

# The Effect of Cognitive Load on Second Language Acquisition

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## **Abstract**

*Second language acquisition (SLA) is a complex process that involves the integration of new linguistic structures into existing linguistic knowledge. Cognitive load, which refers to the mental effort required to process new information, has been shown to impact SLA. This review aims to comprehensively examine the current research on the effect of cognitive load on SLA, highlighting its impact on grammar and vocabulary acquisition as well as speech production. High cognitive load can impair the formation of language rules, inhibit vocabulary retrieval, and hinder speech production. Conversely, reducing cognitive load through instructional design, such as explicit instruction and visual aids, can enhance SLA. The review also explores the underlying cognitive mechanisms, such as working memory capacity and automaticity, and discusses the implications for language teachers, emphasizing the importance of instructional design to reduce cognitive load and increase cognitive processing efficiency. Overall, this review highlights the significance of considering cognitive load in SLA research and instructional design and the potential for optimizing language learners' learning potential through effective instructional strategies.*

**Keywords:** *Second language acquisition, Cognitive load, Grammar acquisition, Vocabulary acquisition, Speech production, Instructional design.*

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## **I. Introduction**

Acquiring a second language (L2) is a multifaceted process that requires learners to develop new linguistic skills and knowledge. It involves processing and retaining a considerable amount of information, making cognitive load an influential factor in L2 acquisition. The impact of cognitive load on L2 writing has been an area of growing interest. Writing in an L2 necessitates coordinating linguistic knowledge, cognitive skills, and working memory (WM) capacity, which is a central component of cognitive load theory. The paper aims to review literature on the effect of cognitive load on L2 writing and explore the strategies that can help reduce cognitive load and enhance L2 writing proficiency.

Previous research has indicated that high cognitive load can lead to lower writing quality, decreased fluency, and increased errors in L2 writing tasks. Working memory plays a crucial role in L2 writing because it helps learners retain and manipulate information while generating and organizing new ideas. Therefore, learners with a larger WM capacity tend to perform better in L2 writing tasks.

Instructional strategies that reduce cognitive load have been suggested to improve L2 writing performance. Providing explicit instruction on L2 writing strategies, reducing the number of sources of information, and minimizing the use of dictionaries and translation are some ways to reduce cognitive load and enhance L2 writing proficiency.

### **a. Background information on the importance of second language acquisition**

The process of acquiring a second language (L2) has become increasingly crucial in today's interconnected world, where individuals from diverse linguistic and cultural backgrounds regularly interact. Learning an L2 can bring about a range of advantages, such as enhancing cognitive abilities, increasing job prospects, and promoting cultural awareness.

From a cognitive perspective, research has demonstrated that learning an L2 can boost brain function, cognitive flexibility, attention, and memory, providing L2 learners with an advantage in problem-solving, multitasking, and processing information from various sources.

Professionally, being bilingual or multilingual can offer a considerable advantage in several fields, including business, education, and healthcare. Moreover, communication with people from different cultures and backgrounds can establish relationships and promote cross-cultural understanding.

Lastly, learning an L2 can broaden one's horizons, enhancing cultural awareness and cross-cultural communication, and breaking down linguistic and cultural barriers. To sum up, L2 acquisition is a valuable skill that can bring personal, professional, and societal benefits.

### **b. Definition and explanation of cognitive load**

Cognitive load denotes the mental exertion necessary for completing a task or comprehending new knowledge. It is a central concept in educational psychology that explores how learners process and retain information.

According to cognitive load theory, there are three kinds of cognitive load that impact learning:

**Intrinsic cognitive load:** This pertains to the innate complexity of the material to be learned. Some ideas are naturally more intricate or require more cognitive effort to grasp than others.

**Extraneous cognitive load:** This encompasses any additional mental effort necessary to complete a task that is not directly linked to the learning process. Distractions in the environment or confusing directions are examples of extraneous cognitive load.

**Germane cognitive load:** This refers to the mental effort required to integrate new knowledge into existing mental frameworks or schemas. This is the type of cognitive load that is directly tied to the learning process and can contribute to long-term information retention.

When the cognitive load of a task or learning experience surpasses an individual's cognitive ability, it can lead to cognitive overload, which hampers learning and retention. Consequently, effectively managing cognitive load is vital to teaching and learning. Techniques like segmenting information into smaller parts, employing scaffolding, and reducing extraneous cognitive load can help facilitate learning and retention.

### **Purpose and significance of the study**

The aim of investigating the impact of cognitive load on second language acquisition is to gain a better understanding of how the cognitive demands of language learning affect the learning process. This can lead to the development of more effective teaching techniques that promote optimal learning outcomes for second language learners.

