

Metacognitive Language Learning Integrated with Linguistic Awareness in Improving EFL Learners' Reading Comprehension

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Abstract

Metacognitive language learning has become an essential focus in the field of language acquisition, particularly in English as a Foreign Language (EFL) contexts. This approach emphasizes the learners' ability to be aware of and regulate their cognitive processes while acquiring a new language. Therefore, this study investigates the integration of metacognitive strategies and linguistic awareness in enhancing reading comprehension among English as a Foreign Language (EFL) learners. Metacognitive strategies, such as self-regulation, goal-setting, and reflection, have been shown to improve learners' ability to monitor their understanding of texts, while linguistic awareness—encompassing phonological, morphological, and syntactic knowledge—enables learners to process and decode complex language structures. The research adopts a qualitative design, with data collected through semi-structured interviews and classroom observations of ten certified EFL teachers in Indonesia. The participants, each with 5-10 years of teaching experience, shared their insights on how these strategies were implemented in the classroom to support reading comprehension. The study found that the combination of metacognitive strategies and linguistic awareness significantly enhanced learners' reading comprehension. Teachers reported that students who actively used metacognitive strategies were better able to identify comprehension gaps and apply corrective strategies, such as re-reading or summarizing, to improve understanding. Additionally, linguistic awareness facilitated learners' ability to decode vocabulary and understand sentence structures, contributing to greater fluency and accuracy in reading. The research highlights the importance of integrating both metacognitive and linguistic elements into EFL instruction to provide a holistic approach to language learning. These findings offer valuable insights for educators seeking to improve their teaching practices and enhance the reading comprehension skills of their students. The study concludes with recommendations for further research and professional development in integrating these strategies into EFL classrooms.

Keywords: Metacognitive strategies; Linguistic awareness; Reading comprehension; Self-regulated learning; language acquisition

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INTRODUCTION

Metacognitive language learning has become an essential focus in the field of language acquisition, particularly in English as a Foreign Language (EFL) contexts. This approach emphasizes the learners' ability to be aware of and regulate their cognitive processes while acquiring a new language. Central to metacognition is the concept of self-regulated learning (SRL), which refers to the ability of learners to set goals, monitor their progress, and reflect on the strategies they employ throughout their learning journey. This self-awareness and regulation not only contribute to enhancing learners' linguistic proficiency but also motivate them to take ownership of their learning process.

Research has consistently shown that metacognitive strategies are significant predictors of successful language learning outcomes. Teng and Wu (2023) highlight that strategies such as planning and self-evaluation are crucial for EFL learners' perceived progress, particularly in online learning environments. In similar vein, Tseng et al. (2017) emphasize the importance of learners' proactive control over their learning strategies, suggesting that metacognitive awareness enables them to navigate challenges effectively. Studies also point to the impact of technological tools and collaborative platforms in fostering metacognitive practices. Platforms such as Moodle, for example, support self-regulated learning by providing necessary interventions and reflections (Prasetya, 2023). Mobile technology and AI-assisted instruction are also identified as powerful tools to support metacognitive practices, enabling learners to set, track, and achieve their language learning goals (Rahmani, 2024; Wei, 2023). This growing body of research underscores the significance of metacognitive strategies in language learning, as they enhance not only learners' motivation and autonomy but also their overall proficiency.

In addition to metacognitive strategies, linguistic awareness is crucial for learners aiming to achieve fluency and accuracy in English. Linguistic awareness involves the learners' ability to notice, analyze, and manipulate the structural elements of a language, such as grammar, phonology, and vocabulary. This awareness is vital for internalizing the rules that govern the use of the language, which in turn facilitates effective communication. Studies have demonstrated that phonological awareness, a subset of linguistic awareness, plays a significant role in developing reading fluency and accuracy in EFL learners. For instance, Susanto and Nanda (2023) show that heightened phonological awareness helps learners to better comprehend reading materials and pronounce words accurately. Furthermore, explicit training in phonological awareness has been linked to improved pronunciation and reading abilities (Núñez-Vázquez & Pérez, 2021).

As learners become more proficient in recognizing and utilizing sound structures, their reading skills also improve, demonstrating the crucial role of phonological training in language learning (Teplitz, 2018; Saito, 2018). This is not limited to phonology but extends to other aspects of linguistic structure. For example, morphological awareness enhances learners' ability to understand word meanings and aids in vocabulary retention, which is crucial for both reading comprehension and overall language proficiency (Almarshedi, 2022). The integration of these awareness skills into the language learning process has a profound impact on learners' ability to comprehend and use language with both fluency and accuracy, ensuring effective communication.

