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Cognitive Processes in Reading Comprehension: A Theoretical Framework for Foreign Language Acquisition

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Abstract – Reading comprehension is a cognitive process essential for language acquisition, particularly in the field of foreign language learning. This paper provides an in-depth exploration of the theoretical foundations of cognitive psychology in the context of reading comprehension in both second and third language acquisition (SLA/TLA). Through an examination of established theories such as schema theory and cognitive load theory, the paper seeks to explain the cognitive processes involved in reading comprehension among foreign language learners. By examining these theories, the paper aims to enhance our understanding of how learners acquire reading skills and develop reading proficiency in foreign languages and explains the cognitive mechanisms that facilitate this process. Furthermore, the paper discusses the implications of these insights for language educators and researchers, highlighting the importance of informed instructional practices and future research directions in the field of foreign language acquisition. Through this exploration of cognitive processes in reading comprehension, the paper contributes to advancing our knowledge of language acquisition and offers practical implications for optimizing instructional strategies in foreign language learning contexts.

Keywords – Reading Comprehension, Cognitive Processes, Theoretical Framework, Second Language Acquisition, Third Language Acquisition.

I. INTRODUCTION

Reading comprehension is a complex cognitive process that plays a crucial role in language acquisition, particularly in the context of foreign language learning. As learners engage with written texts, they must navigate various cognitive processes to extract meaning, infer context, and comprehend the content effectively. In this paper, we explore the theories of cognitive psychology to understand the complex processes involved in how foreign language learners comprehend what they read.

II. SCHEMA THEORY

The term The term "schema" was first used in psychology by the British psychologist Bartlett [1] to describe how past experiences shape our thoughts. He defined "schema" as "an active organization of past reactions or experiences" ([1], p. 201). Rumelhart [2] suggests that all knowledge is packed into units, and these units are schema i.e. a schema is like a mental framework that holds all the main ideas we

remember. Schema theory suggests that individuals organize knowledge into mental frameworks or schemas, which serve as cognitive structures for interpreting and understanding new information. Later, scholars like Rumelhart [2], Carrell [3], and Hudson [4] further advanced Bartlett's theory and applied this concept to reading, emphasizing the importance of background knowledge in understanding texts. According to Brown and Yule [5], a schema is defined as organized background knowledge, stored in fixed schemata, that guides readers to expect or predict aspects in their interpretation of discourse. Eisterhold [6] and Anderson [7] also highlighted the important role of background knowledge on reading comprehension. They all agree that any text does not carry meaning by itself, that the reader brings information, knowledge, emotion and culture to the printed word, as suggested by Brown [8], and they firmly believed that a reader's comprehension relies on the ability to connect the information from the text with the reader's background knowledge. In the context of reading comprehension, schema theory explains how readers use prior knowledge to understand and learn from what they read [2]. It suggests that readers activate existing schemas relevant to the text's content. Schema allows readers to link new information with their prior knowledge and experiences, reducing the unfamiliarity in the content and stimulating the interest. This connection allows readers to make predictions, infer meanings, and construct mental representations of the text. It helps in overcoming reading challenges and ensures accurate understanding.

The literature offers various classifications of schema. Johnson [9] introduces content schema as a crucial schema that readers use to comprehend text. In contrast, Carrell [10] states that content schema isn't sufficient for effective text comprehension. She divides schema into content and formal. Casanave [11] introduces strategy schema, which enables readers to monitor and repair comprehension during reading. According to Widdowson [12], there are two categories of schema: ideational schema i.e. "our knowledge of conceptual content or topic" (p. 108) and interpersonal schema relating to communication mode. Oller [13] and Landry [14] divide schema into content, formal, and abstract. Oller [13] explains that abstract schemata are those that carry the inductive integration to the completely general (abstract, non-material, non-syntacticized) level of pure symbols while Landry [14] identifies abstract schema as hidden thematic factors. Huang [15] adds linguistic or language schemata to these classifications which include "the decoding features needed to recognize words and how they fit together in a sentence" (p. 139). According to the schema theory of reading, there are three types of schema: formal, content and language or linguistic schema [16]. Carrell [10] distinguished linguistic schemata (language knowledge), content schemata (knowledge of the topic) and formal schemata (knowledge of the structures of different types of texts) and explains that all of these aspects are important in the process of interaction between the text and the reader and that if one or all are missing, reading might be difficult.