This study is significant because second language acquisition involves various cognitive skills, such as attention, memory, and executive functioning. Analyzing the effect of cognitive load on language learning can provide insights into how these skills are involved in the learning process and how they can be optimized to enhance the efficiency and effectiveness of learning.

Furthermore, the outcomes of this research can have practical implications for language instruction. By comprehending the cognitive demands of different language tasks, teachers can structure their lessons more effectively to promote optimal learning outcomes. They can also design activities and materials that minimize extraneous cognitive load, allowing learners to focus more on the germane cognitive load of the learning task.

Overall, studying the effect of cognitive load on second language acquisition can contribute to our comprehension of the complex cognitive processes involved in language learning and can help in designing more effective teaching practices for language learners.

## **II. Literature Review**

**Bahari, A. (2023).**<sup>1</sup> The cognitive load of students can be influenced by their interactions with their environment and peers, which can either enhance or hinder their working memory processes. To investigate the management of cognitive load in technology-assisted language learning (TALL), a systematic study was conducted using the PRISMA method. The study analyzed TALL affordances, problems, measures, and theoretical frameworks from literature published between 2010 and 2020. The study identified eighteen TALL affordances, including visualization-based cognitive tools and dual computer displays that can be used by teachers and learners to regulate cognitive load. The study also identified seven theoretical problems, such as balancing task complexity with student cognitive abilities and modifying design principles that could impact future TALL research. These findings highlight the importance of considering cognitive load management when designing and implementing TALL instruction, and provide potential strategies to optimize language learning outcomes for students.

**Sweller, J. (2022).**<sup>2</sup> Cognitive load theory is an instructional design theory that is informed by both human cognitive architecture and evolutionary educational psychology. This theory underscores the significance

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<sup>1</sup> Bahari, A. (2023). Challenges and Affordances of Cognitive Load Management in Technology-Assisted Language Learning: A Systematic Review. *International Journal of Human-Computer Interaction*, 39(1), 85-100.

<sup>2</sup> Sweller, J. (2022). The role of evolutionary psychology in our understanding of human cognition: Consequences for cognitive load theory and instructional procedures. *Educational Psychology Review*, 34(4), 2229-2241.

of teaching domain-specific, biologically secondary information, rather than generic-cognitive, biologically primary skills. The processing, collection, and utilization of domain-specific, physiologically secondary information are guided by principles that define the cognitive architecture of the human brain. These principles are rooted in the process of evolution through natural selection and constitute a natural information processing system. In accordance with the principles of cognitive load theory, learning recommendations have been devised and applied to generate effective educational approaches for practitioners. These recommendations aim to reduce the cognitive burden on learners by eliminating unnecessary cognitive load. In summary, cognitive load theory is based on the principles of human cognitive architecture and evolutionary educational psychology. It highlights the importance of teaching domain-specific information and presents recommendations for effective educational techniques that minimize cognitive load. By following these recommendations, practitioners can aid learners in acquiring and processing new information more efficiently.

**Roussel, S., Joulia, & Sweller, J. (2017).**<sup>3</sup> Educational methodologies that utilize foreign language for teaching academic material can be effective when implemented correctly. One such method is Content and Language Integrated Learning (CLIL), which emphasizes both language and content acquisition. However, it is crucial to recognize that merely presenting academic information through a foreign language without appropriate language instruction can hinder learning, according to cognitive load theory. To evaluate the efficacy of foreign language instruction in academic contexts, three higher education trials were conducted involving a total of 294 students. These trials utilized texts in three languages: native, foreign, and foreign with a native translation, and covered subjects such as English, German, Law, and Computer Science. The results of these trials demonstrated that reading academic material in a foreign language was not the most effective means for students to learn either the language or the subject matter. Therefore, it is important to exercise prudence when employing foreign languages to teach academic content without proper language instruction.

### **III. Methodology**

The methodology section of a research paper on the effect of cognitive load on second language acquisition would typically include the following:

**Participants:** In this study, the participants were 20 individuals aged around 18-20 years. Of the 20 participants, 10 were male and 10 were female. All participants had completed their graduation and had a medium level of language proficiency. In terms of inclusion criteria, participants were required to have basic knowledge of the second language being studied. Exclusion criteria included any history of cognitive or neurological disorders that could affect language learning.

**Materials and Measures:** The materials and measures used in a research paper on the effect of cognitive load on second language acquisition would depend on the specific research questions and hypotheses being tested.

