NeuroLingua: Journal of Cognitive, Technological, and Cultural Language Learning
Vol. 02 No. 01 (2026) 21 - 34
https://journal.ekantara.com/neurolingua

Cognitive and Neurolinguistic Perspectives on Language Processing in Technology-Enhanced EFL Learning: A Systematic Literature Review

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Article Information
Submitted April 25, 2026
Revised May 10, 2026
Accepted June 20, 2026

Keywords:
Language Processing; Neurolinguistics; Working Memory; Executive Functions; EFL Learning; Technology-Enhanced Learning.

Abstract
Background: Language processing plays a central role in second language acquisition because it influences how learners comprehend, store, and produce linguistic information. Recent advances in cognitive science and educational technology have expanded understanding of the factors that support language learning.
Aim: This study aims to synthesize research on cognitive and technological perspectives of language processing in English as a Foreign Language (EFL) learning published between 2000 and 2020.
Method: A Systematic Literature Review (SLR) was conducted using peer-reviewed studies obtained from major academic databases. Selected studies focused on language processing, neurolinguistics, working memory, executive functions, and technology-enhanced language learning.
Results: The review revealed that working memory, executive functions, and neurolinguistic mechanisms significantly influence language processing. Furthermore, technology-enhanced learning environments, particularly Computer-Assisted Language Learning (CALL) and Mobile-Assisted Language Learning (MALL), contribute positively to language acquisition by increasing language exposure, learner engagement, and learning flexibility.
Conclusion: Language processing in EFL learning is influenced by the interaction between cognitive mechanisms and technological learning environments. Integrating these perspectives may contribute to more effective language learning practices and future instructional innovations.

I. Introduction

Language processing has become one of the most significant areas of inquiry in Second Language Acquisition (SLA) because it explains how learners perceive, interpret, store, and produce linguistic information during communication and learning activities. As globalization increases multilingual interaction and digital communication, understanding the cognitive mechanisms underlying language learning has become increasingly important for researchers, educators, and policymakers. Contemporary theories suggest that language acquisition is not simply a matter of exposure to linguistic input but rather a complex cognitive process involving memory systems, attentional resources, executive control, and learning experiences (Ellis, 2019; Ellis & Wulff, 2020; Williams, 2020).

Recent developments in cognitive science have highlighted the central role of working memory in language acquisition and language processing. Working memory enables learners to temporarily retain and manipulate linguistic information while simultaneously processing meaning, grammar, and communicative intent. Previous studies have demonstrated significant relationships between working memory capacity and various language learning outcomes, including vocabulary acquisition, reading comprehension, listening performance, speaking fluency, and writing proficiency. These findings indicate that working memory serves as a fundamental cognitive resource supporting successful language learning and language use (Linck et al., 2014; DeKeyser & Criado, 2012; Robinson, 2015).

In addition to working memory, executive functions have emerged as important cognitive mechanisms that influence language processing. Executive functions encompass attentional control, inhibition, cognitive flexibility, and monitoring processes that regulate goal-directed behavior. During language learning, learners must continuously manage competing linguistic information, maintain attention to relevant input, and suppress interference from previously acquired language systems. Such processes are particularly evident among bilingual and multilingual learners who regularly navigate multiple linguistic environments. Consequently, executive control has been widely recognized as a key component of successful language processing and language acquisition (Green, 1998; Bialystok et al., 2012; Bialystok & Barac, 2012).

Neurolinguistic research has further contributed to understanding the biological foundations of language processing. Advances in cognitive neuroscience have demonstrated that language learning is supported by distributed neural systems involving memory networks, language-specific brain regions, and executive control mechanisms. One of the most influential frameworks in this area is the Declarative/Procedural Model proposed by Ullman (2004), which distinguishes between declarative memory responsible for lexical knowledge and procedural memory responsible for grammatical processing. This model has provided valuable insights into how language knowledge is represented, stored, and accessed within the human brain (Ullman, 2004; Williams, 2020; Sulpizio et al., 2020).

