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INTERNATIONAL SCIENTIFIC JOURNAL OF

2026 / No. 1(2)

Contemporary Pedagogical and Philological Research

AI-ASSISTED VOCABULARY LEARNING AND LONG-TERM VOCABULARY RETENTION

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Abstract. The rapid development of artificial intelligence has introduced new opportunities for vocabulary learning in English as a Foreign Language (EFL) education. AI-powered applications, particularly intelligent chatbots, adaptive vocabulary platforms, and generative AI tools, provide learners with personalized explanations, contextual examples, interactive exercises, and immediate feedback. Although these technologies can facilitate vocabulary acquisition, an important question concerns their effectiveness in supporting long-term vocabulary retention. Learning a word temporarily and remembering it over an extended period are different processes that require repeated exposure, meaningful engagement, retrieval practice, and contextualized use. The present study examines the role of AI-assisted vocabulary learning in developing long-term vocabulary retention among EFL learners. A qualitative literature-based research design is employed to analyze existing theoretical and empirical studies concerning artificial intelligence, vocabulary acquisition, memory consolidation, and digital language learning. Particular attention is given to personalized learning, contextual vocabulary presentation, spaced repetition, active retrieval, multimodal input, and productive vocabulary use. Previous empirical research indicates that AI-supported vocabulary instruction can improve receptive and productive vocabulary knowledge and contribute to delayed retention. Zhang and Huang (2024), for example, found that large language model-based chatbots supported

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vocabulary acquisition among foreign language learners, including the retention of productive vocabulary. More recent research has also compared AI-assisted applications with retrieval-based digital flashcards, highlighting the importance of contextualized and interactive vocabulary practice. The study emphasizes that AI technology alone does not guarantee permanent vocabulary learning. Its effectiveness depends on the quality of instructional activities, the frequency of meaningful retrieval, and learners' active participation. It concludes that combining AI-assisted learning with spaced repetition, contextual practice, and independent vocabulary production can create more sustainable conditions for vocabulary development in EFL education.

Keywords: artificial intelligence, vocabulary learning, long-term retention, EFL students, ChatGPT, vocabulary acquisition, spaced repetition, retrieval practice, digital learning, language education.

INTRODUCTION

Vocabulary knowledge is one of the fundamental components of successful foreign language learning. The ability to understand and use English effectively depends largely on learners' knowledge of words, their meanings, grammatical behavior, pronunciation, collocations, and contextual functions. Without sufficient vocabulary knowledge, learners may experience difficulties understanding written texts, participating in conversations, expressing ideas, and producing academically appropriate language. Vocabulary learning is particularly challenging for students studying English as a Foreign Language because they often have limited opportunities to encounter and use English outside the classroom. Unlike learners living in English-speaking environments, EFL students frequently depend on textbooks, classroom activities, digital resources, and independent study to expand their vocabulary. Another major challenge is vocabulary retention. Students may memorize new words before a test but forget many of them after several days or weeks. This situation demonstrates that vocabulary acquisition should not be evaluated only through immediate test

performance. Long-term retention requires learners to establish stable connections between new words, their meanings, contexts, and existing linguistic knowledge. Nation (2001) emphasizes that vocabulary knowledge involves multiple dimensions, including form, meaning, and use. Knowing a word therefore means more than remembering its translation. Learners need to recognize its pronunciation, spelling, grammatical characteristics, collocations, and appropriate contexts of use. Schmitt (2000) similarly explains that vocabulary acquisition is a gradual process involving repeated encounters with words and the development of different aspects of lexical knowledge. These perspectives demonstrate that effective vocabulary instruction should provide opportunities for meaningful exposure, retrieval, and productive application. In recent years, artificial intelligence has created new possibilities for addressing these challenges. AI-powered educational tools can generate personalized vocabulary exercises, provide contextual examples, explain unfamiliar expressions, and create interactive conversations based on learners' proficiency levels. ChatGPT and other large language models can function as conversational learning partners. Students can ask questions about unfamiliar words, request explanations, compare synonyms, practice collocations, and produce sentences using newly learned vocabulary. Kasneci et al. (2023) argue that large language models offer important educational opportunities through personalized support, immediate feedback, and interactive learning experiences. At the same time, they emphasize the need to consider limitations related to inaccurate information and excessive dependence on automated systems. In vocabulary instruction, AI applications may support learning by presenting words in different contexts and adapting explanations to individual needs. For example, when a student encounters the word "significant," an AI chatbot can explain its meaning, provide synonyms, demonstrate its use in academic sentences, and generate exercises that require the learner to apply it. This type of interaction may help students develop a deeper understanding of vocabulary than memorizing isolated word lists. Zhang and

