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A Cognitive Load Theory Approach to Teaching Reading Comprehension in the English as a Foreign Language Context: An Analytical Review

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ABSTRACT

This analytical review sheds light on the impact of Cognitive Load Theory (CLT) application on reading comprehension and how the findings relate to English as a Foreign Language (EFL) reading comprehension instruction. The aim of this review is threefold. First, it analyzes empirical studies of CLT-informed reading strategies in various settings and evaluates their relevance to EFL learners, taking into consideration differences in linguistic exposure, instructional environments, and cognitive demands. Second, it highlights the main CLT-informed instructional techniques that can help reduce unnecessary cognitive load during reading comprehension tasks. Finally, the review sheds light on challenges of incorporating CLT-based strategies in EFL contexts, including limited language exposure and reduced opportunities for authentic interaction. The findings suggest that while a CLT-based approach can enhance reading comprehension in EFL learners, EFL milieu characteristics should be considered for effective learning. This study offers evidence-based strategies for designing cognitively efficient reading instruction.

Introduction

Reading comprehension is a foundational skill in language acquisition. It plays a pivotal role in learners' academic achievement and communicative competence in one's first language(s) (L1) and also second or foreign languages (Harmer, 2007). Reading helps learners expand their vocabulary knowledge and has positive impacts on spelling and writing as well (ibid). Moreover, it allows students to explore a wide range of topics belonging to different areas of interest (ibid).

Reading ramifies into two main types: extensive reading and intensive reading. The former is mostly done outside the classroom while the latter is mostly done inside. Intensive reading includes a set of tasks with different foci in order to develop lifelong reading skills.

Despite its significance, reading is no easy task. It requires the interplay of various language components and skills (Grabe & Stoller, 2011). Learners should activate their prior knowledge of both content and language in order to decode a text and construct meaning (Anderson & Pearson, 1988).

So, due to this complexity, learners may feel frustrated and unable to understand the text sometimes due to the choice of a text which is not of the learner's interest (Guthrie & Wigfield, 2000). Also, the text may include difficult language and an unfamiliar topic (Nation, 2001). Therefore, the text places cognitive demands on learners and if not taken into account by the teacher, students cognitive resources may be overloaded and impede learning (Sweller et al., 2011). In this respect, cognitive load theory (CLT) takes into consideration the limits of human cognitive resources and endorses teaching methods and strategies that aim to reduce cognitive demands on learners and improve learning (Sweller, 1988).

This analytical review attempts to investigate the application of cognitive load CLT in reading comprehension instruction in general, and the context of EFL reading comprehension instruction, specifically. In particular, it sets out to do the following:

- Conduct an analysis of the implementation of CLT-informed reading practices in different contexts and determine their applicability to EFL contexts.
- Highlight CLT teaching strategies that minimize extraneous cognitive load during reading processes.

As a sub-aim, this review also lists:
- Some challenges associated with implementing CLT strategies in EFL contexts.