Another influential perspective is the usage-based approach, which emphasizes the role of experience and frequency in language learning. According to this perspective, language acquisition emerges from repeated exposure to meaningful language input and communicative interactions. Learners gradually develop linguistic competence by identifying recurring patterns and constructing cognitive representations of language based on usage frequency. Consequently, language processing is viewed as a dynamic interaction between cognitive mechanisms and environmental input rather than a purely rule-based phenomenon (Ellis, 2008; Ellis, 2019; Ellis & Wulff, 2020).

Alongside advances in cognitive and neurolinguistic research, technological innovations have transformed language learning environments. The widespread adoption of digital technologies has facilitated the development of Computer-Assisted Language Learning (CALL) and Mobile-Assisted Language Learning (MALL), both of which provide learners with increased access to authentic language materials, interactive learning experiences, and personalized instructional opportunities. Research indicates that technology-enhanced learning environments contribute positively to learner engagement, language exposure, and communicative competence by creating opportunities for meaningful interaction beyond traditional classroom settings (Hanna et al., 2020; Rajendran & Yunus, 2020; Shadiev et al., 2020).

Mobile technologies have become particularly influential in contemporary language education because they allow learners to engage in language learning activities anytime and anywhere. Previous studies have reported positive effects of mobile-assisted learning on vocabulary development, listening comprehension, speaking performance, learner autonomy, and motivation. Furthermore, mobile applications often provide immediate feedback and individualized learning pathways, which may support cognitive processes associated with language acquisition and language processing (Darsih & Asikin, 2020; Shadiev et al., 2020; Rajendran & Yunus, 2020).

Despite substantial progress in both cognitive language research and technology-enhanced learning, previous studies have often examined these perspectives independently. Cognitive research primarily focuses on memory systems, executive functions, implicit learning, and bilingual language processing, whereas technology-oriented studies tend to investigate instructional effectiveness, learner engagement, and digital learning environments. As a result, there remains a need for a comprehensive synthesis that integrates cognitive and technological perspectives in order to provide a more holistic understanding of language processing in EFL learning (Ellis, 2019; Ullman, 2004; Shadiev et al., 2020).

Therefore, this study aims to systematically review research published between 2000 and 2020 concerning cognitive and technological perspectives on language processing in EFL learning. Specifically, the review seeks to identify major cognitive mechanisms underlying language processing, examine the contributions of technology-enhanced learning environments, and discuss their implications for language instruction and future research. By integrating findings from cognitive psychology, neurolinguistics, second language acquisition, and educational technology, this review contributes to a broader understanding of how language processing can be facilitated and optimized in contemporary EFL contexts (Bialystok et al., 2012; Ellis & Wulff, 2020; Shadiev et al., 2020).

II. Literature Review

Cognitive Language Processing

Language processing refers to the cognitive operations involved in perceiving, interpreting, storing, retrieving, and producing linguistic information. Within the field of Second Language Acquisition (SLA), language processing has become increasingly important because it provides explanations for how learners transform language input into meaningful linguistic knowledge. Contemporary cognitive approaches suggest that language acquisition is strongly influenced by attention, memory, pattern recognition, and learning experiences, indicating that language learning is fundamentally a cognitive activity rather than a purely linguistic phenomenon (Ellis, 2008; Ellis, 2019; Ellis & Wulff, 2020).

One of the dominant perspectives in contemporary SLA research is the usage-based approach. This perspective argues that language learning emerges through repeated exposure to language input and communicative interaction. Rather than relying exclusively on abstract grammatical rules, learners gradually acquire linguistic competence by identifying recurring patterns and constructions in language use. As exposure increases, linguistic representations become stronger and more accessible, facilitating language comprehension and production (Ellis, 2008; Ellis, 2019; Ellis & Wulff, 2020).