Huang (2024) investigated the impact of large language model-based chatbots on second language vocabulary acquisition. Their study involved 52 foreign language learners who were divided into experimental and control groups. Both groups studied the same target vocabulary over eight weeks, while the experimental group received chatbot assistance. The researchers assessed receptive and productive vocabulary knowledge immediately after the learning period and again two weeks later. Their findings indicated that chatbot-assisted learning supported both receptive and productive vocabulary development. Particularly important was the contribution of chatbot interaction to the retention of productive vocabulary and incidental vocabulary learning. These findings suggest that AI-assisted vocabulary learning can extend beyond immediate memorization and support the development of vocabulary knowledge that learners can actively use. Another important factor in vocabulary retention is repeated retrieval. Learners are more likely to remember words when they actively recall their meanings rather than simply rereading definitions. Karpicke and Roediger (2008) demonstrate the importance of retrieval practice in long-term learning. Their research indicates that repeated testing and recalling information can contribute substantially to memory retention. Chukharev-Hudilainen and Klepikova (2016) investigated computer-based spaced repetition in foreign language vocabulary instruction. Their study demonstrated that regularly scheduled vocabulary activities could substantially improve long-term retention among EFL learners. AI-assisted applications can combine these principles by organizing personalized review sessions and generating exercises based on previously studied vocabulary. Recent research has further expanded the investigation of AI-supported vocabulary learning. Tuzcu-Eken (2026) compared an AI-assisted multimedia vocabulary application with a retrieval-based digital flashcard application among university EFL students. The results indicated that both approaches improved receptive vocabulary knowledge, while the AI-assisted application demonstrated higher immediate and delayed learning gains in

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the investigated sample. These findings highlight the potential of combining contextualized multimedia resources with interactive vocabulary production. The relationship between AI-assisted vocabulary learning and long-term retention is especially relevant to Uzbek university students. Many EFL learners in Uzbekistan study vocabulary through traditional translation exercises, textbook activities, and memorization. Although these approaches can introduce new words, students may have difficulties remembering and using them after the initial learning period. AI-assisted tools may provide additional opportunities for repeated exposure, contextual learning, personalized feedback, and independent practice. However, the effectiveness of these tools depends on how they are integrated into the learning process. If students only read AI-generated definitions without recalling or using the target words, their learning may remain superficial. Therefore, it is necessary to investigate how AI-assisted vocabulary learning can support long-term retention and which instructional principles make this process more effective. The purpose of the present study is to examine the relationship between AI-assisted vocabulary learning and long-term vocabulary retention among EFL learners. Particular attention is given to personalized instruction, contextualized vocabulary learning, retrieval practice, spaced repetition, and productive vocabulary use.

METHODS

The present study adopts a qualitative literature-based research design to investigate the role of artificial intelligence in vocabulary learning and long-term vocabulary retention. The methodological framework is informed by second language vocabulary acquisition, cognitive psychology, retrieval-based learning, and computer-assisted language learning. The study draws on established theoretical contributions by Nation (2001), Schmitt (2000), Karpicke and Roediger (2008), and recent empirical investigations of AI-assisted vocabulary learning by Zhang and Huang (2024) and Tuzcu-Eken (2026). The selected literature was examined thematically, focusing on the