Overall, this analytical review attempts to provide evidence-based recommendations for the development of cognitively efficient reading instruction in EFL settings. The goal is not only to enhance learners' reading comprehension but also to promote more effective instructional practices informed by cognitive principles.
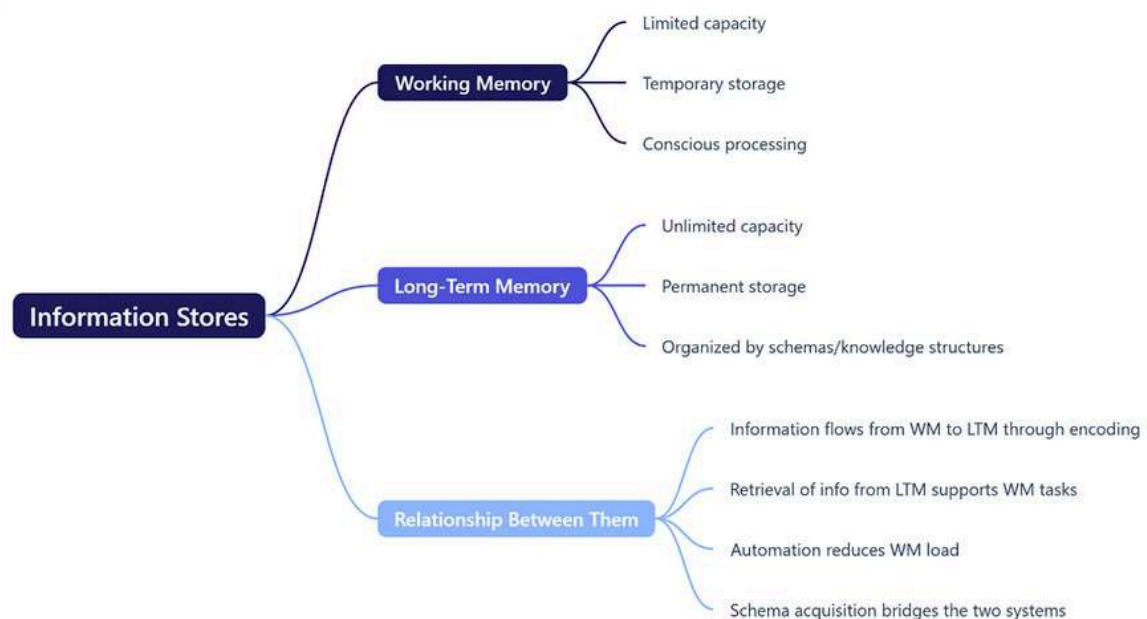
(1) Human Cognitive Architecture

Human cognitive architecture consists mainly of working memory (WM) and long-term memory (LTM) (Atkinson and Shiffrin, 1968; Baddeley & Hitch, 1974). WM is limited in capacity and in duration when processing new information (Miller, 1956; Cowan, 2001). These limitations were identified in experiments using nonsense syllables, lists of digits, and words as the material to be processed. It was found that the learning of these items was constrained by the capacity of working memory. Ideally, the items were unfamiliar to subjects so that their processing wasn't influenced by information held in LTM. Similarly, WM constraints also apply to more complex cognitive activities such as decision-making (Payne, 1976) and reading comprehension, as one of those complex activities.

It has been proven that working memory is only limited when dealing with novel information. However, there is no known limit to its capacity to process information held in long-term memory, especially if that information has been automated. As for long-term memory, there is no known limit to the number of schemas that can be stored (Sweller et al., 2011). All in all, these types of memory differ in terms of duration, storage, and function. The following diagram provides a general and simplified overview of human cognitive architecture.

Human cognitive architecture: processes and stores of information

(2) Cognitive Load Theory

Cognitive load theory (CLT) is a learning theory based on human cognitive architecture, with focus on the interaction between working memory and long-term memory and learning material during the learning process (Sweller, 2024). The theory presumes that cognitive capacity in working memory is limited, and if a learning task is excessively demanding in terms of capacity, learning is inhibited (Jong, 2009). CLT differentiates between three types of cognitive load: intrinsic, extraneous, and germane. Intrinsic load refers to the natural difficulty of the material to be learned or the task at hand. Extraneous load is the mental load caused by poor instructional design or information presentation. Finally, germane load refers to the intellectual effort involved in learning and building schemas, and is useful for knowledge storage over a long period of time. Therefore, effective instruction should be designed in a way that minimizes unnecessary cognitive demands while maximizing opportunities for schema acquisition and automation.

CLT also differentiates between biologically primary information, which we process effortlessly, and secondary information, which requires effortful processing (Sweller, 2024). CLT draws attention to the fact that new information is first processed by a capacity and time-limited working memory before it is coded in an unlimited long-term memory for utilization at a later stage (Sweller et al., 2019). Once information is coded in long-term memory, the capacity and time limits of the working memory are no longer in place, altering our capacity to function (Sweller et al., 2019).

Interestingly, CLT has evolved through the years, incorporating other theories and accounting for replication failure. Failure has incited theory extension and explication, which has facilitated its evolution (Sweller, 2023). The theory has also been applied to other learning environments, like web-based learning and multimedia learning, where it informs the construction of effective instructional materials (Brunken et al., 2003; Feinberg & Murphy, 2002).

In summary, CLT offers a method of instructional design optimization by considering working memory limitations and the central role of long-term memory in learning. Its use is not limited to individual learning but extends to collaborative learning environments and very complicated domain expertise such as resuscitation medicine (Kirschner et al., 2018; Szulewski et al., 2020).

(3) CLT in Language Learning and Reading Comprehension

Cognitive Load Theory has been implemented, although to a lesser extent, in language acquisition and reading, providing much information about learning performance and instructional design. Investigations have also asserted that the use of CLT-based approaches is greatly important for the performance of students in tests of second language acquisition and reading comprehension (Al-Shehri & Gitsaki, 2010; Hadie et al., 2021).

In reading and vocabulary learning online, blended instructional designs have been demonstrated to facilitate superior reading comprehension over split-attention designs. Online dictionary users achieved better results in vocabulary tests but slower performance on reading tasks (Al-Shehri & Gitsaki, 2010). This suggests that cognitive load must be considered in multimedia instructional material design for language learners.

Significantly, CLT methodology has been stretched to accommodate collaborative learning, hence refuting CLT's association with individual work. Findings support that when WM limits are considered, it opens a new door of alternative remedies for productive group learning situations (Kirschner et al., 2018). Bridging CLT principles even further into web-based learning has certainly been instrumental in the service of enhancing the delivery of online instruction (Feinberg & Murphy, 2002).

(4) CLT informed Reading Strategies in ESL and EFL Context

This section offers a compilation of important CLT-informed strategies that have either been tested empirically or proposed theoretically to enhance reading comprehension. These strategies aim to reduce extraneous cognitive load, manage intrinsic load, and encourage germane processing. All of which are essential elements that are required to improve reading outcomes in EFL contexts.

4.1. Pre-reading Schema Activation

Activating learners' background knowledge before reading is of paramount importance, for it has been shown to reduce intrinsic load by providing a mental framework for understanding new content (Sweller et al., 2011; Anderson & Pearson, 1984; Ausubel,1960).). This can be done through the use of techniques such as: advance organizers, pre-reading questions and topic related discussions. These activities prepare learners to process complex texts more efficiently by linking new input with existing mental schemas. They provide a smooth transition to the new material without being bombarded with new information from the outset.

4.2. Segmentation and Chunking

Sometimes, due to syllabus specifications on what to teach or for some other reason we provide students with long texts that are beyond their, what Vygotsky calls, zone of proximal development (ZPD, 1978). Students find themselves in front of a very long text which is hard to decode resulting in cognitive overload. So, breaking down long or complex texts into smaller, more manageable segments helps reduce extraneous load by allowing students to feel at ease while processing the text. This also prevents working memory overload and allows learners to focus on comprehending each part before moving on to the next.

4.3. Use of Visual Aids and Dual Coding

Integrating relevant visuals (e.g., images, diagrams, flowcharts) alongside text supports dual coding- processing information both verbally and visually (Mayer2009). However, if the visuals are irrelevant to the text or replicate the information presented in the text, they should be jettisoned This has been shown to enhance comprehension and recall, especially for abstract or unfamiliar content.