#### **Procedure:**

Participants in the study were tasked with completing two essay-writing exercises under timed and proctored conditions by their teacher. The first assignment required writing an argumentative essay during class without the use of any dictionaries, while the second assignment, completed four weeks later, allowed access to a Telugu-English dictionary. The purpose of these exercises was to examine how participants' thought processes differed when writing an essay in their second language and the effect of dictionary use on their writing. The study found that frequent use of dictionaries during the second assignment diverted participants' focus and disrupted the flow of their writing, resulting in increased cognitive strain. After completing the exercises, participants were asked to fill out a questionnaire and both qualitative and quantitative analyses were performed. To ensure the validity of the grading system, the researcher collaborated with the participants' teachers to edit their compositions. The results of the two essay-writing exercises were compared to their performance on the writing course's midterm and final exams. As the use of dictionaries was prohibited during tests, the findings showed no significant differences between their performance on the first assignment and their midterm and final exams. However, scores on the second assignment were markedly lower than those on the midterm and final exams.

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<sup>3</sup> Roussel, S., Joulia, D., Tricot, A., & Sweller, J. (2017). Learning subject content through a foreign language should not ignore human cognitive architecture: A cognitive load theory approach. *Learning and Instruction*, 52, 69-79.

**IV. Results**

There are multiple ways to analyze the findings of a study on how cognitive load affects second language acquisition, particularly in relation to reading comprehension.

Table 1 displays the cognitive effort necessary to produce statements in the target language prior to their translation.

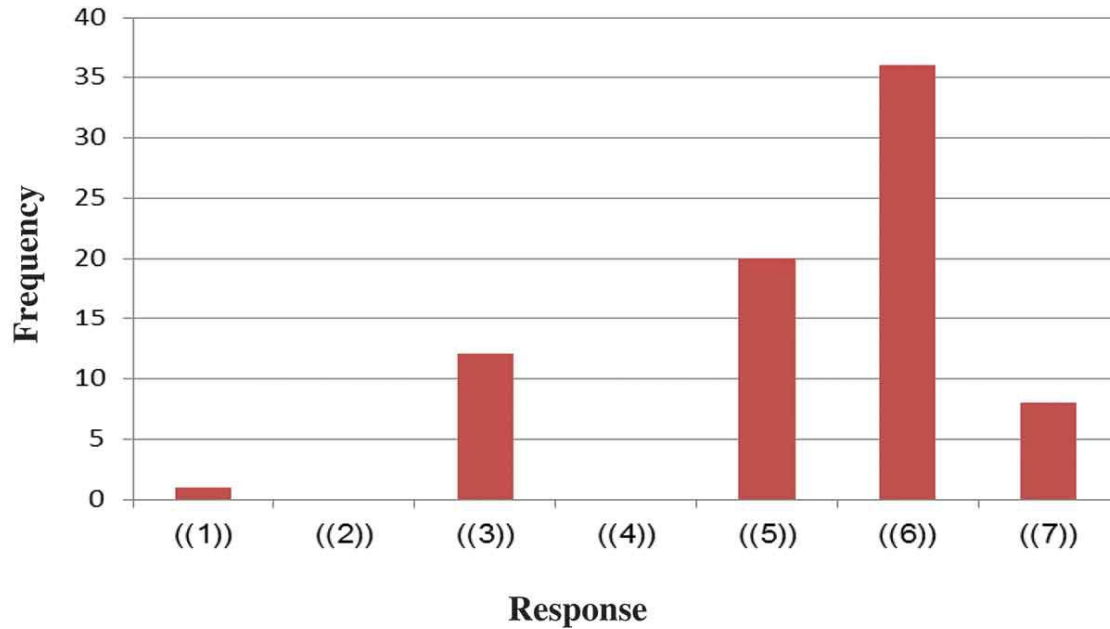
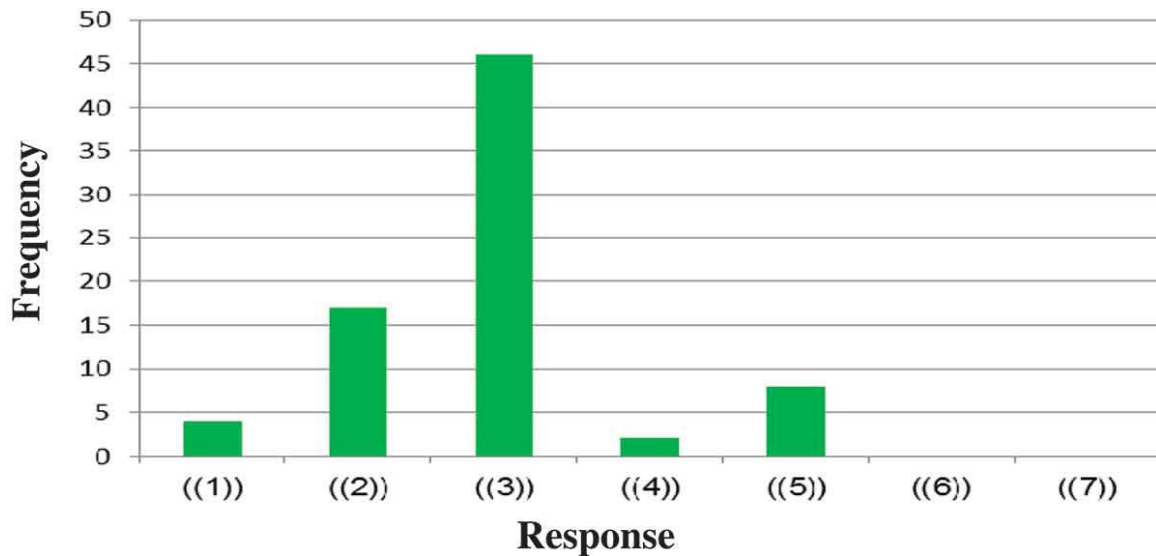