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relationship between AI-supported learning activities and the development of durable vocabulary knowledge. Particular attention was given to personalized vocabulary instruction, contextualized word presentation, interactive communication, multimedia learning, spaced repetition, retrieval practice, and productive vocabulary use. The analysis considered both receptive and productive vocabulary knowledge. Receptive vocabulary refers to the words learners can recognize and understand when they encounter them in reading or listening. Productive vocabulary refers to the words learners can independently use in speaking and writing. These dimensions are important because recognizing a word does not necessarily mean that a learner can use it correctly in communication. Long-term vocabulary retention was examined in relation to learners' ability to recall previously studied words after a period without direct instruction. The analysis also considered whether learners could use retained vocabulary in new contexts. AI-assisted vocabulary learning was evaluated through its potential to provide personalized explanations, generate contextual examples, support repeated practice, and encourage independent production. The study also considered the limitations of AI-assisted vocabulary learning, including inaccurate explanations, superficial engagement, excessive dependence, and insufficient opportunities for independent retrieval. The literature-based approach makes it possible to identify common patterns and pedagogical implications without presenting invented participant data or unconducted experiments as original research findings.

RESULTS

The analysis of existing theoretical and empirical research identifies several important factors through which AI-assisted learning may influence vocabulary acquisition and long-term retention. One of the major advantages of AI-assisted vocabulary learning is the possibility of providing individualized instruction. Traditional vocabulary lessons often introduce the same words and exercises to all students, even though learners differ in their vocabulary knowledge, learning speed,

interests, and educational needs. AI-powered applications can provide explanations and exercises according to individual learning requirements. Students can request simpler definitions, additional examples, translations, pronunciation support, and explanations of differences between similar words. For example, a learner studying the word "environment" may initially receive a basic definition. The learner can then request examples related to environmental protection, academic research, or everyday communication. Such personalization can help students understand vocabulary at different levels of complexity. Kasneci et al. (2023) emphasize that large language models can support personalized learning by adapting explanations and educational content to learners' needs. In vocabulary instruction, this flexibility may increase opportunities for meaningful engagement and help students address individual lexical difficulties. However, personalization should not be limited to presenting information. Effective vocabulary learning also requires activities that encourage students to recall, recognize, and independently use newly learned words.

Understanding vocabulary in context is essential for developing comprehensive lexical knowledge. Words frequently have different meanings depending on the situations in which they are used. Therefore, memorizing isolated translations may not provide sufficient information about their actual communicative functions. AI applications can generate multiple sentences, dialogues, short texts, and situational examples containing target vocabulary. For instance, students learning the word "approach" can examine its use in educational, scientific, professional, and everyday contexts. This allows learners to understand how the same word may function differently depending on the subject and communicative purpose. Nation (2001) emphasizes the importance of understanding word meaning, form, and use as interconnected dimensions of vocabulary knowledge. AI-generated contextual examples may support this process by exposing learners to different patterns of lexical use. Zhang and Huang (2024) provide empirical evidence concerning the potential of

chatbot interaction in second language vocabulary acquisition. Their findings suggest that conversational AI can support vocabulary learning through interactive engagement and incidental exposure to words. Nevertheless, students should verify unfamiliar explanations and examples when accuracy is particularly important. Spaced repetition is one of the most important principles associated with long-term vocabulary learning. Rather than studying a word intensively in a single session, learners encounter and review it at intervals over an extended period. This approach provides repeated opportunities to retrieve information from memory and strengthens the accessibility of previously learned vocabulary. Karpicke and Roediger (2008) demonstrate that retrieval practice plays a significant role in long-term retention. Chukharev-Hudilainen and Klepikova (2016) also provide empirical evidence that computer-based spaced repetition can improve vocabulary retention among EFL learners. AI-assisted learning applications may support this process by generating personalized review activities and adjusting the presentation of vocabulary according to learners' previous performance. For example, a student who repeatedly forgets a particular word may receive additional practice, while words that are consistently recalled correctly may be reviewed less frequently. Such adaptive review can help learners distribute their study time more effectively. However, spaced repetition should involve active retrieval rather than simple exposure. Students should attempt to remember the meaning of a word before viewing its definition.