Furthermore, language processing involves both explicit and implicit learning mechanisms. Explicit learning occurs when learners consciously attend to linguistic forms and rules, whereas implicit learning develops through repeated exposure without conscious awareness of the acquired knowledge. Previous studies have shown that a substantial portion of language acquisition occurs implicitly, particularly in naturalistic learning environments where learners encounter language in meaningful contexts. Consequently, successful language learning depends on the interaction between conscious learning strategies and unconscious cognitive processes (Williams, 2005; Rebuschat & Williams, 2012; Williams, 2020).

Working Memory and Language Learning

Working memory has been widely recognized as one of the most influential cognitive variables in second language acquisition. It refers to the capacity to temporarily maintain and manipulate information during complex cognitive tasks. In language learning contexts, working memory enables learners to retain lexical items, process grammatical structures, integrate semantic information, and formulate linguistic responses simultaneously. Because language processing requires continuous coordination among multiple cognitive activities, working memory serves as a critical foundation for language acquisition and language use (Linck et al., 2014; Robinson, 2015; DeKeyser & Criado, 2012).

A growing body of research has demonstrated significant relationships between working memory capacity and language learning outcomes. Learners with stronger working memory resources generally achieve higher levels of performance in vocabulary learning, reading comprehension, listening comprehension, speaking fluency, and writing proficiency. These findings suggest that working memory facilitates efficient language processing by enabling learners to manage larger amounts of linguistic information during communication and learning activities (Linck et al., 2014; Robinson, 2015; Ellis, 2019).

The influence of working memory is particularly evident during the early stages of language acquisition when linguistic knowledge has not yet become automatized. As learners gain proficiency and accumulate linguistic experience, many language processes become increasingly automatic, thereby reducing cognitive demands on working memory. Nevertheless, working memory continues to contribute to complex language tasks that require advanced comprehension, production, and problem-solving abilities (DeKeyser & Criado, 2012; Linck et al., 2014; Robinson, 2015).

Neurolinguistic Mechanisms of Language Processing

Neurolinguistics has provided important insights into the neural foundations of language learning and language processing. Advances in cognitive neuroscience have demonstrated that language processing involves interactions among language-specific brain regions, memory systems, and executive control networks. These findings have challenged traditional views of language as an isolated cognitive function and instead emphasize its integration with broader neurocognitive systems (Williams, 2020; Sulpizio et al., 2020; Pliatsikas, 2020).

One of the most influential theoretical frameworks in neurolinguistics is the Declarative/Procedural Model proposed by Ullman (2004). According to this model, language acquisition relies on two complementary memory systems. Declarative memory is responsible for storing lexical knowledge, vocabulary, and semantic information, whereas procedural memory supports the acquisition and automatization of grammatical structures. This distinction provides a neurocognitive explanation for the observation that vocabulary learning and grammar learning often follow different developmental trajectories in second language acquisition (Ullman, 2004; Williams, 2020; Ellis, 2019).

Recent neurocognitive studies have further demonstrated that language processing involves distributed neural networks rather than isolated brain regions. During language comprehension and production, multiple cognitive systems interact to support lexical retrieval, semantic integration, syntactic processing, and attentional control. These findings highlight the complexity of language processing and reinforce the importance of integrating cognitive and neurological perspectives when investigating language learning phenomena (Sulpizio et al., 2020; Pliatsikas, 2020; Williams, 2020).

Executive Functions and Bilingual Language Processing

Executive functions refer to higher-order cognitive processes responsible for regulating attention, behavior, and goal-directed actions. These functions include inhibitory control, cognitive flexibility, attentional regulation, and monitoring processes. Research has increasingly emphasized the importance of executive functions in language learning because successful communication requires learners to select relevant information, suppress interference, and adapt to changing linguistic contexts (Green, 1998; Bialystok et al., 2012; Bialystok & Barac, 2012).

