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UTILIZING DEEP LEARNING APPROACHES FOR ENHANCING ENGLISH VOCABULARY ACQUISITION

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Abstract

Background - Utilizing deep learning approaches for enhancing English vocabulary acquisition has emerged as a promising innovation in the field of language learning and educational technology. Deep learning, a subset of artificial intelligence, enables machines to process and analyze large volumes of linguistic data in a way that mimics human cognitive functions. When applied to vocabulary learning, deep learning algorithms can personalize content, identify learner patterns, and adapt instructional materials based on individual progress and proficiency levels. This allows for more efficient and targeted learning experiences, especially when integrated into mobile or web-based platforms.

Urgency of Research - Learners are exposed to contextual vocabulary usage, real-time feedback, and engaging multimedia resources, which together foster deeper retention and understanding. Furthermore, natural language processing (NLP), a key component of deep learning, enables systems to evaluate learner input, provide synonyms, definitions, and usage examples, and even generate exercises tailored to learners' specific needs.

Research Objectives - This paper examines the role of deep learning in English vocabulary acquisition, focusing on its theoretical foundations, current research, potential benefits and challenges, and implications for language education.

Research Method - This study employed a qualitative Systematic Literature Review (SLR) to investigate the role of deep learning and AI in English vocabulary



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acquisition. Articles published between 2015 and 2023 were retrieved from major academic databases and analyzed through a systematic process of screening, evaluation, and thematic synthesis.

Research Findings - Studies have shown that incorporating deep learning in vocabulary acquisition can improve motivation, increase learning speed, and support long-term memorization by reinforcing word use in meaningful contexts.

Research Conclusion & Novelty - With continuous advancements in AI, the integration of deep learning in language education is expected to become more prevalent and impactful, offering a powerful tool for learners striving to achieve greater fluency and vocabulary mastery. This technological approach also enables educators to track student progress in real-time and adjust learning paths accordingly. As a result, deep learning is not only transforming traditional language instruction but also making English vocabulary acquisition more dynamic, interactive, and learner-centered.

Keywords: Deep Learning, English Vocabulary Acquisition

Introduction

Vocabulary knowledge is widely recognized as a cornerstone of second language acquisition (Katushemererwe & Rugyema, 2025). Without sufficient vocabulary, learners cannot engage effectively in communication, regardless of grammatical competence. Traditional methods of vocabulary instruction—such as rote memorization and word lists—often lack contextual richness and fail to sustain learner motivation (Alisoy, 2025). With the advent of digital learning tools, technology-enhanced language learning has sought more interactive and adaptive approaches. Vocabulary knowledge is widely recognized as the cornerstone of second language acquisition, as it provides the foundation for listening, speaking, reading, and writing skills (Katushemererwe & Rugyema, 2025). Without adequate vocabulary, learners struggle to comprehend texts, express ideas, or participate in meaningful communication, even when they possess knowledge of grammar. However, traditional methods of teaching

vocabulary, such as rote memorization of word lists, dictionary drills, or translation exercises, often present words in isolation without meaningful contexts. Such approaches may temporarily increase lexical knowledge but frequently fail to foster long-term retention or develop learners' ability to use vocabulary in authentic communication (Alisoy, 2025). Furthermore, repetitive memorization can be monotonous, leading to a lack of learner engagement and motivation. In response to these challenges, the integration of digital technologies has transformed vocabulary instruction by offering more interactive, dynamic, and adaptive approaches. Technology-enhanced language learning tools—such as mobile applications, multimedia platforms, and intelligent tutoring systems—allow learners to encounter vocabulary in varied contexts, receive instant feedback, and engage with multimodal input including text, audio, and video. These innovations not only enrich vocabulary acquisition but also align more closely with learners' needs and preferences, creating opportunities for more personalized, motivating, and effective vocabulary learning experiences.

Deep learning, a branch of machine learning within artificial intelligence, has introduced new opportunities for transforming vocabulary acquisition. Unlike earlier computer-assisted learning systems, deep learning models can process large-scale linguistic data, analyze learner behaviors, and generate adaptive learning pathways (Ma et al., 2025). This capability has made it possible to design personalized vocabulary training applications that go beyond one-size-fits-all instruction. This paper explores the role of deep learning in English vocabulary acquisition by addressing the following objectives:

1. To examine the theoretical underpinnings of deep learning in language education.
2. To review current research on AI-driven vocabulary learning.