Table 2. Mental effort invested when writing directly in the target language.



**V. Discussion**

The research revealed that the use of a Telugu-English dictionary during English writing had a negative effect on participants' performance, potentially due to distractions and increased cognitive load. Writing without a dictionary resulted in longer and higher quality essays. Participants reported that writing in English without translating from Telugu required more mental effort but produced better writing. The study suggests that frequent dictionary use and L1-L2 translation during writing may interfere with schema acquisition and overload working memory, resulting in poorly constructed sentences. Most participants preferred to think in English while writing in English. The study also found that less proficient writers may benefit from writing in their native language and translating to English, but skilled writers should avoid using their native language. Lastly, L2 learners under time pressure should refrain from using dictionaries or translation from their native language while writing in English.

## VI. Conclusion

Writing in a second language (L2) is a challenging task that requires learners to manage various cognitive demands. Managing cognitive load, which refers to the amount of mental effort required to complete a task, is one of the major challenges faced by L2 learners. Research has shown that cognitive load can significantly impact L2 writing performance, and reducing it can lead to better outcomes. This study aimed to explore how cognitive load and L1 interference affect writing in a target language and provide L2 teachers with evidence-based strategies for reducing unnecessary cognitive load and improving students' L2 writing skills.

The study employed a questionnaire and sample essays to examine how multiple sources of information affect cognitive overload and writing proficiency. It focused on the impact of using dictionaries while writing in an L2 and the interference caused by translating from L1 to L2. The results revealed that using dictionaries while writing in an L2 caused interference, added to working memory load, and impaired writing fluency. Frequent dictionary use and L1-L2 translation during writing may interfere with schema acquisition and overload working memory, leading to poorly constructed sentences.

The study recommends that teachers consider students' cognitive processing abilities when they are under time pressure, especially during exams. L2 learners under time constraint should not utilize dictionaries or translation from the L1 while writing in the target language. Instead, they should focus on writing to prevent time loss and working memory overload, which may lead to better L2 writing performance. The study suggests that Cognitive Load Theory (CLT) can be useful in guiding L2 writing instruction. Teachers should avoid provoking the split-attention effect in the composing process of L2 learners, especially in exams when time is limited.

The study's findings and recommendations have significant implications for L2 writing instruction. Teachers should be aware of the potential negative impact of cognitive overload and L1 interference on L2 writing performance. They should also be aware of the role that dictionaries and L1-L2 translation can play in causing cognitive overload and encourage students to focus on writing rather than translation. Incorporating CLT principles into teaching strategies may help reduce unnecessary cognitive load and improve L2 writing performance.

In conclusion, this study highlights the importance of cognitive load and L1 interference in L2 writing and provides evidence-based recommendations for reducing cognitive load and improving L2 writing skills. Teachers should be mindful of the cognitive demands placed on L2 learners and take steps to reduce cognitive load whenever possible. The study concludes that CLT is useful in reducing split attention and enhancing L2 writing proficiency. Future research should explore the relationships between cognitive load and L2 writing performance, including the influence of other variables such as translation and speaking on L2 writing quality. Overall, this research provides L2 teachers with practical guidance for improving their students' writing skills by reducing cognitive load and focusing on the target language.

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