The Inhibitory Control Model proposed by Green (1998) provides a theoretical explanation for how bilingual individuals manage multiple language systems. According to this model, bilingual speakers continuously activate and suppress competing linguistic representations during communication. This process requires substantial executive control and may contribute to the development of enhanced attentional regulation and cognitive flexibility. Consequently, bilingual language use has frequently been associated with improved executive functioning and metalinguistic awareness (Green, 1998; Bialystok et al., 2012; Sulpizio et al., 2020).

Although the existence of a bilingual advantage remains debated, many studies suggest that bilingual experience contributes to cognitive adaptation and executive control development. Continuous management of multiple languages may strengthen neural systems responsible for attention, monitoring, and conflict resolution, thereby supporting language processing and cognitive performance in both linguistic and non-linguistic domains (Bialystok et al., 2012; Bialystok & Barac, 2012; Pliatsikas, 2020).

Technology-Enhanced Language Learning

The rapid development of digital technologies has transformed language learning environments and expanded opportunities for language acquisition. Technology-enhanced language learning encompasses a wide range of digital tools and platforms designed to support language instruction and independent learning. These technologies provide learners with access to authentic language materials, interactive activities, and opportunities for communication beyond traditional classroom settings (Hanna et al., 2020; Rajendran & Yunus, 2020; Shadiev et al., 2020).

Computer-Assisted Language Learning (CALL) has emerged as one of the most influential approaches in technology-enhanced language education. CALL environments integrate multimedia resources, digital learning platforms, and online communication tools to facilitate language acquisition. Previous studies have reported that CALL contributes positively to learner engagement, language exposure, and instructional effectiveness. Moreover, digital learning environments allow learners to receive immediate feedback and participate in individualized learning experiences, both of which support cognitive processes associated with language learning (Hanna et al., 2020; Shadiev et al., 2020; Rajendran & Yunus, 2020).

The effectiveness of CALL may be explained through cognitive learning theories that emphasize repeated exposure, active engagement, and meaningful interaction. By providing learners with opportunities to process language input multiple times and in diverse contexts, digital technologies may strengthen cognitive representations and facilitate language acquisition. Consequently, CALL can be viewed not only as a technological innovation but also as a cognitive support mechanism that enhances language processing (Ellis, 2019; Hanna et al., 2020; Shadiev et al., 2020).

Mobile-Assisted Language Learning (MALL)

The increasing availability of smartphones and mobile devices has contributed to the rapid expansion of Mobile-Assisted Language Learning (MALL). Unlike traditional classroom-based learning, MALL enables learners to access educational resources anytime and anywhere, thereby extending learning opportunities beyond formal instructional settings. This flexibility has made mobile technologies particularly valuable in EFL contexts where opportunities for authentic language exposure may be limited (Darsih & Asikin, 2020; Shadiev et al., 2020; Rajendran & Yunus, 2020).

Research has demonstrated that mobile technologies support various aspects of language learning, including vocabulary acquisition, listening comprehension, speaking performance, learner autonomy, and motivation. Mobile applications frequently incorporate multimedia content, gamification elements, and interactive feedback systems that encourage sustained learner engagement. These features create learning environments that promote active language processing and facilitate meaningful interaction with language input (Darsih & Asikin, 2020; Shadiev et al., 2020; Hanna et al., 2020).

Furthermore, MALL aligns closely with contemporary theories of learner-centered education because it allows learners to control the pace, location, and timing of their learning activities. By increasing accessibility and flexibility, mobile technologies may enhance opportunities for repeated language exposure and practice, thereby supporting cognitive mechanisms associated with language acquisition. Consequently, MALL represents a significant technological advancement with important implications for future language education (Shadiev et al., 2020; Rajendran & Yunus, 2020; Ellis, 2019).