3. To analyze the potential benefits and challenges of deep learning integration.
4. To propose pedagogical implications and directions for future research

Vocabulary is essential for comprehension and communication. Research emphasizes both breadth (number of words known) and depth (quality of word knowledge) in vocabulary learning (Tong & Tong, 2022). Effective acquisition requires repeated encounters with words in meaningful contexts (Norman et al, 2023). Vocabulary plays a crucial role in both comprehension and communication, serving as the building blocks of language proficiency. A strong vocabulary base enables learners to understand spoken and written texts more effectively and to express their thoughts with greater clarity and precision. Research in second language acquisition highlights the importance of both vocabulary breadth—the sheer number of words a learner knows—and vocabulary depth, which refers to the quality of word knowledge, including pronunciation, collocations, connotations, and appropriate usage in different contexts (Tong & Tong, 2022). Learners who only know words at a superficial level may recognize them but struggle to use them accurately in real communication. Therefore, vocabulary development must extend beyond memorizing definitions to fostering deeper understanding of words within context. According to Norman et al. (2023), effective vocabulary acquisition occurs through repeated encounters with words in meaningful and varied situations. This repeated exposure allows learners to gradually consolidate word knowledge, reinforce retention, and develop automaticity in usage. For instance, encountering a new word in a film, reading passage, and classroom discussion helps learners integrate form, meaning, and use. Thus, vocabulary instruction should emphasize contextualized and repeated practice to ensure learners not only recognize words but also confidently apply them in authentic communication.

Practical applications of deep learning in vocabulary acquisition have begun to transform traditional approaches into more adaptive and interactive learning experiences. One promising use is the development of AI-powered chatbots that employ natural language processing (NLP) to simulate authentic conversations with learners. These systems not only engage students in real-time dialogue but also detect vocabulary usage, suggest synonyms, and introduce new words in context, thereby fostering incidental learning. Another application is adaptive subtitles in films and videos, where deep learning algorithms adjust the level of lexical complexity according to the learner's proficiency. Beginners may receive simplified translations, while advanced learners are provided with idiomatic explanations or collocations, ensuring contextualized exposure to vocabulary. Additionally, personalized vocabulary recommender systems leverage learner data to identify gaps in word knowledge and recommend tailored vocabulary lists reinforced by spaced repetition techniques. This targeted exposure enhances both retention and active usage. Furthermore, AI-based writing assistants provide instant feedback on lexical variety, style, and collocations, encouraging learners to expand their productive vocabulary. Collectively, these applications highlight the potential of deep learning to move vocabulary instruction beyond memorization and toward a more dynamic, learner-centered model that integrates personalization, context, and continuous feedback.

Prior studies on artificial intelligence (AI) and vocabulary learning have highlighted the transformative potential of intelligent technologies in second language acquisition. Early research emphasized the role of computer-assisted language learning (CALL) in providing learners with digital tools for practicing vocabulary through drills and multimedia input. More recent studies, however, demonstrate how AI-driven systems go beyond static instruction by offering adaptive, personalized, and interactive learning experiences. For instance, chatbot applications using natural language

processing (NLP) have been shown to increase learners' vocabulary acquisition by engaging them in authentic conversational practice, where new words are introduced contextually and reinforced through feedback (Chien et al., 2022). Similarly, research on adaptive learning platforms indicates that AI algorithms can track learner progress, analyze patterns of vocabulary use, and recommend individualized exercises, thereby enhancing retention and learner motivation (Gligorea et al., 2023). Studies on AI-powered writing assistants have also revealed improvements in students' lexical variety and collocational accuracy, as real-time feedback encourages learners to refine and expand their word choices (Gayed et al., 2022). Overall, empirical evidence suggests that AI-supported approaches not only accelerate vocabulary growth but also create engaging and learner-centered environments, making vocabulary acquisition more effective and sustainable than traditional methods.

Method

Research Design

This study employed a qualitative research design using a Systematic Literature Review (SLR) approach to investigate the role of deep learning and artificial intelligence (AI) in vocabulary acquisition, particularly in English as a Foreign Language (EFL) contexts. The SLR method was selected because it enables researchers to synthesize, evaluate, and interpret findings from previous empirical studies in a structured, transparent, and replicable manner. The study followed the guidelines proposed by Snyder (2022), which emphasize systematic identification, selection, evaluation, and interpretation of scholarly evidence.