Linguistic or language schema refers to the readers' background knowledge of the linguistic rules of specific language. This includes knowledge of linguistic elements such as vocabulary, grammar, phonetic rules etc. Without specific language schema, readers would not be able to comprehend specific information within a text or to activate higher-level schema for understanding. The language schema is essential for reading comprehension, serving as a prerequisite for both form and content schema. According to Eskey & Grabe [17], good readers are those who know the language. Effective reading involves both decoding and interpreting texts, as highlighted by Eskey [18], who states that "good readers are both decoders and interpreters of texts" (p. 94). Readers' decoding skills are as important as their reading skills. They should be able to decode both the lexical units and the syntactic structures they encounter in texts. Eskey [18] contends that "even educated guessing at meaning is no substitute for accurate decoding and that successful comprehension of any text is impossible without effective decoding skills" (p.97). According to Carrell and Eisterhold [19], second language readers must possess certain linguistic knowledge to decode texts. Thus, accumulating linguistic information is essential for readers seeking to decode the meaning of a passage.

When reading in a second or third language, developing linguistic schema, acquiring vocabulary, and understanding grammar are essential for effective decoding and comprehension, enabling readers to navigate texts with confidence and understanding. Initially, readers must construct linguistic schema, which forms the foundation of text comprehension and is a vital component of background knowledge.

Vocabulary acquisition is a big challenge for foreign language learners, who often struggle with memorization. To address this, teachers can combine the new words with the previously learned vocabulary which will activate students' existing schema. Teachers should also pay attention to the context in which words are encountered i.e. to the contextual usage, which will facilitate and enhance reading comprehension. Grammar knowledge is equally important and also plays a significant role in reading. Emphasizing grammar in teaching and explaining grammar concepts encountered in texts activates students' schema and facilitates grammar acquisition and reading comprehension.

Students who lack sufficient vocabulary and grammar knowledge often encounter numerous unfamiliar words during reading, which reduces comprehension regardless of their reading skills or background knowledge. To facilitate reading comprehension, teachers should guide students in analyzing complex sentences and acquiring new vocabulary and grammar concepts to overcome reading difficulties. Good readers can figure out what words mean and how sentences are put together. This is really important for understanding text. Without these skills, it's almost impossible to understand what you're reading. For example, think about how hard it would be to read a book if you didn't know what most of the words meant. That's why it's important for students to learn and practice vocabulary and grammar. It helps them understand what they read better. Language schema is really important for understanding text. It's like the foundation of reading, and you need it before you can understand the meaning and structure of what you're reading.

Content schema, as defined by various researchers, refers to the the reader's familiarity with the theme or the background knowledge of a text, including an understanding of its topic and the cultural elements essential for interpretation. According to Brown [8], content schemata contain knowledge about people, the world, culture, and the universe. Carrell [29] describes it as the background knowledge of the content area of a text i.e. as a reader's background knowledge associated with the content domain of the text [10], while Johnson [9] emphasizes the importance of the reader's background knowledge and knowledge about the culture of the text for comprehension. Oller [13] suggests that content schemata relate to specific arrangements of things in the material world as perceived by individuals. Landry [14] defines content schemata as the "clearly evident relationships obvious from a topic" (p. 1). Aebersold & Field [20] highlight the challenge students face when the topic is unfamiliar by stating, "If the topic ... is outside [students'] experience or base of knowledge, they are adrift to an unknown sea" (p. 41), emphasizing the importance of activating content schema for comprehension. Carrell [10] adds that content schema covers topic familiarity, cultural knowledge, conventions, and previous domain experience. Overall, content schema serves as the background knowledge related to a reading passage, covering conceptual information about the topic and its coherence within a text.

One's cultural background significantly influences their approach to reading, as indicated by Kaplan [21], Long [22], and Nostrand [23], who stress the impact of culturally specific schemata on comprehension. Nostrand emphasizes how texts from one culture can mislead readers from another culture, underlining the importance of activating students' relevant schema i.e. background knowledge. To facilitate comprehension, it's essential to present these texts within their authentic cultural context and use topics that relate to them .

Content schemata, which can be specific to a culture, play a crucial role in reading comprehension, especially among foreign language learners, as culture significantly influences how individuals interpret and understand texts. As pointed out by Carrell [24], culture is a significant component of content schemata. This cultural orientation strongly shapes reading habits, as readers analyze and interpret texts according to their cultural background ([27]). Therefore, readers' understanding of a passage is often determined by their cultural context, because any type of writing reflects the culture it originates from, and should be interpreted and understood within that context. Students with limited language skills or those learning a second or third language may find understanding content schema to be a big challenge that they need to overcome. If readers lack the necessary cultural background knowledge, they may struggle to comprehend a text fully, even if they have enough linguistic knowledge, as linguistic schemata alone cannot interact effectively with the content of the text. As noted by Carrell & Eisterhold [16], the absence of culturally specific schema from a reader's background can impede comprehension. Koh [25]