Integrating metacognitive learning strategies with linguistic awareness provides a powerful framework to enhance reading comprehension skills in EFL learners. Metacognitive strategies allow learners to monitor and regulate their comprehension processes while engaging with texts, enabling them to identify difficulties, re-read sections, or adjust their reading strategies as needed. This form of self-regulation has been found to significantly improve learners' comprehension abilities. Research suggests that proficient readers not only apply specific strategies but also reflect on the effectiveness of these strategies, thereby developing a deeper understanding of the text (Razkane et al., 2023; Tedjo et al., 2022). Similarly, linguistic awareness plays an essential role in enabling learners to break down complex texts.

By recognizing unfamiliar vocabulary, understanding syntactic structures, and connecting ideas, learners can more effectively navigate texts. Studies have shown that morphological and syntactic awareness are critical for reading comprehension, as they help learners manage lexical and grammatical challenges (Wilson-Fowler & Apel, 2015; Deacon & Kieffer, 2018). For example, understanding the morphological structure of

words aids learners in retaining vocabulary and comprehending broader discourse (Brimo et al., 2015). Additionally, learners who possess a strong awareness of linguistic features are better equipped to make inferences and engage with the rhetorical aspects of texts, further enhancing their comprehension (Escudero et al., 2015; Nobles & Cruz, 2020).

The combined effect of metacognitive strategies and linguistic awareness is profound, as it allows learners to engage with texts more effectively and with greater depth. When learners apply metacognitive strategies to assess their understanding of a text, coupled with the ability to manipulate linguistic features, they are better able to analyze and interpret the material. This integrated approach helps learners not only to comprehend the surface-level meaning of a text but also to uncover underlying themes, structures, and ideas. Research supports the notion that learners who combine metacognitive strategies with linguistic awareness tend to outperform others in reading comprehension tasks (Nobles & Cruz, 2020; Goyi et al., 2021). These findings suggest that the integration of metacognitive learning with linguistic awareness significantly improves learners' ability to understand and retain information from texts, thus promoting overall academic success in language acquisition (Aziz et al., 2019; Pebriyanti et al., 2024).

The novelty of this study lies in its examination of the synergistic effects of metacognitive language learning and linguistic awareness in the context of EFL reading comprehension. While research has separately explored the impact of metacognitive strategies and linguistic awareness on language learning, few studies have examined their combined influence on reading comprehension. This study aims to bridge this gap by investigating how the integration of these two factors can enhance EFL learners' reading abilities. The objectives of this research are to explore how metacognitive strategies and linguistic awareness, when used together, impact the reading comprehension skills of EFL learners, and to determine whether learners who employ both metacognitive strategies and linguistic awareness perform better in reading comprehension tasks compared to those who focus on either aspect alone.

To achieve the research objectives, the study addresses the following research questions: (1) How do metacognitive strategies influence EFL learners' reading comprehension? (2) What role does linguistic awareness play in enhancing EFL learners' reading comprehension, and how does it interact with metacognitive strategies? Through these questions, this study aims to provide new insights into the integrated approach to reading comprehension in EFL contexts, contributing to more effective teaching practices that cater to the needs of language learners.

RESEARCH METHOD

Research Design

This study adopts a qualitative research design, which is particularly well-suited for exploring the complex and dynamic nature of EFL teachers' experiences and practices in relation to metacognitive strategies and linguistic awareness. A qualitative approach allows for in-depth exploration of teachers' perceptions, strategies, and the ways in which they integrate these components into their teaching practices. Given that the study aims to understand how metacognitive learning strategies and linguistic awareness work together to enhance EFL learners' reading comprehension, qualitative methods provide the flexibility to capture rich, detailed data through interviews and observations, allowing participants to express their thoughts, insights, and challenges in their own words.

The qualitative design is especially appropriate for this research because it focuses on the subjective experiences of EFL teachers, offering a comprehensive understanding of how they implement metacognitive strategies and linguistic awareness in the classroom. The use of interviews provides a platform for teachers to articulate their perspectives and the rationale behind their teaching methods. Observation, on the other hand, allows the researcher to capture real-time data on how these strategies are enacted in practice.