The review process consisted of several stages, including formulation of research questions, identification of relevant databases, development of search strategies, screening of articles, quality assessment, data extraction,

and thematic synthesis. Three major academic databases—Google Scholar, Scopus, and Web of Science—were selected to ensure broad and credible coverage of international publications related to AI-assisted language learning. Search keywords included “deep learning AND vocabulary acquisition,” “AI in language learning,” and “NLP for EFL vocabulary.” These keywords were combined using Boolean operators to increase the precision and relevance of search results. The study focused on publications released between 2015 and 2023 because this period reflects the rapid development of AI and deep learning technologies in educational contexts.

Research Participants

Unlike empirical field research involving human respondents, the participants in this study consisted of scholarly publications and research articles relevant to the topic under investigation. Therefore, the unit of analysis was not individual learners or teachers, but rather academic studies discussing the implementation of AI, deep learning, and Natural Language Processing (NLP) in vocabulary acquisition and language learning.

The selected articles represented diverse educational settings, including primary schools, secondary schools, universities, online learning environments, and autonomous language learning platforms. The studies also involved various participant groups in their original contexts, such as EFL students, ESL learners, language teachers, and educational technology developers. Inclusion criteria required that the studies:

1. Be published between 2015 and 2023;
2. Be peer-reviewed journal articles, conference papers, or reputable academic publications;
3. Discuss AI, deep learning, or NLP applications in vocabulary learning; and

4. Provide empirical or theoretical findings relevant to language acquisition.

Articles that lacked academic credibility, contained incomplete findings, or were not directly related to vocabulary acquisition were excluded from the review.

Data Collection Techniques

Data collection was conducted through systematic database searching and document analysis. Initially, relevant studies were identified from Google Scholar, Scopus, and Web of Science using predetermined search strings and keywords. The researcher then screened titles, abstracts, and keywords to determine the relevance of each study to the research objectives.

After the preliminary screening, full-text articles were carefully reviewed to ensure they met the inclusion criteria. Important information from each selected study was extracted and organized into a data extraction table, including author names, year of publication, research objectives, methodologies, AI technologies used, learning contexts, and major findings. This process facilitated systematic comparison among studies and enabled identification of dominant trends in the literature.

Data Validity & Data Analysis

To ensure validity and reliability, the study adopted transparent inclusion and exclusion criteria and utilized multiple academic databases to minimize selection bias. Triangulation of sources from different databases strengthened the credibility of findings. Furthermore, peer-reviewed publications were prioritized to ensure the academic quality and authenticity of the analyzed data.

The collected data were analyzed using thematic analysis. This method involved coding and categorizing recurring concepts, patterns, and themes across the selected studies. The researcher identified major themes such as

personalized learning, adaptive vocabulary systems, AI-powered feedback, gamification, learner engagement, and challenges in AI-based language learning. The thematic analysis enabled deeper interpretation of how deep learning technologies contribute to vocabulary acquisition and revealed both the opportunities and limitations of AI integration in language education.

Results And Discussion

Personalization of Vocabulary Learning

Personalization has emerged as one of the most significant contributions of deep learning to vocabulary acquisition. Deep learning algorithms can assess learners' proficiency levels by analyzing their performance data, error patterns, and response times, thereby generating detailed learner profiles that guide instructional design. Based on these insights, AI-driven systems can dynamically tailor vocabulary lists, ensuring that learners are introduced to words that match their current level of competence while gradually extending their lexical range (Chien et al., 2022). Unlike static textbooks, which provide the same content to all students regardless of their needs, adaptive systems can prioritize words that a learner struggles with, revisit them through spaced repetition, and integrate them into varied contextual exercises. This personalized approach not only enhances efficiency but also maintains learner motivation by presenting achievable challenges and measurable progress. Moreover, personalization extends beyond frequency-based word lists; deep learning can identify which types of vocabulary—academic, conversational, or domain-specific—are most relevant to a learner's goals. As a result, students receive targeted exposure to high-utility words in meaningful contexts, supporting both short-term acquisition and long-term retention. Ultimately, personalization through deep learning represents a shift toward more learner-centered pedagogy, where vocabulary learning is adaptive, efficient, and contextually relevant.