suggests that a readers' comprehension of a text depends on their relevant prior knowledge about the subject matter, and stresses the importance of activating content schemata for effective and meaningful interpretation, rather than relying solely on literal word-by-word interpretation, which is common among foreign language learners or readers. Therefore, educators must raise students' awareness of successful reading, emphasize the importance of activating relevant content schemata, encourage and advise students to read broadly to develop and enrich their content schema, enhancing their reading comprehension skills in both second and third languages, and teach them how to activate their prior knowledge. The studies conducted by Rumelhart and Bransford [26] also emphasize the significance of content schemata in reading comprehension, revealing that readers must possess content knowledge in order to understand the text effectively. However, it is not important for the reader just to have the background knowledge, but this knowledge also needs to be activated by the reader or the text itself to ensure accurate understanding. According to Carrell [3], the text must activate all appropriate cognitive schemata in the reader, in order to be fully comprehended. To understand the text better, readers choose the most appropriate schemata to interpret the words they encounter, because sometimes words alone don't make clear meanings. If the reader lacks appropriate schema i.e. some information related to the text, there won't be a complete or perfect comprehension because the degree to which a student comprehends the text is determined by their content schema. This schema can also help students to overcome vocabulary limitations, especially those learning second or third language. Therefore, teachers should focus on enriching and activating students' content schema.

Formal schema, defined by Carrell [27], as our background knowledge concerning the formal, rhetorical organizational structures of different kinds of texts, is fundamental for interpreting written material. Brown [8] suggests that formal schemata encompasses our knowledge of discourse structure. Oller [13] further elaborates on formal schemata, describing them as the result of inductive connections formed across distinct states of affairs, indexed as similar in some respects. Landry [14] defines formal schemata as "distinct connections based on understanding generalizations and mindsets" (p. 1). In terms of the effects of formal schemata on readers' comprehension, Tudor and Tuff [28] state that formal schemata are more important compared to content schemata. On the other hand, according to Carrell [27], content schemata affected reading comprehension more compared to formal schemata, as evidenced by the results of her experimental study investigating their simultaneous effects on readers' comprehension. This aligns with her statement that content schemata are more important than formal schemata. According to Carrell [29], formal schema refers to abstract, encoded, internalized patterns of meta-linguistic, discoursed, and textual organization that shape our understanding of meaningful piece of language". Simply, formal schemata refer to the structure of a text and represent the reader's knowledge on the style, i.e. the readers' ability to distinguish various styles, formats, and structures within the text. In other words, these schemata encompass the reader's knowledge on the genre, rhetorical structure, and discourse. As mentioned before, understanding formal schema is essential for comprehending a text, as certain content can only be expressed through specific forms or structures. Integrating language and content schemata into reading allows students to understand the text's meaning, but may still struggle with comprehending its organizational structure. Texts encompass various genres and structures, including fiction (novels, short stories, plays, poems) and nonfiction (description, narration, exposition, argumentation). However, exist numerous subcategories within these, including newspaper reports, poems, short stories, editorials etc. Understanding these distinctions enhances comprehension and facilitates navigation through diverse reading materials. In summary, formal schema is the knowledge of different text genres and their respective structural organization, language structures, vocabulary, grammar etc.

The development of formal schema is crucial for readers learning foreign languages, and it relies on the guidance provided by teachers. In reading classes designed for second and third language learners, teachers play a crucial role in introducing students to various literary genres and their distinctive features. Within the reading classes, to facilitate the learning process, teachers often use different text types as exemplars, allowing students to become familiar with different genres and styles. This is essential for students to develop formal schemata and to enhance their ability to read and comprehend texts in foreign

languages. In this context, formal schema is mainly used to help students identify the genre, structure, or form of a given text written in foreign language, providing them with essential tools to understand meaning in unfamiliar linguistic contexts. Teachers engage students in discussions regarding the rules and practices associated with each genre, and reading strategies tailored to different text types, helping them feel more comfortable and confident when reading unfamiliar texts. Teachers may use a variety of teaching methods and techniques to help students understand these concepts and to develop their reading comprehension skills. Students are encouraged to use formal schema independently to identify genres and apply relevant reading strategies and techniques, which helps them develop autonomy and proficiency in reading foreign languages. This way of teaching reading not only helps students get better at understanding texts in foreign languages but also makes them feel more confident when they read different kinds of reading material.