Active retrieval involves recalling information from memory without immediately referring to the original learning material. In vocabulary learning, this may involve remembering a word’s meaning, producing its translation, completing a sentence, or using it in an original paragraph. AI chatbots can support retrieval practice by asking students questions and requiring them to respond independently.

For example, an AI chatbot may present the definition of a word and ask the learner to identify it. Alternatively, it may provide a target word and request an original

sentence demonstrating its meaning. These activities encourage students to retrieve vocabulary from memory rather than simply recognize familiar information. Karpicke and Roediger (2008) demonstrate that repeated retrieval can produce stronger long-term learning than repeated study alone. Therefore, AI-assisted vocabulary instruction should prioritize activities that require learners to actively recall and apply target words. Vocabulary knowledge includes both receptive and productive dimensions. Receptive vocabulary refers to words learners understand when they encounter them in written or spoken language. Productive vocabulary involves the ability to use words independently and appropriately. AI applications may support both dimensions through different types of activities. For receptive vocabulary development, students can ask AI tools to explain unfamiliar words, provide synonyms, and generate reading passages containing target vocabulary. For productive vocabulary development, students can practice writing sentences, creating dialogues, answering questions, and composing short paragraphs. Zhang and Huang (2024) investigated both receptive and productive vocabulary development among foreign language learners. Their findings indicated that large language model-based chatbot assistance supported vocabulary acquisition and contributed particularly to the retention of productive vocabulary. This is an important finding because productive vocabulary knowledge is often more difficult to develop than simple word recognition. Students may understand a word when reading but experience difficulties using it independently. Interactive AI activities can provide additional opportunities to overcome this difficulty by encouraging learners to produce vocabulary in meaningful contexts.

Another important characteristic of AI-assisted vocabulary learning is the possibility of integrating different forms of information. Multimedia vocabulary instruction may combine written definitions, pronunciation, images, audio, and contextual examples. Mayer (2009) explains that multimedia learning can support understanding when verbal and visual information are appropriately organized and

integrated. In vocabulary instruction, visual representations may help students connect unfamiliar words with concrete objects, actions, and situations. For example, an AI-supported vocabulary activity about transportation may include written descriptions, images, and contextual sentences related to different vehicles.

This combination may provide additional memory connections and make vocabulary learning more meaningful. Tuzcu-Eken (2026) examined an AI-assisted multimedia vocabulary application and compared it with a retrieval-based digital flashcard application. The study involved 128 university students from three EFL classes. Both applications improved receptive vocabulary knowledge, but the AI-assisted multimedia application produced significantly higher immediate and delayed vocabulary gains than the retrieval-based application in the investigated sample. The interviews also indicated that learners valued contextualized multimedia resources and AI-assisted productive activities. These findings suggest that combining visual input, contextual information, and interactive practice may contribute to vocabulary development. Nevertheless, multimedia materials should be relevant to the target vocabulary. Excessive visual information may distract learners and increase cognitive demands. Incidental vocabulary learning occurs when learners acquire new words while participating in activities whose primary purpose is not memorizing vocabulary. For example, students may encounter unfamiliar expressions while discussing a topic with an AI chatbot or reading an AI-generated story. In these situations, vocabulary acquisition occurs as part of meaningful communication. Zhang and Huang (2024) identify incidental vocabulary learning as one of the potential benefits of large language model-based chatbot interaction. AI chatbots can generate conversations around students' interests, academic subjects, and everyday experiences. This creates opportunities to encounter unfamiliar words in meaningful contexts. For example, a student interested in environmental issues may participate in an AI-supported discussion about climate change, renewable energy, and sustainable development.

During this interaction, the learner may encounter new vocabulary and gradually develop an understanding of its meaning and use. However, incidental exposure alone may not guarantee long-term retention. Newly encountered vocabulary should be reviewed and used in subsequent activities.

