The Role of Cognitive Load Theory in Educational Psychology in Guiding English Reading Teaching

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Abstract

Cognitive load theory (CLT) is one of the most influential theories in educational psychology. The idea is that the finite nature of learners' memory means that effective learning can only occur if the cognitive load is kept within the limits of what working memory can carry. This paper analyzes the concept of cognitive load theory and applies the theory to analyze secondary school English reading teaching with the goal of promoting the efficiency of English reading teaching.

Keywords

Cognitive Load; Educational Psychology; English Language Teaching.

1. Introduction

Cognitive load theory is one of the most influential theoretical frameworks in the field of English language learning and teaching. As an instructional design theory based on human cognitive structure, the core of cognitive load theory is the finiteness of memory, and effective learning can only occur if the cognitive load is controlled within the limits of working memory. In the context of cognitive load theory, there are problems in current secondary school English reading teaching such as students' insufficient reading background knowledge and vocabulary reserves leading to high endogenous cognitive load, students' high exogenous cognitive load due to unreasonable presentation of reading materials and instructional design, and students' low associative cognitive load due to teachers' insufficient attention to students' guidance of reading strategies. Based on this, teachers should use corresponding reading teaching strategies to regulate students' cognitive load so that the total cognitive load of students can be controlled at a reasonable level.

2. Cognitive Load Theory Research

CLT was first proposed by John Sweller, a cognitive psychologist at the University of New South Wales, Australia, in 1988, based on earlier research by Miller et al. CLT divides human cognitive structure into two parts: working memory and long term memory(Sweller,1988). Working memory, also known as short-term memory, is limited in capacity, storing only five to nine pieces of basic information at a time. Moreover, the interaction between elements stored in working memory also needs to occupy working memory space, and the amount of information that can be processed simultaneously is even smaller, only 2 to 3 pieces of basic information can be processed at a time. However, the capacity of long term memory is almost unlimited, and the information stored in it can be both small, fragmented information and large, complexly interacting, serialized information. Long-term memory is central to learning, and lasting meaningful learning cannot occur if the content in long-term memory does not change. Cognitive load theory suggests that the primary function of instruction is to attempt to store information in long term memory.

Table 1. Common cognitive load effects and their explanations

Cognitive load effects	Explanations
Sample Effect	Providing learners with samples that demonstrate solutions produces better learning outcomes than learning directly through problem solving.
Attention distraction effect	When the picture information is separated from the corresponding textual explanation information, it tends to distract the learner's attention and thus increases the cognitive load, which can be reduced by integrating the information together.
Redundancy effect	Redundant sources of information that do not help build cognitive schemas can interfere with learning.
Formal effect	Replacing a single source of information with multiple forms (e.g., visual, auditory), such as using sound with diagrams, is more conducive to learners' information processing than using text alone with diagrams.
Target freedom effect	Replacing traditional questions that provide learners with specific objectives with goal free (less explicit learning objectives) questions is more conducive to learning transfer.
Transient effect	For difficult tasks where learners tend to forget the information they have just acquired, it is necessary to provide resources that can be used repeatedly by learners.

3. The Causes of Students' Cognitive Load Problems in English Reading Teaching

3.1. The Cognitive Load Generated by Students' Insufficient English Vocabulary Reserves

According to the cognitive load theory, the endogenous cognitive load is related to the difficulty of the learning material itself and the students' current level of expertise. Currently, secondary school students generally do not accumulate enough vocabulary, which is the basis of reading. Insufficient vocabulary storage obviously causes a certain degree of reading barriers, which affects students' comprehension of reading chapters and makes it difficult for them to read fluently, thus increasing the relative difficulty of reading materials. At the same time, students lack the necessary background knowledge to comprehend the reading material, which further exacerbates their difficulties in reading comprehension and makes it difficult for students to achieve a better learning effect in English reading classrooms by creating a higher level of endogenous cognitive load in English reading learning.

3.2. Reading Material Presentation and Instructional Design are not Reasonable

According to the cognitive load theory, the exogenous cognitive load is related to the way the learning materials are organized, presented and the instructional design. In the current English reading teaching process in secondary schools, many teachers adopt the top-down reading teaching mode, i.e., they analyze and translate the reading materials syntactically word by word and sentence by sentence in a verbal way, and require students to master all of them. This results in too much redundant information, which not only results in a high exogenous cognitive load for students, but also affects their overall grasp of the chapter. In addition, in order to liven up the classroom, teachers may design a question for students to think about in the introduction of the reading class that is not related to the main idea of the text and has little direction, because the question is not necessary for the teaching activity, which will undoubtedly increase the exogenous cognitive load of students. The redundant information generated by too much

text description in English during the presentation of the reading lesson also adds to the exogenous cognitive load of students.