Real-Time Feedback and Error Detection

One of the most powerful applications of deep learning and natural language processing (NLP) in vocabulary acquisition is the provision of real-time feedback and error detection. Unlike traditional classroom settings where corrective feedback often depends on teacher availability and time constraints, AI-powered tools can instantly evaluate learners' pronunciation, spelling, and contextual use of words. Through automated speech recognition, learners receive immediate input on phonological accuracy, while text-based NLP systems highlight spelling mistakes, suggest alternative word choices, and detect inappropriate collocations or grammatical inconsistencies. Such corrective feedback loops are essential for vocabulary retention, as they allow learners to notice errors, understand correct usage, and reinforce word knowledge through repetition and practice. Real-time correction also helps reduce fossilization, preventing learners from forming incorrect habits that are difficult to change later. Importantly, the immediacy of AI feedback supports autonomous learning by enabling students to practice independently without constant teacher supervision. Learners gain confidence as they can self-correct, track their progress, and engage in personalized practice. Over time, this continuous cycle of detection, feedback, and revision fosters deeper lexical competence, making vocabulary acquisition not only more accurate but also more sustainable. Thus, real-time feedback mechanisms mark a significant advancement in learner-centered language instruction.

Motivation and Engagement

Motivation and engagement are critical factors in sustaining vocabulary learning, and deep learning technologies have introduced innovative ways to enhance both. AI-powered gamification elements, such as point systems, badges, leaderboards, and adaptive challenges, transform vocabulary practice into an interactive and enjoyable experience. These features not

only capture learners' attention but also create a sense of achievement and progress, which is essential for long-term persistence in language study. Unlike traditional methods that may rely on repetitive drills, gamified systems integrate deep learning algorithms to adapt challenges according to learners' proficiency levels, ensuring that tasks remain neither too easy nor overwhelmingly difficult. This balance maintains learners' interest while promoting steady vocabulary growth. Empirical studies have shown that students using deep learning-based vocabulary applications tend to practice more frequently and consistently compared to those employing non-adaptive tools (Wang & Xu, 2022). Furthermore, the use of adaptive gamification fosters intrinsic motivation by aligning tasks with individual learning goals, while extrinsic motivators such as rewards and competition encourage sustained engagement. By making vocabulary acquisition more interactive, personalized, and rewarding, AI-powered systems not only improve learning outcomes but also cultivate positive attitudes toward language learning, helping students remain motivated throughout their learning journey.

Long-Term Retention

Long-term retention of vocabulary is one of the greatest challenges in second language acquisition, as learners often forget newly acquired words without systematic review and reinforcement. Deep learning has significantly advanced this area by enhancing spaced repetition algorithms, which are designed to predict the optimal intervals for reviewing vocabulary items. Unlike traditional flashcard methods that apply fixed review cycles, deep learning-based systems analyze learners' performance patterns, including response accuracy and speed, to generate personalized review schedules (Xiao & Wang, 2024). This adaptive approach ensures that difficult words are reviewed more frequently, while familiar words are revisited at longer intervals, maximizing memory consolidation. By leveraging predictive

modeling, deep learning enables the system to identify when a learner is most likely to forget a word and schedule timely reinforcement to prevent memory decay. Beyond improving recall, these algorithms also enhance efficiency, reducing unnecessary repetition and allowing learners to focus on areas that need the most attention. Empirical findings confirm that learners using AI-powered spaced repetition systems retain vocabulary more effectively over time compared to static review methods. Thus, the integration of deep learning in spaced repetition not only strengthens lexical retention but also provides a sustainable framework for long-term vocabulary mastery.