III. COGNITIVE LOAD THEORY

Schema Theory, explored in the previous section, focuses on organizing our prior knowledge and explains how it helps us understand new information and its influence on reading comprehension. Now, we focus on the Cognitive Load Theory (CLT), which is another significant aspect of cognitive processing in learning. Like Schema Theory, it's about how we learn and process information, but it focuses on the limits of our brain's capacity to process new information i.e. how much information our brains can handle at once during learning.

The cognitive load theory (CLT), a psychological theory, originated from the field of cognitive science, was developed by the Australian educational psychologist John Sweller in the late 1980s [30], explaining how the design of learning materials affects human brain during learning. Since the 1990s, cognitive load theory has been studied by researchers worldwide in different disciplines [31] and it has been applied in various teaching areas, such as teaching foreign languages [32]. Cognitive load theory examines the mental resources required for learning, memory and problem-solving tasks, focusing on the amount of information that can be stored and processed in the brain's working memory at a given moment, needed to complete a task [33], [34]. Effective learning relies on the management of the cognitive load, which is the mental effort required to process information. This load is limited by the capacity of working memory, the system responsible for holding and processing information temporarily. The cognitive load theory emphasizes the limitations of the working memory capacity when processing new information [35], highlighting the total mental activity within an individual cognitive system during a given period of time. When learners deal with a large amount of information, they need to manage numerous elements in their working memory and relate them to understand the material. However, this load often exceeds the capacity of working memory, leading to cognitive overload and restricted learning. Sometimes students may feel overwhelmed by the extensive amount of information they receive that surpasses their capacity to absorb. Sweller [30] highlighted the issue of cognitive overload in learning, emphasizing that students may be taught ineffectively because teaching strategies do not align with their learning methods. He states that the human working memory has minimal capacity and cannot process a large amount of information at the same time [36]. Therefore, it is crucial for teachers to consider students' cognitive capacities when designing teaching materials and activities. Otherwise, it may overwhelm students, leading to ineffective learning results and failure to learn, as they often deal with cognitive overload. Teachers should be able to analyze, to understand students' challenges, to solve problems and to tailor teaching materials to align with students' cognitive processing abilities [30].

Cognitive load theory, as described by Sweller [30], explores the organization of information within long-term memory, responsible for storing our knowledge and skills permanently and working memory, responsible for carrying out intellectual tasks related to consciousness. Long-term memory (LTM) stores all the knowledge and skills we've learned in different kinds of schemas. Before information can be stored in long-term memory, it must first be processed by the working memory, which connects new information with the existing schema (knowledge), stored in the long-term memory, enhancing the efficiency of processing this new knowledge [37], [38]). In other words, when we learn something new, our brain automatically tries to associate it with what we already know, which aids in comprehending and storing

the new information better. As new knowledge gets stored in learners' long-term memory, they become more efficient at processing similar content in the future because they already have the information available in their long-term memory, minimizing the time for content processing and freeing up the working memory [39], [40]. Additionally, as more information gets stored in the long-term memory, the demand on the working memory decreases and the capacity for the working memory to process new material increases [38]. The long-term memory has unlimited capacity and contains a wide range of schema that represent information, knowledge, and meaning [37]. On the other hand, working memory has limited capacity and may become overloaded when processing too much information, leading to difficulty in processing new information or connecting it with the existing knowledge stored in the long-term memory [39], [38], [37]. To decrease cognitive overload, it is recommended to break down learning into smaller segments and activities that do not overload memory capacity, allowing learners time to process new information and to connect it with their existing knowledge (schema). Additionally, well-designed instruction should promote both schema construction and schema automation, since automation frees up working memory for other tasks [35]. When we repeatedly apply certain learned structures (schemata), they can become automatic, or automated. Once automated, these structures do not require conscious effort to process because they're stored in long-term memory and can be accessed quickly.

In reading comprehension, cognitive load theory highlights the role of intrinsic, extraneous, and germane cognitive load in processing textual information. Second language learners may experience increased cognitive load when decoding unfamiliar vocabulary, analyzing complex syntactic structures, or integrating new linguistic features, which can impact their comprehension abilities. Beyond simply accessing word meanings, comprehension entails constructing a mental representation of the text, as noted by scholars such as Kintsch [41] and Zwaan & Radvansky [42], involving various cognitive processes such as accessing word meanings, memory retrieval, forming connections with prior knowledge, and making inferences to integrate current sentence with prior sentences and knowledge, as highlighted by Moss et al. [43]. The process of reading comprehension involves numerous interactive variables that have attracted attention in recent years. When learners interact with a text, they use different cognitive procedures to effectively process information, including retrieving and storing new input. These processes are crucial in helping learners to use reading strategies to comprehend the text, highlighting the importance of intrinsic, extraneous, and germane cognitive load in the reading comprehension process. These three types of cognitive load [37], [44]; [40]) make up the capacity of the working memory.