3.3. English Reading Instruction Ignores Students' Associative Cognitive Load

According to cognitive load theory, some additional cognitive resources that students invest in facilitating the construction of schemas are associated cognitive load. For example, students' use of text-marking strategies to improve their understanding of the content of English reading materials facilitates effective learning despite the increased associative cognitive load in the process. Research has shown that the use of various learning strategies can facilitate the construction and automation of schemas, although they increase the cognitive load of learners' relevance. In the current teaching situation, teachers do not pay attention to teaching and training students on reading strategies, but focus on explaining language knowledge in reading chapters, which leads most students to pay too much attention to detailed information in chapters, such as grammar rules or sentence structure, in reading comprehension, and cannot spontaneously use various reading strategies to read effectively. Since students are less likely to use reading strategies in reading, their associative cognitive load will naturally be at a lower level, and accordingly, their reading self-efficacy and motivation will be lower.

4. Implications of Cognitive Load Theory for English Reading Teaching

4.1. Optimize the Way of Presenting Knowledge Information

Cognitive load theory defines the function of teaching, and the main function of teaching is to store information in students' long term memory. Long-term memory is infinite, short term memory is relative to long term memory, and short term memory is limited. Understanding instruction from the perspective of cognitive theory, controlling students' working memory resources and thus regulating their s cognitive load is the central issue of teaching. Therefore, in classroom teaching, teachers need to ensure that students receive knowledge all within a tolerable memory capacity and that the knowledge capacity is appropriate to enable students' long-term memory to store more knowledge as an effective knowledge capacity.

Teachers should guide students to present reading materials in the form of diagrams. Reading materials are an important factor that affects students' reading. Students who speak English as a second language lack a solid foundation in second language grammar and vocabulary. English reading materials are much more abstract compared to Chinese reading materials, and charts and graphs are intuitive, concise, clear, and concrete, which help students understand the reading materials. In their study, Robert et al. found that applying charts to difficult and complex teaching content can greatly reduce the cognitive load of learners. Therefore, in the English reading classroom, teachers should guide students to work in groups to integrate the content of reading materials into a chart according to its framework structure. On the one hand, the use of diagrams can make teaching easy to understand and facilitate students' overall understanding of the reading content from a macro perspective. On the other hand, the use of diagrams simplifies the reading material and eliminates unnecessary and redundant information, which can reduce the exogenous cognitive load of students.

4.2. Controlling Redundant Information and Reducing Extrinsic Cognitive Load

Mayer (1989) has done an experiment in which he adjusted the position of text and annotations, one by inserting the annotations next to the corresponding words in the text respectively, and one by placing the annotations centrally under the text, and the experiment showed that the learners who learned with the first way of information presentation performed significantly better than the second group. Therefore, when dealing with multiple forms of information such as text, diagrams and pictures, learners' attention should be prevented from being distracted as much as possible, for example, by highlighting effective information and minimizing visual

search. When the questions are presented, the effective information can be marked with different color fonts; if the length is long, it can be divided into smaller parts; more structured questions can be inserted or converted into diagrams. When more information about the problem needs to be presented, hyperlinks can be set on the interface, and learners can open specific information by themselves according to their needs, which helps learners focus on the core information of the problem.

4.3.   Dual Channel Principle

The dual channel principle means that learners can achieve better learning results by learning based on the picture and the picture narration than by learning based on the picture and the textual description of the picture. The channel effect in psychology refers to the fact that during learning, learners process information from both the visual and auditory channels better than information from one of the channels alone. Research has shown that by using both visual and auditory working memory components simultaneously, the capacity of effective working memory can be expanded than by using one of the components alone. That is, learning can be facilitated by effectively integrating both types of resources through the use of dual visual and auditory representational techniques. This also means that multimedia instructional design should avoid the excessive use of single-channel representations and use a better combination of auditory and visual "text plus narration" or "image plus narration". At the same time, the narration and text or image representation should fit perfectly to avoid increasing the cognitive load of learners.

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