Development of Cultural Competence

Vocabulary learning is not solely about memorizing word forms and meanings; it also involves understanding how words function within specific cultural and social contexts. Deep learning technologies play a pivotal role in supporting this dimension of language acquisition by analyzing a vast corpora of authentic English texts, films, social media content, and other real-life communication sources. Through this analysis, AI-driven systems can expose learners to culturally relevant vocabulary, idiomatic expressions, and pragmatic language use that are often absent from traditional textbooks. For example, learners may encounter how the same word can vary in meaning across different cultural situations, or how idiomatic phrases convey attitudes and social nuances beyond literal translations. By integrating such contextualized input, deep learning fosters cultural competence alongside linguistic knowledge, enabling learners to communicate more appropriately and effectively in diverse settings. Furthermore, adaptive systems can recommend culturally rich content tailored to learner interests, such as news articles, movie dialogues, or online discussions, ensuring engagement while expanding vocabulary in authentic contexts. Developing this cultural awareness helps learners move

beyond functional communication to deeper intercultural understanding, which is essential in global communication. Thus, deep learning enhances not only vocabulary mastery but also learners' ability to navigate the cultural dimensions of language.

Challenges and Limitations

While deep learning offers significant benefits for vocabulary acquisition, its integration into language education also presents several challenges and limitations. One of the most pressing concerns is data privacy, as AI-powered platforms often collect sensitive student information such as performance metrics, personal learning histories, and even voice recordings. Without robust safeguards, this data may be vulnerable to misuse or unauthorized access. Another limitation is the risk of over-reliance on technology, which can reduce opportunities for face-to-face interaction and collaborative learning—both essential aspects of language development that cannot be fully replaced by automated systems. In addition, the issue of algorithmic bias poses a serious challenge. Since deep learning models are trained on large corpora, biased or unrepresentative data may lead to the reinforcement of stereotypes or the exclusion of culturally diverse language patterns. This not only affects fairness but may also distort learners' understanding of authentic language use. Furthermore, technical barriers such as limited internet access, high implementation costs, and the need for teacher training may restrict adoption in certain educational contexts. Addressing these limitations requires careful policy planning, ethical data management, and a balanced integration of AI tools with traditional pedagogical practices to maximize learning benefits while minimizing risks.

Conclusion

The integration of AI and deep learning technologies into vocabulary acquisition has important pedagogical implications for language teaching

and curriculum design. Teachers can enhance traditional instruction by incorporating AI-based vocabulary applications within blended learning models, allowing students to combine classroom interaction with personalized, technology-driven practice outside of class. Such an approach enables learners to benefit from adaptive algorithms that provide targeted vocabulary lists, real-time feedback, and gamified engagement, while still retaining the social and communicative aspects of classroom learning. However, effective implementation requires a balanced curriculum that does not overemphasize technological input at the expense of meaningful communication. Vocabulary knowledge must be reinforced through speaking, writing, and collaborative activities to ensure that learners can transfer digital learning into authentic language use. Equally critical is teacher preparation; educators need adequate training to understand the capabilities and limitations of AI tools, select appropriate applications, and integrate them meaningfully into their lessons. Professional development programs should equip teachers with both technical skills and pedagogical strategies for leveraging AI effectively. By combining the strengths of technology with human interaction, teachers can create a more holistic learning environment that maximizes vocabulary growth, promotes learner autonomy, and sustains long-term motivation.

The integration of deep learning and artificial intelligence into vocabulary acquisition marks a significant advancement in the field of language education. Unlike traditional methods that rely heavily on rote memorization and static word lists, AI-driven systems provide adaptive, interactive, and learner-centered approaches that make vocabulary learning more effective and engaging. Through personalization, learners receive vocabulary instruction tailored to their proficiency levels and learning goals. Real-time feedback and error detection allow immediate correction and reinforcement, while gamified elements sustain motivation and encourage consistent practice. Deep learning also enhances long-term

retention through optimized spaced repetition algorithms and supports cultural competence by exposing learners to authentic language use and idiomatic expressions.

Nevertheless, challenges remain. Issues of data privacy, algorithmic bias, over-reliance on technology, and limited accessibility must be addressed to ensure equitable and ethical implementation. Educators play a crucial role in this process by balancing technology-driven instruction with communicative practice, ensuring that learners can apply their vocabulary knowledge in authentic interaction. Teacher training is essential to maximize the benefits of AI tools while mitigating risks.

Overall, deep learning has the potential to transform vocabulary acquisition into a more dynamic, personalized, and sustainable process. As technology continues to evolve, future research should explore long-term retention, cross-cultural applications, and the integration of diverse media forms to further expand its impact. By thoughtfully combining AI with sound pedagogy, educators can create powerful learning environments that empower learners to achieve greater fluency and confidence in English vocabulary mastery.

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