Conceptual Framework

Based on the reviewed literature, language processing in EFL learning can be conceptualized as the product of interactions among cognitive mechanisms, neurolinguistic systems, and technology-enhanced learning environments. Cognitive factors such as working memory, executive functions, attention, and implicit learning influence how learners process, store, and retrieve linguistic information. Neurolinguistic perspectives explain how these cognitive processes are supported by memory systems and neural networks responsible for language acquisition and language use. Meanwhile, technological innovations provide learning environments that facilitate repeated exposure, meaningful interaction, and learner engagement (Ullman, 2004; Ellis, 2019; Shadiev et al., 2020).

Therefore, a comprehensive understanding of language processing requires the integration of cognitive, neurological, and technological perspectives. Such an approach may contribute to more effective language learning models and provide valuable guidance for educators seeking to optimize language instruction in increasingly digital learning environments (Ellis & Wulff, 2020; Bialystok et al., 2012; Shadiev et al., 2020).

III. Method

Research Design

This study employed a Systematic Literature Review (SLR) design to examine cognitive and technological perspectives on language processing in English as a Foreign Language (EFL) learning. A systematic review approach was selected because it enables researchers to identify, evaluate, and synthesize evidence from multiple studies in a structured and transparent manner. Through this approach, the study aimed to provide a comprehensive overview of the cognitive mechanisms and technological factors that influence language processing and language acquisition (Snyder, 2019; Petticrew & Roberts, 2006; Xiao & Watson, 2019).

Research Site and Participants

As a literature review study, no human participants were directly involved. Instead, the units of analysis consisted of scholarly publications obtained from major academic databases, including Scopus, Web of Science, ERIC, ScienceDirect, SpringerLink, Wiley Online Library, and Taylor & Francis Online. The selected studies focused on language processing, neurolinguistics, working memory, executive functions, bilingual language processing, Computer-Assisted Language Learning (CALL), and Mobile-Assisted Language Learning (MALL).

The review focused on studies published between 2000 and 2020. This period was selected because it represents significant developments in cognitive language research, neurolinguistics, and technology-enhanced language learning. Only peer-reviewed journal articles written in English were included in the review to ensure the quality and relevance of the selected literature (Ellis, 2019; Linck et al., 2014; Shadiev et al., 2020).

Instrument

The primary instrument used in this study was a literature review protocol developed to guide the article selection and evaluation process. The protocol consisted of inclusion criteria, exclusion criteria, quality assessment indicators, and data extraction procedures. This instrument ensured consistency and transparency throughout the review process and reduced the possibility of selection bias (Snyder, 2019; Xiao & Watson, 2019).

Inclusion Criteria

The studies included in this review met the following criteria:

1. Published between 2000 and 2020.
2. Published in peer-reviewed academic journals.
3. Written in English.
4. Focused on language processing, neurolinguistics, cognitive mechanisms, working memory, executive functions, bilingual language processing, CALL, or MALL.
5. Related to second language acquisition or EFL learning contexts.

Exclusion Criteria

Studies were excluded if they:

1. Were not peer-reviewed.
2. Focused primarily on clinical language disorders.
3. Were not directly related to language learning or language processing.
4. Provided insufficient methodological information.
5. Were duplicate publications.

Data Collection

The data collection process was conducted between January and March 2024 using several academic databases, including Scopus, Web of Science, ERIC, ScienceDirect, SpringerLink, and Taylor & Francis Online. The literature search employed combinations of keywords such as language processing, neurolinguistics, working memory, executive functions, bilingual language processing, Computer-Assisted Language Learning (CALL), Mobile-Assisted Language Learning (MALL), and EFL learning. These keywords were combined using Boolean operators (AND, OR) to maximize the retrieval of relevant studies.

Initially, 247 records were identified through database searches. After removing duplicate publications, 214 studies remained for title and abstract screening. Subsequently, 76 full-text articles were assessed for eligibility based on the predetermined inclusion and exclusion criteria. Following the evaluation process, 30 studies were selected and included in the final review. The selection procedure was conducted systematically to ensure the relevance, quality, and credibility of the reviewed literature (Petticrew & Roberts, 2006; Snyder, 2019; Xiao & Watson, 2019).

To improve the transparency of the review process, the study adopted a four-stage screening procedure consisting of identification, screening, eligibility assessment, and inclusion. This procedure enabled the researcher to systematically select studies that directly addressed cognitive and technological perspectives on language processing in EFL learning.

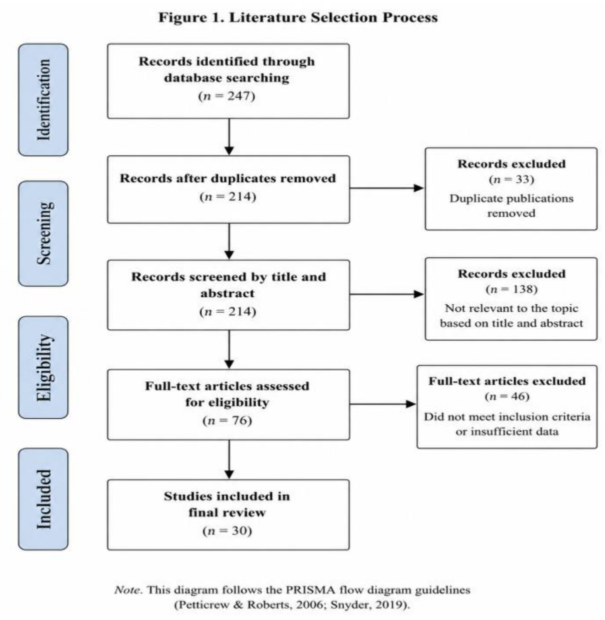

Figure 1. Literature Selection Process

Data Analysis

The selected studies were analyzed using thematic synthesis. Initially, key findings, theoretical perspectives, methodologies, and conclusions from each study were extracted and organized into a review matrix. Subsequently, studies were categorized into major themes including cognitive language processing, working memory, neurolinguistic mechanisms, executive functions, bilingual language processing, CALL, and MALL.

Following categorization, similarities and differences among studies were identified and interpreted to generate broader patterns and conceptual relationships. This thematic approach enabled the researcher to synthesize findings from diverse studies while maintaining the contextual richness of individual investigations (Braun & Clarke, 2006; Snyder, 2019; Xiao & Watson, 2019).

IV. Result and Discussion

Result

The analysis of the selected studies revealed three major themes regarding language processing in EFL learning: (1) cognitive mechanisms underlying language acquisition, (2) neurolinguistic foundations of language processing, and (3) the contribution of technology-enhanced learning environments to language development.

Cognitive Mechanisms in Language Processing

A substantial number of reviewed studies identified working memory as a key factor influencing language acquisition and language processing. Working memory was consistently associated with vocabulary learning, reading comprehension, listening comprehension, grammatical development, and language production. Learners with greater working memory capacity generally demonstrated superior language learning outcomes because they were able to process and retain larger amounts of linguistic information simultaneously (Linck et al., 2014; Robinson, 2015; DeKeyser & Criado, 2012).

Executive functions also emerged as important predictors of language learning success. The reviewed studies indicated that attentional control, inhibition, and cognitive flexibility support learners in managing competing linguistic information during communication. These findings suggest that language processing extends beyond linguistic knowledge and involves broader cognitive control mechanisms (Green, 1998; Bialystok et al., 2012; Bialystok & Barac, 2012).

Neurolinguistic Foundations of Language Processing

The reviewed literature demonstrated strong support for neurocognitive explanations of language acquisition. The Declarative/Procedural Model appeared as one of the most frequently cited frameworks for explaining language learning processes. Studies consistently reported that vocabulary learning is closely associated with declarative memory systems, whereas grammatical learning relies more heavily on procedural memory systems (Ullman, 2004; Williams, 2020; Sulpizio et al., 2020).

