. But, here we have to pause for a while to think over the accurate integration of technology with pedagogy, because the inaccurate integration can enhance the cognitive load of the students instead of reducing it. Before discussing the accurate ways to develop multimedia learning materials and accurate use of technology in classroom, it is important to understand the cognitive load of students.

**Cognitive Load** theory was developed by John Sweller in the late 1980. According to this theory cognitive load is a processed information or total amount of mental efforts being used in active or working memory in one time (Moreno & Park, 2010; Hsiao, 2010). Working memory is characterized as limited capacity and duration to attain new information or instructions and exceeding of these limits cause in overload of working memory and learning inhibition (Sweller, 2003, 2004). Therefore, the basic implication and focus of this theory is to develop such instructional designs that took into consideration the capacity of working memory and helps in managing the

cognitive load. Teachers should develop and use such teaching methods and materials that can help in decreasing or managing cognitive load of students (Hollender, & et. al., 2010; Kalyuga, 2011). Cognitive load theory distinguishes between three types of cognitive load i.e. intrinsic, extraneous and germane cognitive load.

Intrinsic cognitive load is related to the internal complexity of the learning materials or tasks. It is produced in the working memory during the process of information organization. In short, an intrinsic cognitive load is generated when more learning tasks are provided in a limited time span and when students have lack of relevant prior knowledge. It is mainly affected by the difficulty of learning content (Gerjets, & Scheiter, 2003). Excessive intrinsic load, cause in lacuna of motivation and creates barrier for the learning of students (Jung, et. al., 2016).

Extraneous cognitive load comes under the control of teachers or instructional designers and generated by the mode or method in which instructions are presented to the students (Chandler, & Sweller, 1991). It is determined by the process of information presentation, duration of the learning content, nature of the learning task and the structural features of the learning strategy (Sweller, 2010; Jung, et. al., 2016). In contrast to intrinsic and extraneous cognitive load, germane cognitive load is considered as learning relevant and effective cognitive load (Kalyuga, 2011). It is generated by the mental resources and efforts that are devoted towards the construction, acquisition and automation of schemas in long term memory (Sweller, et. al., 1998; Debie, & Leemput, 2014).

A schema is considered as a conceptualization of specific idea or object.

After looking on the different aspects of Cognitive Load, it is very clear that while developing or using the E-contents or multimedia learning modules, it is very important to consider the cognitive load of students. While preparing power point presentations, multimedia modules, videos etc., teachers should consider the following principles and guidelines given below which can help them to reduce the cognitive load of their students.

## **2. Linking of modules with the previous knowledge of the students**

Intrinsic Cognitive Load can be reduced by presenting the simple and complex learning material along with pre-training to enhance prior knowledge of the students (Gerjets, et. al., 2006; Salden, et. al., 2006; Si, et. al., 2014). In short, the content of multimedia learning materials should be followed by the prior knowledge of the students. Intrinsic cognitive load will enhance automatically, as the gap between the prior knowledge and new knowledge of the students increases. Therefore, while developing videos, PPTs etc. teachers should start discussing from the basic concepts learnt in previous class or in previous session. It is only possible when the teachers know about the level of previous knowledge of their students. Another thing is that, those who develop E-contents for online learning should start their lessons/modules from the general concepts in order to establish a link between the prior and new knowledge of the students.

## **3. Information to be provided in small segments or frames**

There is limited space of our working memory (Sweller, 1988; 1994), therefore it is very crucial to provide instructions in segments or frames rather than as one continuous unit. Intrinsic cognitive load enhances when more learning tasks or materials are presented in limited time period. It is often seen that teachers run the e-contents or videos continuously without presenting it into parts, which automatically causes an increase in Intrinsic Cognitive Load. Hence, it is essential that teacher should instruct in segments and can use the pause time for the assessment or clearing the doubts of the students.

## **4. Avoid excessive use of Animations**

Multimedia learning materials are helpful in reducing the difficulty level of the content or vice versa. Sometimes, the presence of redundant material (activities not related to the learning process), words, pictures and animations enhance the complexity of the content and also results in enhancing the intrinsic and extraneous cognitive load of the learners and interrupt their learning too (Chang, & Yang, 2010; Kalyuga, & Liu, 2015). To overcome this, problem teachers or multimedia modules developers should know that students learn better from graphics and narrations in contrast to graphics, narration and on-screen text. Along with this, corresponding words and pictures should be presented near to each other rather than

separate or on more distance. The style of the language should be conversational not formal and the voice should be friendly human voice rather than a machine voice (Mayer, et. al., 2003).

## **5. Appropriate Integration of Technological and Pedagogical Knowledge**

As extraneous cognitive load deals with the pedagogical knowledge (PK) of the teachers, therefore it comes under the control of teachers. If the teachers know the suitable pedagogy to teach different contents and the students understand and enjoy their (teachers) different styles of teaching, it will reduce the extraneous cognitive load of the students to greater extent. But unfortunately, teachers have lack of pedagogical knowledge (Das, 2015; Guerriero, 2017). Along with this, teacher use ICT based pedagogy in their classes but they have poor technological knowledge (TK) (Alice, 2012; Hossain, 2016; Pratap, 2018) which cause high extraneous cognitive load of students. Here the positive thing is that teachers have positive attitude towards training and enhancing their profession growth (Westbrook, et.al, 2013). Therefore, to overcome all these problems, there should be provision of technological and pedagogical training for in-service and pre-service teachers. However, it is recommended by many educational reforms and policies (Roy, et. al., 2015) but still lots of work has to be completed for its proper implications.

## **6. Emphasis on Problem solving ability of the students**

As germane cognitive load is a positive one and help the students to learn better, hence the teachers should focus on it. It can be increased by facilitating automation and schema construction in the working memory by the use of ICT in the classroom. The content delivered through multimedia or E-contents should focus on the use of cognitive activities of the students such as elaboration, abbreviation, comparison, and inference (Moreno & Park, 2010). In short, teachers should motivate or reinforce the students to put efforts to understand or find out the solutions of different problems.

## **7. Conclusion**

Integration of technology with pedagogy is need of the hour. Most of the educational institutes are also following this enthusiastically. The number of online learning material and modules being uploaded are increasing day by day. But the question is that whether these E-contents or modules are being developed by considering the principles listed above to reduce cognitive load of the students. The reduction of cognitive load of the learners is very essential for their academic growth and psychological well-being. In nutshell, there are two important points to minimize the cognitive load and maximize the academic achievement of the students. The main emphasis is to develop E-content by considering the principles of multimedia and secondly to use technology in the classroom in accordance with the demand of the students and the nature of the content to be taught.

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