Motivation is an important factor in successful vocabulary learning because students need to devote time and attention to repeated practice. Traditional vocabulary exercises may become repetitive, particularly when learners are required to memorize long lists of unfamiliar words. AI-assisted activities can make vocabulary learning more interactive through conversations, personalized tasks, immediate feedback, and topic-based exercises. Zhang and Huang (2024) emphasize the potential of chatbot interaction to support personalized and engaging vocabulary learning. Tuzcu-Eken (2026) also reports positive learner experiences concerning multimedia support and interactive vocabulary activities. These findings suggest that AI tools may create more engaging learning environments. Nevertheless, motivation should not be evaluated only through students' enjoyment of technological applications. Long-term vocabulary development requires consistent practice and measurable improvement in vocabulary knowledge.

Despite its potential benefits, AI-assisted vocabulary learning has several limitations. First, AI-generated explanations may occasionally contain inaccurate definitions, unnatural examples, or inappropriate collocations. Second, students may become overly dependent on automated translations and explanations instead of developing independent vocabulary-learning strategies. Third, excessive assistance may reduce the mental effort required for remembering and using new words. For example, if students always request translations before attempting to understand a word from context, they may miss opportunities to develop independent inferencing skills. Kasneci et al. (2023) emphasize the importance of critically evaluating AI-generated educational content and recognizing the limitations of large language models. Another limitation concerns the measurement of long-term retention. Immediate post-tests may

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demonstrate that students have learned new words, but they do not necessarily establish whether that knowledge remains accessible after several weeks or months. Therefore, AI-assisted vocabulary programs should include delayed assessments and opportunities for productive vocabulary use.

DISCUSSION

The findings of the literature-based analysis indicate that artificial intelligence can contribute to vocabulary learning by providing personalized instruction, contextualized examples, interactive communication, and opportunities for repeated practice. However, the relationship between AI-assisted learning and long-term vocabulary retention is influenced by several interconnected factors. One of the most important conclusions is that vocabulary learning should be understood as a gradual process rather than a single memorization activity. Nation (2001) and Schmitt (2000) emphasize the multidimensional nature of vocabulary knowledge. Learners need to understand not only the meanings of words but also their forms, grammatical characteristics, collocations, and communicative functions. AI tools can support this development by providing different types of vocabulary activities. For example, students may initially learn a word through an explanation, encounter it in a contextualized sentence, review it through a retrieval exercise, and subsequently use it in an original paragraph. This sequence provides multiple opportunities to strengthen vocabulary knowledge. The empirical findings of Zhang and Huang (2024) are particularly relevant because their research examined both receptive and productive vocabulary knowledge. Their study demonstrated that students who used a large language model-based chatbot achieved stronger vocabulary outcomes than learners in the comparison group, including better retention of productive vocabulary. This finding suggests that conversational AI may offer benefits beyond traditional vocabulary memorization. Another important issue concerns the role of retrieval practice. Karpicke and Roediger (2008) demonstrate that active retrieval is essential for strengthening

long-term memory. This principle has important implications for AI-assisted vocabulary instruction. Students should not simply read definitions or receive automatically generated translations. They should be required to recall words and use them independently. Chukharev-Hudilainen and Klepikova (2016) further support the value of spaced repetition in computer-assisted vocabulary learning. AI applications may make these principles more accessible by organizing personalized review sessions and providing additional practice for difficult words. The findings of Tuzcu-Eken (2026) also demonstrate the importance of comparing different forms of digital vocabulary instruction. The study found that an AI-assisted multimedia application produced higher immediate and delayed receptive vocabulary gains than a retrieval-based flashcard application among the investigated university students. This suggests that vocabulary learning may benefit from combining retrieval activities with contextualized multimedia resources. However, these findings should not be interpreted as evidence that AI-assisted applications are universally superior to all traditional or digital learning methods. The effectiveness of particular applications may depend on students' proficiency, learning preferences, cognitive readiness, instructional design, and the quality of the vocabulary materials. Another important issue concerns the difference between vocabulary recognition and productive use. Students may recognize a word in a multiple-choice exercise but remain unable to use it in writing or speaking. AI chatbots can help address this problem by creating opportunities for productive vocabulary practice. For example, learners may be asked to write original sentences, explain concepts, participate in dialogues, or summarize short texts using target vocabulary. Such activities can help students move from passive recognition toward active vocabulary use. For Uzbek university students, these findings have particular educational relevance. Students may benefit from AI-assisted vocabulary activities that combine English definitions, Uzbek translations when necessary, contextualized examples, pronunciation practice, and repeated retrieval. However, teachers should

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ensure that AI remains a supplementary learning resource rather than replacing systematic vocabulary instruction. The most effective approach is likely to combine technological support with established vocabulary-learning principles. Overall, the literature suggests that AI-assisted vocabulary learning can contribute to long-term retention when it encourages repeated exposure, active retrieval, contextual understanding, and productive use.