Additionally, neurocognitive studies revealed that language processing is supported by distributed neural networks involving language regions, memory systems, and executive control areas. These findings reinforce the view that language acquisition is a multidimensional process involving complex interactions among cognitive and neurological systems (Pliatsikas, 2020; Sulpizio et al., 2020; Williams, 2020).

Technology-Enhanced Language Learning

The findings further indicated that technology-enhanced learning environments contribute significantly to language acquisition and language processing. Research on CALL consistently reported positive effects on learner engagement, language exposure, and instructional effectiveness. Digital learning environments provide learners with opportunities for repeated practice, immediate feedback, and access to authentic language materials, all of which support language development (Hanna et al., 2020; Rajendran & Yunus, 2020; Shadiev et al., 2020).

Similarly, studies investigating MALL reported improvements in vocabulary acquisition, listening skills, speaking performance, learner autonomy, and motivation. Mobile technologies enable learners to engage with language learning materials beyond traditional classroom settings, thereby increasing opportunities for language exposure and interaction (Darsih & Asikin, 2020; Shadiev et al., 2020; Rajendran & Yunus, 2020).

Table 1. Summary of Major Findings

Theme	Main Findings
Working Memory	Positively associated with vocabulary learning, grammar acquisition, reading, listening, speaking, and writing.
Executive Functions	Support attentional control, inhibition, monitoring, and language management.
Neurolinguistics	Language acquisition involves declarative and procedural memory systems.
CALL	Enhances engagement, interaction, and language exposure.
MALL	Improves flexibility, learner autonomy, and language practice opportunities.

Discussion

The findings of this review indicate that language processing is a multidimensional phenomenon influenced by cognitive mechanisms, neurolinguistic systems, and technology-enhanced learning environments. Across the reviewed studies, cognitive factors consistently emerged as the primary determinants of successful language acquisition. Specifically, working memory, executive functions, attention, and implicit learning mechanisms were repeatedly identified as essential components supporting learners' ability to process and retain linguistic information (Ellis, 2019; Linck et al., 2014; Williams, 2020).

The findings concerning working memory support previous research suggesting that language acquisition depends heavily on learners' capacity to temporarily store and manipulate linguistic information. During language learning activities, learners must simultaneously process vocabulary, syntax, meaning, and discourse structures. Therefore, learners with stronger working memory capacity generally demonstrate superior language learning outcomes because they can allocate cognitive resources more efficiently during language processing tasks (Linck et al., 2014; Robinson, 2015; DeKeyser & Criado, 2012).

These findings reinforce the argument that working memory functions as a core cognitive resource underlying second language acquisition.

Furthermore, the reviewed studies highlight the importance of executive functions in language learning. Executive functions enable learners to regulate attention, suppress irrelevant information, and adapt to changing communicative demands. Such abilities become particularly important in multilingual and bilingual contexts where language users frequently encounter competing linguistic representations. Consistent with the Inhibitory Control Model, bilingual language users often develop enhanced attentional control because they continuously manage multiple language systems during communication (Green, 1998; Bialystok et al., 2012; Bialystok & Barac, 2012). Consequently, language processing should not be viewed solely as a linguistic activity but rather as a broader cognitive process involving executive control mechanisms.

The review also demonstrates the significant contribution of neurolinguistic perspectives to understanding language processing. Neurolinguistic research suggests that language acquisition involves interactions among multiple memory systems and neural networks. The Declarative/Procedural Model proposed by Ullman (2004) provides a useful framework for explaining how lexical and grammatical knowledge are acquired through different neurocognitive pathways. According to this perspective, declarative memory primarily supports vocabulary learning, whereas procedural memory facilitates grammatical acquisition and automatic language use. The reviewed studies consistently support this distinction, indicating that language learning involves complex interactions between cognitive and neurological systems (Ullman, 2004; Sulpizio et al., 2020; Williams, 2020).