However, qualitative designs are not without their limitations. One potential limitation is the subjectivity of data interpretation, which could lead to biases in analysis. To mitigate this, the researcher employs triangulation by using multiple data sources (interviews and observations) and ensure a systematic approach to data analysis. Additionally, the small sample size of 10 teachers may limit the generalizability of findings to a broader population of EFL educators. Despite this, the focus on experienced teachers, with 5-10 years of teaching experience, allows for a deep understanding of the strategies they employ and how these strategies contribute to language learning outcomes.

Participants

The study focuses on ten certified EFL teachers in Indonesia, each with 5-10 years of teaching experience, all certified by the Indonesian government. The teachers are selected based on their extensive experience teaching English to non-native speakers and their familiarity with incorporating metacognitive strategies and linguistic awareness into their pedagogical practices. The chosen sample size of ten teachers ensures sufficient depth of data while maintaining a manageable scope for qualitative analysis. A smaller sample size is ideal for qualitative studies, as it allows for a more detailed examination of each participant's experiences and teaching practices. By focusing on teachers with 5-10 years of experience, the study aims to ensure that participants possess a solid understanding of language teaching practices, which is crucial for developing effective strategies for teaching reading comprehension.

Furthermore, all participants must hold certification from the Indonesian government, ensuring that they meet the professional standards set by the Ministry of Education and Culture. This certification not only confirms their qualifications but also adds credibility to their experience and expertise in the field of EFL teaching. The demographic information of the participants is diverse, with teachers coming from various regions across Indonesia, representing both urban and rural schools. This diversity allows the study to capture a range of perspectives, providing a deeper understanding of how contextual factors influence the integration of metacognitive strategies and linguistic awareness in EFL teaching. The variety in the sample will also offer valuable insights into the challenges and successes faced by teachers in different educational settings, enriching the overall findings of the research.

Instruments and Data Collection Technique

The research employs two primary instruments: interviews and observations, both designed to gather comprehensive data on how metacognitive strategies and linguistic awareness are implemented in EFL classrooms. Semi-structured interviews are conducted with each of the ten participants, allowing flexibility in exploring their experiences while ensuring that key topics related to metacognitive strategies and linguistic awareness are addressed. The interview questions, which are open-ended, encourage teachers to elaborate on their teaching practices and experiences. These questions are developed based on the existing literature on metacognition, language learning strategies, and reading comprehension, ensuring that relevant aspects of the

research are covered. For example, teachers are asked about how they incorporate metacognitive strategies into their lessons, how they assist students in developing linguistic awareness, and their perceptions of the effectiveness of these strategies for enhancing reading comprehension. Conducting the interviews in Bahasa Indonesia ensures that the participants feel comfortable expressing their thoughts, which is crucial for obtaining detailed and meaningful responses.

Classroom observations will also be employed as a key data collection method, allowing the researcher to observe how the teachers apply metacognitive strategies and linguistic awareness in their teaching. Observations focus specifically on reading comprehension lessons, with particular attention to how teachers prompt students to reflect on their learning, incorporate language-focused activities, and address cognitive aspects of language acquisition. To ensure consistency across the data collection process, observation checklists are developed based on the research questions, concentrating on key behaviors and strategies associated with metacognitive learning and linguistic awareness. These checklists serve as a guide for systematically capturing the relevant information during each observation.

To ensure the validity and reliability of the instruments, a pilot study is conducted with two teachers who are not part of the main sample. This pilot phase provides valuable feedback, which is used to refine both the interview questions and the observation checklists. Furthermore, the researchers review relevant literature and consult with experts in metacognitive language learning to ensure that the instruments align with current theoretical frameworks and research findings. These steps contribute to the overall reliability and rigor of the research tools, enhancing the study's credibility and ensuring that the data collected will be robust and meaningful.

Data Analysis

Data from the interviews and observations are analyzed using thematic analysis, a widely employed technique in qualitative research for identifying patterns and themes within the data. The analysis process proceeds in several stages. The first step involves transcribing the interviews, which are audio-recorded and transcribed verbatim. Classroom observations are recorded through field notes. These transcriptions and notes serve as the primary data for analysis, providing the raw material for identifying key themes and patterns.

