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AI-Based Vocabulary Games: Enhancing Memory and Speaking Confidence among University Students

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ABSTRACT

Vocabulary knowledge strongly predicts oral proficiency, yet many university students struggle to retain new words long enough to use them spontaneously in speech. AI-based vocabulary games, which pair adaptive repetition algorithms with interactive game mechanics, have been proposed to address this gap. This study examines how an AI-based vocabulary game influenced memory recall and speaking confidence among eight university students in a general English course at a private university in Indonesia. Using a qualitative case study design, data were collected over a five-week intervention through pre- and post-intervention interviews, reflective journals, and observation of students' in-app performance. Findings show that the application's adaptive, spaced-repetition features supported more durable vocabulary retention than students' prior rote-memorization habits, while its game-like scoring and instant feedback reduced the psychological pressure typically linked to speaking practice. Repeated, low-stakes retrieval of target words within the game gradually carried over into spontaneous classroom speech, producing fewer hesitations and greater willingness to volunteer answers orally. However, challenges remained, including uneven engagement outside scheduled sessions and the game's limited ability to model natural conversational register. In conclusion, the study contributes to the growing literature on AI-mediated informal digital learning of English (AIIDLE) and offers practical implications for integrating adaptive gamified applications into vocabulary and speaking instruction in higher education.

Keywords: AI-based vocabulary games, memory recall, speaking confidence, gamification, higher education, language learning technology

ABSTRAK

Pengetahuan kosakata merupakan salah satu prediktor paling menentukan bagi kemahiran berbicara, namun banyak mahasiswa masih kesulitan mempertahankan kosakata baru cukup lama untuk digunakan secara spontan dalam berbicara. Permainan kosakata berbasis kecerdasan buatan (AI), yang memadukan algoritma pengulangan adaptif dengan mekanisme permainan interaktif, telah diusulkan sebagai solusi untuk mengatasi kesenjangan ini. Penelitian ini mengkaji bagaimana sebuah permainan kosakata berbasis AI memengaruhi daya ingat kosakata dan kepercayaan diri berbicara pada delapan mahasiswa yang mengikuti mata kuliah Bahasa Inggris umum di sebuah universitas swasta di Indonesia. Dengan menggunakan desain studi kasus kualitatif, data dikumpulkan selama intervensi lima minggu melalui wawancara pra- dan pasca-intervensi, jurnal reflektif, serta observasi kinerja mahasiswa dalam aplikasi. Temuan menunjukkan bahwa fitur pengulangan adaptif dan spaced-repetition pada aplikasi tersebut mendukung retensi kosakata yang lebih tahan lama dibandingkan kebiasaan hafalan mekanis sebelumnya, sementara sistem skor permainan dan umpan balik instan mengurangi tekanan psikologis yang biasanya menyertai latihan berbicara. