UNDERSTANDING THE IMPACT OF COGNITIVE LOAD ON VOCABULARY RETENTION IN EFL: A THEORETICAL ANALYSIS

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Abstract: Vocabulary acquisition plays an important role in English as a Foreign Language (EFL) learning, significantly affecting communication, comprehension and academic performance. However, many EFL learners struggle to retain new vocabulary due to cognitive load. This study aims to investigate the impact of cognitive load on vocabulary retention in EFL learners, drawing from Cognitive Load Theory (CLT) and insights from neuroscience. The research emphasizes the importance of managing cognitive load effectively, as cognitive load plays a critical role in improving vocabulary retention. The findings suggest that reducing cognitive load in the classroom can significantly improve vocabulary retention and provide valuable insights for EFL teachers in designing more effective learning strategies. The research contributes to existing knowledge in language learning and neuroscience, offering practical recommendations for language learning practice.

INTRODUCTION

Mastery of vocabulary is an essential component in achieving language proficiency, supporting learners in developing skills such as reading, speaking, writing, and listening. Although grammar and pronunciation are important, effective communication in English cannot be achieved without an adequate foundation in vocabulary knowledge (Min, Y. K., 2013). That any stage of L2 learning, having a strong vocabulary base significantly enhances students' ability to communicate effectively, understand different types of texts, and perform well in academic settings.

However, depsite its significance, many EFL learners often struggle with memorizing and recalling new words due to cognitive demands (Rosyada-AS & Apoko., 2023). One of the critical factors contributing to this difficulty is cognitive load, which affectss the brain's ability to process and retain information. According to Cognitive Load Theory (CLT), the human brain has a limited capacity for process information, and when the cognitive load becomes excessive, it can hider vocabulary retention (Sepp et al., 2019). In addition, cognitive load plays a crucial

role in the ability of learners to process, store, and retrieve new information, which directly impacts vocabulary retention (Van Gerven et al., 2000).

Although CLT has been extensively applied to areas such as reading comprehension and listening (Bai, 2018; Asyiah, 2017), there is limited research specifically examining its impact on vocabulary retention in language learning. Addressing this gap is crucial, as understanding a learner's cognitive limitations can inform more effective strategies to reduce cognitive overload and improve learning outcomes. This study aims to fill that gap by examining how different levels of cognitive load during vocablary learning influence retention outcomes among English Language Learners. Given that vocabulary knowledge is a highly complex construct, which resists any single explanation (Schmitt., 2019), understanding how cognitive factors like load contribute to retention is crucial for developing more effective teaching strategies.

Cognitive Load Theory, developed by Sweller (1988, 1989), is an instructional theory that explains how cognitive resources are focused and used during learning and problem-solving. CLT is based on the understanding that the human brain has a limited capacity for processing information, and when cognitive load exceeds this capacity, learning becomes less effective (Sweller, 1988, 1989; Van Merrienboer & Sweller, 2005). CLT highlights the limitations of working memory and suggests that learning can be enhanced by managing cognitive load effectively, such as by building schemata to organize information (Kirschner, 2002). When cognitive load is too high, learners may struggle to absorb and retain new information (Sisakhti et al., 2021). This concept is particularly important in vocabulary acquisition, where the mental effort to learn and store new words can overwhelm learners' cognitive resources (Hornay, P. M. A., 2021). If cognitive load exceeds the learner's mental capacity, their ability to focus, understand, and remember vocabulary is significantly impaired (Sweller, 2016).

In recent years, neuroscience has made significant strides in uncovering how the brain processes and stores new information, particularly in the context of learning and memory (D'Esposito & Postle, 2015). These insights are invaluable for understanding how cognitive functions, such as memory formation and information retention, are influenced by the brain's mechanisms, particularly in educational settings (Ferebee & Davis, 2019). A key concept that has emerged from this research is the role of cognitive load in shaping learning outcomes. Cognitive load refers to the mental effort required to process new information, and it plays a crucial role in determining whether learners can successfully store information in long-term memory (Paas et al., 2004; Sweller, 2016). Research shows that when cognitive load is managed effectively, learners are more likely to encode information successfully, leading to enhanced

memory retention (Plass & Kalyuga, 2019). However, when cognitive load exceeds the brain's working memory capacity, learners can experience cognitive overload, which impairs their ability to retain information (Hultberg et al., 2018; Jaeger, Shipley, & Reynolds, 2017). This phenomenon is particularly relevant in language learning, where students often struggle to remember and apply new vocabulary due to complex cognitive demands that can affect learning success or failure (Chew & Cerbin, 2021).

Neuroscience provides further insight into this challenge by showing how working memory plays a role in storing and processing new vocabulary information (Baddeley, A. 1992). Working memory has a limited capacity, so it is necessary to manage cognitive load properly so that new information can be transferred to long-term memory (Ofen, N., et al., 2016). According to Kirschner (2002), Cognitive Load Theory (CLT) is based on the understanding that human working memory is limited. When learning, a lot of cognitive energy is used, and often, inappropriate ways of presenting material can overwhelm the brain, disrupting the learning process and information storage. If the cognitive load is optimized, neural connections associated with vocabulary learning and retention will be strengthened, improving students' ability to remember and use new words effectively. When cognitive load is optimized, the connection between these regions is strengthened, improving the efficiency of memory storage and retrieval. Conversely, excessive cognitive load can disrupt this process, leading to poor retention of new information (D'Esposito & Postle, 2015).

Brain plasticity describes to the brain's remarkable ability to change and adapt through learning, which plays a crucial role in how we acquire and retain vocabulary. Research indicates that learning a foreign language not only enhances cognitive functions but also physically alters brain structure, leading to improved memory retention (Fong et al., 2022). This understanding of brain plasticity highlights the need for instructional strategies that align with natural learning processes, aiming to minimize cognitive overload while effectively promoting vocabulary acquisition (Plass & Kalyuga, 2019). By applying these insights to teaching methods, educators can develop practical solutions, such as adjusting the complexity and quantity of new vocabulary presented, which can help reduce cognitive load and enhance long-term memory retention for EFL learners.

This study investigates the impact of cognitive load on vocabulary retention in English language learners, using a neuroscience approach. The findings aim to help educators design strategies that manage cognitive load effectively, enhancing vocabulary retention in EFL

classrooms. This research contributes to both language learning and neuroscience, offering practical implications for teaching methods.

RESEARCH METHODS

This method is carried out through a qualitative literature review by searching and analyzing literature from various trusted sources, such as Scopus, Google Scholar, and Sinta. The main focus of the literature search is on studies that discuss the impact of cognitive load on vocabulary retention. Relevant articles will be selected and analyzed to identify existing findings on the impact of cognitive load on vocabulary retention. In addition, this study will examine the factors that influence the impact as well as learning strategies that can reduce cognitive load and improve vocabulary recall in English language learners. The results of this literature analysis will be synthesized to find patterns, similarities and differences from previous studies. Based on this synthesis, this study aims to provide conclusions on the extent to which cognitive load affects vocabulary retention, while providing guidance for future English language learning research and practice.

RESULTS AND DISCUSSION

Cognitive Load Theory (CLT) was first developed by John Sweller (1988) who stated that human cognitive capacity is limited in processing information. CLT is used to help design teaching strategies that can maximize information processing without overloading students' brains (Feldon, D. F. 2007). In this case, an understanding of how working memory, short-term memory, and long-term memory work is crucial in managing students' cognitive load during the learning process. Working memory refers to the system responsible for temporarily holding and processing information needed to perform cognitive tasks (Cowan, N. 2008). This means that working memory is not just about temporarily storing information, but also about how our brains use that information to think, strategize, or make decisions. It has a limited capacity and can easily become overloaded. In this regard, Baddley (1986) also added that human working memory can only handle a limited amount of information at a time, while long-term memory can store unlimited information. Therefore, if too much information is presented at once, students can experience cognitive overload, which inhibits learning.

On the other hand, short-term memory also temporarily stores information, but it does not necessarily involve processing or deep understanding (Baddeley, A. 1992). Short-term memory is often thought of as similar to working memory, but there are important differences

between the two. Short-term memory focuses more on temporarily storing information without much in-depth processing. Short-term memory allows us to hold small amounts of information for very short periods of time, but without the involvement of complex cognitive processing. In general, short-term memory serves to store information that will be used immediately and has a limited capacity, which can only hold about 7 items of information in less than 30 seconds (Miller, 1956). The role of short-term memory is crucial in learning, especially in situations where students need to recall information immediately, such as when they are following instructions or memorizing certain facts (Jamaludin, D. N. 2022). However, information in short-term memory will not last long unless it is further processed and transferred to long-term memory. (Norris, D. 2017).

Long-term memory is the system that stores information for longer periods, where information is retained after it has been processed and learned effectively (Bower, 1975). lnformation that has been stored in long-term memory can be accessed again at any time, and that is what allows us to recall facts, skills, and past experiences. For learning to be efficient, information must be transferred from working memory to long-term memory through proper cognitive processing. Sweller (2015) states that effective learning occurs when information processed by working memory is transferred to long-term memory. This allows students to recall and use the information in the future. The capacity of long-term memory is considered unlimited, but to store information here, good cognitive processing is required in the early stages of learning.

Cognitive Load refers to the amount of mental effort required to understand and process information during the learning process, especially in learning that involves understanding complex material or new information. Although some experts claim that human memory capacity is unlimited, information received is not immediately processed into long-term memory. In this context, Cognitive Load Theory emphasizes that learning will be more effective if the material provided is not too complicated or overwhelming, so that students' working memory is not overburdened. To achieve more effective learning, cognitive load must be managed properly, allowing information to be transferred from short-term memory to long-term memory efficiently.

There are three types of cognitive load in CLT: intrinsic load, extraneous load, and germane load. Intrinsic load is related to the natural complexity of the material, extraneous load is caused by inefficient ways of presenting information, while germane load is cognitive effort that supports the formation of knowledge schemas. Intrinsic cognitive load (Sweller 1994) is a

type of mental load that relates to the natural difficulty of the material or information that students must understand. It refers to how complicated the material itself is, without considering the way the material is presented or the activities used for learning. In other words, it is only about how difficult the content of the lesson is, not about how the material is taught. To reduce the intrinsic cognitive load, we can either simplify the material or increase students' expertise in understanding the information.

Extrinsic cognitive load differs from intrinsic cognitive load in that it does not depend on how difficult the subject matter is. Rather, extrinsic cognitive load is determined by the way information is presented and the actions students must take during the learning process. In contrast to intrinsic cognitive load, extrinsic cognitive load can be changed by changing the way is taught (Sweller et al., 2019). Extrinsic cognitive load consists of unnecessary information that enters students' working memory. This load can greatly affect learners who are new to learning English. As they still have limited language skills, if they are given too much information at once, it can feel overwhelming. As a result, their cognitive capacity will be overloaded, making it difficult to understand or learn the material well.

Germane cognitive load is a type of cognitive load that helps students learn better. This type of load comes from linking relevant information from long-term memory or context with new information elements (Sweller, 2010; Sweller et al., 2011). This happens when learning activities are specifically designed to help students build understanding and master the material. This load contributes to the way students organize information in their brains and makes it easier to remember. In other words, germane cognitive load arises from well-designed tasks that can help students learn without exceeding their working memory capacity.

This principle of cognitive load is important for helping EFL learners retain vocabulary because well-designed learning tasks can make it easier to remember and use new words. Vocabulary retention is a crucial aspect of language acquisition, especially for EFL learners to comprehending a language. Vocabulary retention refers to the process where language learners not only recognize new vocabulary, but are also able to remember it for future use (Hashemzadeh, M. 2012). This is important because a good understanding of vocabulary correlates with reading, writing, speaking and listening skills in a second language. In reading skills, for example, learners who have extensive vocabulary tend to understand complex texts more easily. Similarly, in speaking and writing skills, better vocabulary mastery allows learners to express their ideas more clearly and precisely.

Furthermore, vocabulary learning and vocabulary retention are yet matters of difficulty to language learners (Zimmerman, 1998). Many learners try to find effective ways to remember new words so that they are stored in long-term memory, but in reality, forgetting vocabulary is a common problem. They often feel frustrated because they can't remember new words after learning them. This suggests that the main challenge in vocabulary learning is not simply acquiring new words, but retaining and accessing them easily when speaking or writing. This issue is becoming increasingly relevant, especially for EFL. Vocabulary retention impacts communication fluency, and practicing fluency through activities like speed reading and re-reading can boost vocabulary and improve communication (Nation, 2017). Learners who are able to recall and use relevant vocabulary in various communication contexts will be better able to participate in meaningful and efficient conversations by choosing words that fit the appropriate context and using them correctly to avoid miscommunication (Leong & Ahmadi 2017). Conversely, difficulty in remembering vocabulary is often a major obstacle to fluent communication, both in informal and academic situations. Therefore, vocabulary retention is not just a matter of memorizing words in isolation, but is also related to how they are integrated into the broader language system and used effectively in various situations.

In the context of language learning, vocabulary retention refers to the process by which a person not only recognizes new vocabulary, but is also able to store it in memory for reuse in relevant communication situations. Vocabulary retention is the ability to store or remember as many words as possible by engaging in various learning activities (Stavy & NorsehaUnin, 2019).

EFL learners face numerous challenges in retaining new vocabulary (Rosyada & Apoko 2023). Additionally, cognitive overload can hinder retention when learners are presented with too much information at once. The mental effort required to process and store large amounts of vocabulary may exceed the capacity of working memory, leading to forgetfulness. Other factors, such as low motivation and inadequate use of effective learning strategies, also contribute to the difficulty in retaining vocabulary over time.

Several factors influence vocabulary retention, including frequency, context, and repetition (Lee, 2023). Frequent exposure to vocabulary enhances retention, as repeated encounters strengthen memory associations and facilitate recall. Context also plays a pivotal role; words learned in meaningful and relevant contexts are more likely to be retained because learners can link the vocabulary to real-life situations or prior knowledge (Zarfsaz & Yeganehpour, 2021). Repetition, especially spaced repetition, is another critical factor, as it

allows learners to revisit and reinforce vocabulary over time, promoting the transfer of knowledge from short-term to long-term memory. These factors highlight the importance of creating engaging and contextually rich learning environments to support vocabulary retention.

To understand why such learning environments are effective, insights from neuroscience provide valuable explanations by revealing how the brain processes and retains language-related information. Neuroscience, which is the study of the nervous system and how the brain works, has become one of the important disciplines in understanding the mechanisms of learning, including in language learning (Petitto, L. A., & Dunbar, K. N., 2009). This approach seeks to integrate findings on brain function to maximize the language learning process. In the context of second or foreign language learning, such as English as a Foreign Language (EFL), neuroscience provides insights into how the brain processes, stores and retrieves language information.

The neuroscience approach highlights the roles of various brain regions in language acquisition and retention. Vocabulary retention, as a part of language acquisition, involves both declarative memory for storing word meanings and procedural memory for learning usage patterns. Neuroscientific research has shown that these memory systems work in tandem to support learners in retaining vocabulary effectively (Ullman, 2004).

Additionally, the neuroscience approach emphasizes the importance of neuroplasticity, which refers to the brain's ability to adapt and reorganize itself in response to learning experiences (Voss et al., 2017).). Engaging learners in multisensory activities, such as pairing words with images, sounds, or physical actions, activates multiple areas of the brain, enhancing both memory encoding and retrieval (Shams & Seitz, 2008). Furthermore, neuroscience emphasizes the importance of well-scheduled repetition, the use of diverse sensory methods, and active engagement as key processes to strengthen the brain's neural networks. By repeatedly using vocabulary in meaningful contexts, learners can reinforce these neural connections, leading to improved retention and recall (Mahan, J. D., & Stein, D. S., 2014).

By bridging cognitive neuroscience and language education, this approach provides a scientific foundation for designing more effective vocabulary learning strategies. Teachers and researchers can leverage insights from neuroscience to create brain-friendly learning environments that optimize retention and foster deeper language comprehension.

This highlights how research can support managing cognitive load to improve vocabulary retention. Based on the literature review conducted, a number of studies show that effective

management of cognitive load will affect vocabulary retention in English language learning. Sweller (1994) explains that high cognitive load can inhibit information processing. This happens because our working memory has a very limited capacity, only able to store a small amount of information at a time. If the material being learned is too difficult (high intrinsic load) and the instructional design adds additional load (extrinsic load), then this total load can exceed the capacity of working memory. As a result, the ability to comprehend and recall information will decrease, so the learning objectives are not achieved. So teaching, especially in the field of language, must avoid overload so that learning remains effective. Abbassi et al. (2018) stated that the use of memory strategies such as grouping words and using images can reduce cognitive load and improve students' ability to remember vocabulary. These strategies help students process information more systematically, making it easier to store in long-term memory. Applying this memory strategy not only improves vocabulary retention but also provides a more personalized and adaptive approach according to students' needs.

In addition, Ye Wei's (2018) research shows that a relaxed brain state, characterized by the production of α (alpha) waves, can facilitate more effective learning. This relates to a decrease in cognitive load, which helps students remember vocabulary better, while stressful conditions that increase β (beta) waves can inhibit learning. Under relaxed conditions, the brain can more easily process and store new information as it is not burdened by emotional or cognitive pressure. In contrast, stress distracts the brain from learning, making information difficult to remember. Therefore, creating a comfortable and supportive learning atmosphere can be key in improving students' vocabulary retention.

Lin & Yu's (2017) study also showed that the use of multimedia, especially sound, in vocabulary learning can reduce cognitive load and improve vocabulary retention. The integration of sound helps students remember words more easily in the long term, showing that a multimodal approach can improve vocabulary learning outcomes.

Di Carlo's (2017) research also confirms the importance of cognitive-based strategies, such as information grouping and association, to aid vocabulary processing and recall. These strategies support learning by strengthening neural connections in the brain, which in turn improves vocabulary retention. They allow students to connect new information with existing knowledge, making it easier to understand and retain information. In addition, clustering and association help the brain process information more efficiently, reducing the risk of cognitive overload. The findings also highlight how cognitively designed learning not only supports vocabulary acquisition but also improves students' overall thinking skills.

Based on the literature review, effective management of cognitive load plays a crucial role in improving vocabulary retention in English language learning. Strategies such as grouping words, using images, and multimedia integration help reduce cognitive load, making it easier for students to process and store information in long-term memory. Creating a relaxed learning environment, as well as using cognitive-based strategies like association, can further enhance vocabulary recall. These findings suggest that implementing these strategies can make vocabulary learning more effective and engaging, ultimately improving students' ability to retain and apply new words.

However, these studies have some limitations. Most were conducted in specific countries, such as Iran or Taiwan, so the results may not be generalizable to the global context, including Indonesia. In addition, many studies only measured short-term impacts, so further research is needed to explore the long-term effects of these strategies. Future research could also explore how cognitive load management affects other language skills, such as speaking or writing.

Overall, these findings suggest that memory strategies, multimedia, material segmentation and brain relaxation have important roles in reducing cognitive load and improving vocabulary retention. The practical implication is that educators need to implement these strategies in the classroom, such as organizing materials in small segments, using multimodal approaches, or creating a comfortable learning atmosphere. Thus, vocabulary learning is not only more effective but also provides a more engaging learning experience for students.

CONCLUSIONS AND RECOMMENDATION

Cognitive load is directly related to English language learning, especially in terms of vocabulary retention. High cognitive load can reduce students' ability to process and store new information in long-term memory, which will hinder vocabulary recall. When students are burdened with too much information or difficult to understand, their working memory becomes overwhelmed, and new information, including vocabulary, is difficult to remember. Therefore, the management of cognitive load is essential to improve the effectiveness of vocabulary learning.

Previous studies have shown that strategies such as word grouping, image use, multimedia, and material segmentation can help reduce cognitive load and improve vocabulary retention. Research by Abbassi et al. (2018) revealed that the use of memory strategies such as

word grouping and images helped students process information more systematically. In addition, multimodal approaches involving the use of sound, images and text, as found in Lin & Yu's (2017) study, can also reduce cognitive load and improve vocabulary learning outcomes. Thus, these strategies not only make it easier for students to learn vocabulary but also help them remember words in the long run.

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