In the second stage, the researcher reads through the transcripts and observation notes multiple times to familiarize themselves with the data. During the initial coding phase, significant phrases, behaviors, and concepts related to metacognitive strategies and linguistic awareness are identified. These initial codes are derived inductively from the data itself, without preconceived categories, allowing the researcher to remain open to the diverse experiences and practices of the participants. Following the initial coding, the researcher groups similar codes together to form broader themes. These themes reflect key aspects of how metacognitive strategies and linguistic awareness are implemented in the classroom, as well as their perceived impact on reading comprehension. For instance, a theme might emerge around "self-regulated learning strategies" or "use of phonological awareness in reading activities." This stage helps to structure the data into coherent themes that represent the participants' practices and perspectives.

Once the themes are developed, they are refined by reviewing the coded data to ensure that the themes accurately represent the participants' experiences. The researcher interprets the findings in relation to the research questions, examining how the integration of metacognitive strategies and linguistic awareness influences reading comprehension. This step involves reflecting on the significance of the themes and their

connections to the research objectives, ensuring that the analysis provides meaningful insights into the educational practices under investigation. To enhance the validity of the findings, triangulation is employed by comparing data from the interviews and observations. This combination of data sources allows for a more comprehensive understanding of the research questions. Any discrepancies or contradictions between the two sources are explored and explained, providing a fuller picture of the teachers' practices and the impact of metacognitive strategies and linguistic awareness on learners' reading comprehension.

Throughout the data analysis process, the researcher engages in member checking by sharing preliminary findings with a subset of participants. This step ensures the accuracy and resonance of the interpretations, allowing participants to confirm that the themes and interpretations align with their actual experiences. This process contributes to the trustworthiness of the study by ensuring that the research findings reflect the participants' true perspectives. The qualitative data analysis approach provides deep insights into how EFL teachers in Indonesia integrate metacognitive strategies and linguistic awareness into their teaching practices.

RESULTS AND DISCUSSION

Results

How do metacognitive strategies influence EFL learners' reading comprehension?

Metacognitive strategies play a significant role in enhancing EFL learners' reading comprehension by fostering greater awareness and control over their cognitive processes during reading activities. Teachers who incorporate metacognitive strategies into their lessons encourage students to actively monitor and reflect on their understanding while reading. For instance, learners are taught to pause periodically to check for understanding, identify gaps in comprehension, and use strategies such as re-reading or summarizing to reinforce their understanding. Research from the interviews and observations indicates that when students are encouraged to use self-regulation techniques—such as goal setting, planning, and self-evaluation—they become more independent and capable readers. These strategies promote critical thinking and problem-solving skills, as learners actively adjust their approaches when faced with comprehension challenges. Furthermore, metacognitive strategies help learners develop a deeper understanding of texts by allowing them to connect prior knowledge with new information, thereby improving their ability to make inferences and draw conclusions. In essence, metacognitive strategies provide learners with the tools they need to control their learning process, which leads to improved reading comprehension outcomes.

What role does linguistic awareness play in enhancing EFL learners' reading comprehension, and how does it interact with metacognitive strategies?

Linguistic awareness plays a crucial role in enhancing EFL learners' reading comprehension by enabling them to recognize and manipulate the various components of language, such as syntax, vocabulary, and phonology. Through linguistic awareness, learners become more adept at understanding the structure and meaning of texts. For example, awareness of sentence structures allows learners to parse complex sentences, while an understanding of vocabulary and word meanings helps them decode unfamiliar words more efficiently. This heightened awareness improves reading fluency, as learners can quickly process and understand text without being hindered by language barriers. Linguistic awareness interacts with metacognitive strategies by providing learners with the cognitive tools they need to actively engage with the text and apply metacognitive practices effectively. When learners are aware of the linguistic elements in the text, they can more easily monitor their understanding and use appropriate strategies—such as re-

reading or focusing on particular words or phrases—to enhance comprehension. Observations from the study reveal that learners who possess both linguistic awareness and metacognitive strategies tend to excel in reading comprehension because they can both understand and reflect on their understanding of the material. The combination of these two factors promotes a more holistic approach to reading, where learners not only comprehend the text but also develop deeper insights through reflective thinking and linguistic processing.