In addition to cognitive and neurolinguistic factors, technological innovations have emerged as significant contributors to language learning. The reviewed literature demonstrates that technology-enhanced learning environments create opportunities for repeated language exposure, interactive communication, and individualized learning experiences. Computer-Assisted Language Learning (CALL) and Mobile-Assisted Language Learning (MALL) provide learners with access to authentic language resources and immediate feedback, thereby facilitating language processing and language acquisition (Hanna et al., 2020; Rajendran & Yunus, 2020; Shadiev et al., 2020).

The effectiveness of technology-enhanced language learning may be explained through cognitive learning theories. Digital learning environments encourage repeated engagement with linguistic input, which strengthens cognitive representations and promotes long-term retention. Furthermore, mobile technologies allow learners to access language learning materials beyond classroom settings, increasing opportunities for practice and exposure. These findings suggest that technology functions not merely as an instructional tool but also as a cognitive support mechanism that facilitates language processing and language development (Ellis, 2019; Shadiev et al., 2020; Hanna et al., 2020).

Overall, the findings indicate that effective language learning results from interactions among cognitive resources, neurolinguistic mechanisms, and technology-enhanced learning environments. An integrated approach that combines these dimensions may provide a more comprehensive understanding of language processing and contribute to the development of more effective language learning models. Such an approach is particularly relevant in contemporary educational contexts where digital technologies increasingly influence how languages are learned and used (Ellis & Wulff, 2020; Williams, 2020; Shadiev et al., 2020).

Implications

The findings of this review have several implications for language education. First, language instruction should consider cognitive differences among learners, particularly variations in working memory capacity and executive functions. Teachers should design learning activities that reduce unnecessary cognitive load while maximizing meaningful language exposure and interaction. Second, instructional practices should incorporate technology-enhanced learning environments to provide learners with flexible opportunities for language practice beyond the classroom. Third, language educators should adopt pedagogical approaches that integrate cognitive principles, neurolinguistic insights, and technological tools in order to support more effective language acquisition and language development (Ellis, 2019; Hanna et al., 2020; Shadiev et al., 2020).

Limitations and Future Research

Several limitations should be acknowledged. First, this review included only studies published in English between 2000 and 2020, which may have excluded relevant research published in other languages. Second, differences in research designs, participant characteristics, and measurement instruments limited direct comparisons across studies. Third, technological developments have continued to evolve rapidly beyond the review period, particularly with the emergence of artificial intelligence and adaptive learning technologies.

Future studies should investigate how emerging technologies such as artificial intelligence, intelligent tutoring systems, and immersive virtual environments interact with cognitive mechanisms to influence language processing and language acquisition. Further research should also explore the neurocognitive effects of technology-enhanced learning environments using advanced neuroscientific methods in order to provide deeper insights into the relationship between cognition, technology, and language learning (Pliatsikas, 2020; Williams, 2020; Shadiev et al., 2020).

V. Conclusion

This study reviewed research concerning cognitive and technological perspectives on language processing in EFL learning published between 2000 and 2020. The findings demonstrate that language processing is influenced by multiple cognitive mechanisms, including working memory, executive functions, attention, and implicit learning. Neurolinguistic evidence further indicates that language acquisition involves interactions between declarative and procedural memory systems that support lexical and grammatical development.

The review also highlights the significant contribution of technology-enhanced learning environments, particularly CALL and MALL, in facilitating language acquisition through increased language exposure, learner engagement, and learning flexibility. These technologies provide opportunities for meaningful interaction and repeated language practice, which strengthen cognitive processes associated with language learning.

Overall, language processing should be understood as a multidimensional phenomenon resulting from interactions among cognitive resources, neurolinguistic mechanisms, and technological learning environments. Integrating these perspectives may contribute to more effective language instruction and provide valuable directions for future research in second language acquisition and language education.

VI. Acknowledgments

The authors would like to thank all scholars and researchers whose published works formed the foundation of this study. Appreciation is also extended to colleagues and reviewers for their constructive feedback, which contributed to the improvement of this manuscript.

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