4.4. Worked Examples and Scaffolding

Students may find difficulty in answering comprehension questions just because they encounter that type of question or exercise for the first time (Nation & Snowling1997). Imagine giving beginning EFL learners an exercise on word reference for the first time, asking them to find, for example, the referent of a word like 'them'. Some students might understand what's required from them, while the majority would be puzzled. So, worked examples can also be effective in reading. For instance, modeling how to answer comprehension questions or analyze a text structure guides learners in applying strategies independently. Worked examples can be faded as a means to gradual release of responsibility where support is gradually reduced helps transition learners from guided to autonomous learning (Renkl et al., 2000), in this case autonomous reading.

4.5. Reducing Split Attention

Another way to reduce cognitive load and enhance comprehension is through the reduction of split attention (Chandler & Sweller, 1991). For example, giving students a text on one side of a paper and comprehension tasks on the other requires students to hold the question in memory and go back to the text and search for the answer. If the question is long, they forget it halfway and keep moving back and forth, thus exhaustion of working memory and longer processing time. Therefore, if related information is presented in an integrated format, rather than in separate sources, it helps avoid split-attention effects. For example, a teacher can place a glossary directly within the text or embed questions within paragraphs to support comprehension without overloading working memory. Instead of writing "Read the passage and refer to the vocabulary list at the end," one can do this: "The desert is an arid (very dry) environment…".

The application of these strategies has a positive effect on reading comprehension instruction by allowing for improved text comprehension, greater retention, an enhanced ability to decode a text and infer meaning, and, above all, improved learner confidence and motivation. Furthermore, these strategies are particularly effective for lower-proficiency learners, who are more susceptible to cognitive overload due to their limited linguistic resources. Therefore, the classroom would be a more cognitively supportive reading environment. Although many CLT-based strategies are developed in L1 or ESL settings, they can be effectively tailored to EFL environments with attention to contextual constraints. Ultimately, applying CLT to reading instruction in EFL settings promotes not only comprehension but also learner engagement, motivation, and long-term retention, which are key outcomes for successful language acquisition.

(5) Challenges in Implementing CLT in EFL Contexts

While CLT is a useful model for enhancing reading comprehension, its use in EFL contexts is not without issues. The authors list some of these issues in this section.

5.1. Limited Language Exposure

Among the major challenges in EFL settings is the very limited contact with the target language outside the classroom. Unlike ESL students, who will more likely use English in actual, everyday life contexts, EFL students will typically have exposure to English only in the formal classroom setting. This limits opportunities for schema building as well as background knowledge necessary for successful reading comprehension.

As a result, EFL students may perceive high intrinsic cognitive load in processing new material even when instruction is highly structured. This has the potential to compromise the efficacy of CLT-based methods that assume some degree of linguistic knowledge or experiential knowledge.

5.2. Teacher Preparedness and Training

Another significant challenge is the lack of teachers' training in instructional design and cognitive load principles. EFL teachers most likely would be unaware of CLT or not even have resources and facilities to apply it to instructional practice.

5.3. Resource Constraints

The application of CLT strategies can require adapted materials like visual aids, texts, and segmenting or scaffolding software. In resource-constrained educational environments, these materials might be scarce or nonexistent. This makes it difficult to reduce extraneous load or facilitate dual coding. Also, where there is poor access to technology, it is hard to integrate multimedia resources that otherwise enhance comprehension through visual-verbal integration.

Summary

This review has investigated how CLT can be effectively used to teach reading comprehension in EFL contexts. Through the analysis of research, it was possible to identify several CLT-related techniques, such as worked examples, dual coding, segmentation, and scaffolding, that can reduce cognitive overload in the process of reading. On the whole, the integration of these strategies not only creates a more reader-supportive environment, which also has an immediate increase in understanding, but it also helps in the long run the development of reading and language skills.

The study has also tapped into some difficulties, such as lack of teacher training and resource constraints, that educators may experience while trying to put CLT-based instruction to work in EFL classrooms. However, CLT remains a plausible medium for the enhancement of reading instruction, and the authors suggest further studies be carried out to integrate, evaluate, and generate new CLT-informed reading instruction techniques and also to expand the scope of research on CLT to other language skills and components.

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