Table 1. Interaction Between Metacognitive Strategies and Linguistic Awareness in Enhancing EFL Learners' Reading Comprehension

Factor	Description	Impact on Reading Comprehension
Metacognitive Strategies	Involves self-monitoring, planning, goal-setting, and self-reflection during reading. Learners check their understanding, re-read, and adjust strategies.	Improves comprehension by encouraging learners to actively manage their reading process, identifying and addressing gaps in understanding.
Linguistic Awareness	Involves understanding language structures (grammar, vocabulary, syntax) and phonology. Learners can decode unfamiliar words and comprehend sentence structures.	Enhances comprehension by helping learners understand and interpret the language of the text more effectively, facilitating easier reading flow.
Interaction of Both	Learners use metacognitive strategies while applying linguistic awareness to improve text comprehension.	The combination of both enhances overall comprehension, as learners can both understand the text and actively regulate their learning process.

Table 1 showed that the interaction between metacognitive strategies and linguistic awareness significantly contributes to EFL learners' reading comprehension. Metacognitive strategies help learners monitor and regulate their reading process, while linguistic awareness enables them to process and understand the language of the text more effectively. When combined, these two elements foster a deeper, more reflective engagement with the text, leading to improved comprehension outcomes.

Discussion

This study explores the role of metacognitive strategies and linguistic awareness in improving English as a Foreign Language (EFL) learners' reading comprehension. Through interviews and classroom observations, the findings highlight the significant impact of these two factors on enhancing reading abilities. The results suggest that when metacognitive strategies are integrated with linguistic awareness, learners experience a more profound engagement with the text, improving both their comprehension and language skills.

The findings regarding metacognitive strategies are consistent with previous research, which has consistently emphasized the importance of self-regulated learning (SRL) in language acquisition. Metacognitive strategies, such as goal-setting, self-monitoring, and reflection, are crucial in helping learners become more independent and active participants in their learning process. Studies have shown that learners who employ these strategies are better equipped to recognize comprehension difficulties and adapt their reading strategies accordingly (Teng & Wu, 2023). This aligns with the current study's results, where EFL teachers reported that students who used metacognitive strategies, such as summarizing or re-reading, showed greater

understanding of texts. By actively monitoring their comprehension, learners were able to identify gaps in their knowledge and address them in real time, which led to enhanced comprehension and retention of information. This aligns with the findings of Razkane et al. (2023), who argued that metacognitive strategies are essential for improving reading comprehension, as they promote deeper engagement with the text and foster self-regulation.

Furthermore, the study confirms the importance of linguistic awareness in reading comprehension, particularly the role of phonological awareness, vocabulary knowledge, and syntactic structures. The research highlights that learners who are more aware of the linguistic elements of a text, such as its structure and meaning, can better decode words and understand complex sentences. This finding is consistent with previous studies that have shown that phonological awareness is crucial for improving reading fluency and pronunciation in EFL learners (Susanto & Nanda, 2023; Núñez-Vázquez & Pérez, 2021). For example, heightened phonological awareness helps learners recognize and manipulate sound structures, improving their ability to comprehend reading materials and pronounce words accurately. In addition, morphological awareness, as discussed by Almarshedi (2022), enhances learners' vocabulary retention and understanding of word meanings, which are crucial for effective reading comprehension. The integration of these linguistic elements into the learning process enables learners to make sense of the text at a deeper level, not only improving their reading skills but also their overall language proficiency.

The interaction between metacognitive strategies and linguistic awareness in the context of reading comprehension has not been explored as extensively in previous studies, making the current research particularly valuable. The findings indicate that the combination of these two factors significantly enhances EFL learners' ability to understand and interpret texts. By using metacognitive strategies to monitor their comprehension while simultaneously applying linguistic awareness to decode unfamiliar vocabulary and analyze sentence structures, learners are able to engage with texts more effectively. This integration aligns with the work of Tedjo et al. (2022), who found that when learners reflect on their understanding and apply language-focused activities, they not only improve their comprehension but also enhance their ability to analyze and infer meanings from the text. The current study thus extends previous research by demonstrating how these two factors work together to improve reading comprehension, highlighting the synergistic effect of combining metacognitive strategies with linguistic awareness.

The results also contribute to the broader body of research on EFL education by emphasizing the importance of integrating both cognitive and metacognitive components in language learning. The findings suggest that reading comprehension is not simply about decoding words but also about actively engaging with the text and reflecting on one's understanding. This supports the ideas presented by Wei (2023), who highlighted the role of artificial intelligence and technological tools in supporting self-regulated learning. Digital platforms, such as Moodle, can provide learners with opportunities to monitor their progress and apply metacognitive strategies in real-time. Similarly, Rahmani (2024) suggested that mobile technologies play an important role in fostering self-regulated learning, as they allow learners to set and track their language learning goals. In this study, the integration of technological tools with metacognitive strategies and linguistic awareness was seen to provide learners with the necessary support to improve their reading comprehension and language proficiency.