PEDAGOGICAL IMPLICATIONS

The findings have several implications for English language teaching in higher education institutions. Teachers should integrate AI-assisted vocabulary activities into regular EFL instruction while maintaining clear learning objectives. AI tools can be used to generate personalized vocabulary exercises, explain unfamiliar words, provide contextualized examples, and create interactive dialogues.

Students should also be encouraged to practice newly learned vocabulary through independent sentence production and short writing activities. Spaced repetition should be incorporated into vocabulary instruction to ensure that previously studied words are reviewed over time. Rather than focusing exclusively on immediate vocabulary tests, teachers should introduce delayed assessments to evaluate whether students can remember and use words after an extended. Another important implication concerns learner autonomy. Students should be taught how to use AI tools responsibly, verify explanations, compare examples, and recognize inaccurate information. Teachers can also encourage students to maintain digital vocabulary journals in which they record unfamiliar words, meanings, collocations, example sentences, and subsequent review activities. Finally, AI-assisted vocabulary instruction should be adapted to students' proficiency levels and educational needs. This approach can make vocabulary learning more accessible while supporting independent and sustainable language development.

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LIMITATIONS OF THE STUDY

The present study has several limitations. First, it is based on a qualitative analysis of existing literature rather than an original experimental investigation involving Uzbek university students. Second, research on AI-assisted vocabulary learning uses different technologies, instructional approaches, participant groups, and assessment procedures. Consequently, the results of individual studies cannot automatically be generalized to all EFL learning environments. Third, long-term vocabulary retention is measured differently across studies. Some investigations use delayed post-tests after several weeks, whereas others focus on immediate vocabulary development. Another limitation concerns the distinction between receptive and productive vocabulary knowledge. Improvement in word recognition does not necessarily demonstrate an equivalent improvement in independent vocabulary use. Future research should investigate AI-assisted vocabulary learning among Uzbek university students through experimental and longitudinal research designs. Such studies could compare AI-supported vocabulary instruction with traditional methods and digital flashcard activities while including immediate and delayed vocabulary assessments. Further research should also examine the influence of learner motivation, proficiency level, retrieval frequency, and contextualized practice on long-term vocabulary retention.

CONCLUSION

The present study examined the role of artificial intelligence in vocabulary learning and long-term vocabulary retention among EFL learners. The analysis indicates that AI-assisted vocabulary learning offers important opportunities for improving lexical development through personalized explanations, contextualized examples, interactive communication, multimedia resources, and repeated vocabulary practice. Previous empirical research by Zhang and Huang (2024) demonstrates that large language model-based chatbots can support receptive and productive vocabulary

acquisition and contribute to the retention of productive vocabulary. Similarly, Tuzcu-Eken (2026) provides evidence that AI-assisted multimedia vocabulary applications can support immediate and delayed vocabulary development among university EFL students. However, the findings also demonstrate that technological support alone cannot guarantee long-term retention. Sustainable vocabulary learning requires active retrieval, spaced repetition, meaningful contextual exposure, and opportunities for independent vocabulary production. For Uzbek university students, AI-assisted vocabulary learning can provide additional opportunities to develop English lexical competence and improve independent learning practices. Nevertheless, AI applications should complement rather than replace established vocabulary-learning principles and teacher guidance.

In conclusion, the educational value of AI-assisted vocabulary learning lies in its ability to create personalized, interactive, and context-rich learning environments while encouraging students to actively remember and use new words. Integrating artificial intelligence with retrieval practice, spaced repetition, and productive language activities can contribute to more effective and sustainable vocabulary development in EFL education.

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