Intrinsic load relates to the inherent difficulty and complexity of the material being learned and is influenced by students' prior knowledge [30]. Basically, it's the natural complexity of the information that needs to be understood, involving cognitive activities essential for forming connections between information elements, integrating them with the existing knowledge and forming new knowledge structures in the working memory. Sweller [30] called this process "element interactivity".

Extrinsic load occurs when external factors such as poor design, ineffective presentation formats, and inappropriate material obstruct the learning process i.e. when teaching methods or materials do not contributie to the learning process [30]. These factors impede the integration of new knowledge from working memory into long-term memory, interfering with the development of schemata, long-term memories, and the learning process. Teachers can minimize extraneous load by employing effective explanations, teaching strategies and appropriate presentations to facilitate and enhance the learning [37], [44], [40], [34].

Germane load, on the other hand, refers to a beneficial type of cognitive load that positively impacts working memory by facilitating productive thinking and processing, ultimately contributing to meaningful learning and long-term memory formation and development [37], [34]. Teachers can enhance germane load through various strategies such as careful sequencing, use of modelling, scaffolding, prompting and dual coding. Sweller [30] proposed that germane load doesn't add to cognitive load but rather reallocates working memory resources from irrelevant activities to those relevant to learning. Balancing all types of cognitive load is crucial for effective learning i.e. educators must manage these loads to maximize learning effectiveness. Overloading working memory with extraneous or intrinsic load

can hinder learning, while ensuring sufficient capacity for germane load promotes optimal learning outcomes [30]. Effective teaching minimizes extraneous load, optimizes intrinsic load, and maximizes germane load to ensure optimal learning outcomes. Educators are encouraged to minimize extraneous load, optimize intrinsic load, and increase germane load to facilitate successful learning outcomes.

Learning a new language can be challenging due to the brain's capacity to handle large amount of information in working memory before transferring it to long-term memory to form schema. To facilitate effective language learning, it's crucial to explore the different types of cognitive load, ensuring that educational materials facilitate the process of foreign language acquisition rather than impede it. Understanding the key principles of the cognitive load theory is essential for educators to select appropriate teaching tools and methods that would minimize cognitive load and enhance germane load, thus aiding in the integration of learning into long-term memory. This approach enhances learners' acquisition of schema and requires teachers to have a deep understanding of the subject matter and appropriate pedagogical knowledge to effectively teach it [45]. Additionally, teachers should adapt their teaching methods based on students' feedback to reduce cognitive load and facilitate learning [37]. As educators, it's crucial to use strategies and appropriate pedagogical methods and resources that encourage students to make connections in their learning, enabling them to integrate new knowledge into long-term memory. This paper aims to raise awareness among teachers about the significance of cognitive load theory in designing lessons, helping them make better learning environments for language students.

IV. CONCLUSION

In this article, we have described two fundamental theories in the field of language learning and reading comprehension: schema theory and cognitive load theory. Schema theory explains how our prior knowledge and experiences organize and shape our understanding of new information, having a significant impact on reading comprehension. Through the lens of schema theory, educators understand the importance of activating and building students' background knowledge (schemata) to improve their reading comprehension abilities, particularly in the context of learning foreign languages. Moreover, cognitive load theory explains the cognitive processes involved in learning and problem-solving tasks, emphasizing the limitations of working memory and the significance of managing cognitive load effectively. By understanding the principles of cognitive load theory, educators can design instructional materials and strategies that optimize learning experiences, reduce cognitive overload, and promote deeper understanding and retention of information, crucial elements in facilitating reading comprehension in foreign language learners. Understanding the key principles of both schema theory and cognitive load theory, educators have valuable tools at their disposal to create more effective and engaging learning environments for language learners. They can adapt teaching methods to activate students' existing schema (prior knowledge), organize learning to manage cognitive load, and encourage connections between new knowledge and prior experiences. Moreover, teachers can use various teaching strategies and resources to accommodate different learning preferences, thereby improving students' reading comprehension skills and overall language proficiency. As this research paper emphasizes, an integrated understanding of schema theory and cognitive load theory provides educators with a comprehensive framework for addressing the complex challenges associated with reading comprehension in foreign language learning contexts. By using the knowledge and strategies derived from these theories, educators can assist language learners to read and comprehend texts more effectively, ultimately enhancing their language skills and facilitating their progress towards achieving linguistic fluency and proficiency.

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