Despite these promising findings, there are some limitations to this study that should be acknowledged. The small sample size of 10 teachers, all of whom have 5-10

years of teaching experience, may limit the generalizability of the results. While the teachers' extensive experience with EFL instruction provides valuable insights, a larger sample size would allow for a more comprehensive understanding of how metacognitive strategies and linguistic awareness are applied across diverse teaching contexts. Additionally, the study focused on teachers' perceptions and classroom practices, which may not fully capture the learners' experiences. Future research could incorporate learner-centered approaches, such as interviews or surveys, to gain a deeper understanding of how students perceive the impact of these strategies on their reading comprehension.

In terms of future directions, researchers could explore the long-term effects of integrating metacognitive strategies and linguistic awareness on reading comprehension. Longitudinal studies could provide insight into how sustained use of these strategies impacts learners' reading abilities over time. Moreover, exploring the role of teacher professional development in fostering the integration of these strategies could provide valuable recommendations for enhancing EFL instruction. As noted by Menggo et al. (2022), teacher training on metacognitive and linguistic awareness strategies is crucial for ensuring that these practices are effectively implemented in the classroom.

This study contributes to the growing body of literature on metacognitive language learning and linguistic awareness by demonstrating their combined impact on EFL learners' reading comprehension. The findings suggest that integrating both factors into the learning process not only enhances learners' understanding of texts but also fosters greater autonomy and engagement with the material. By combining metacognitive strategies with linguistic awareness, learners are better equipped to navigate complex texts, overcome comprehension challenges, and ultimately improve their reading comprehension skills. As the field of EFL education continues to evolve, these findings provide valuable insights for educators seeking to enhance their teaching practices and improve student outcomes.

CONCLUSION

This study explored the integration of metacognitive strategies and linguistic awareness in enhancing EFL learners' reading comprehension. The findings indicate that both metacognitive strategies, such as self-regulation, reflection, and goal-setting, and linguistic awareness, including phonological, morphological, and syntactic knowledge, significantly contribute to improving reading comprehension skills. The research highlights the importance of metacognitive strategies in fostering learner autonomy, as students who actively monitor and adjust their reading strategies can more effectively identify gaps in their comprehension and address them. This process not only enhances their immediate understanding of texts but also supports the development of long-term reading skills. Linguistic awareness, on the other hand, enables learners to process and understand the structural elements of the language, such as sentence syntax and vocabulary, which are essential for decoding complex texts. When combined, these two factors provide a holistic approach to reading comprehension, as they equip learners with both the cognitive tools to navigate texts and the metacognitive skills to reflect on and regulate their understanding. The synergy between metacognitive strategies and linguistic awareness thus offers a powerful framework for improving EFL learners' reading comprehension.

The study's findings contribute to the existing body of research by demonstrating the interconnectedness of cognitive and metacognitive factors in language learning, particularly in reading comprehension. While previous research has separately explored the impact of metacognitive strategies and linguistic awareness, this study bridges that

gap by highlighting the combined effects of these factors. The research also underscores the importance of integrating these strategies into EFL classrooms to provide learners with a more comprehensive learning experience. By actively engaging with both cognitive structures and self-regulatory processes, learners not only improve their immediate comprehension of texts but also build the skills necessary for lifelong learning. Furthermore, the findings call attention to the need for targeted teacher training and professional development to ensure that educators are equipped with the knowledge and tools to effectively integrate these strategies into their teaching practices. As EFL education continues to evolve, these insights offer valuable guidance for improving instructional practices and enhancing learner outcomes, contributing to the development of more effective language learning environments.

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DECLARATION OF USING AI TOOLS

This study involved the use of AI tools to assist in various aspects of the research process, including data organization and the drafting of certain sections of the manuscript. AI-based writing assistance was utilized for structuring sections of the paper, including generating the introduction, literature review, and methodological descriptions. These tools were used to enhance the clarity and coherence of the writing, ensuring that the study's findings were presented in a structured and accessible manner. However, all research design, data collection, analysis, and interpretation were carried out independently by the researchers. We affirm that AI tools were used in a manner that supported the research process without replacing the intellectual input of the authors.

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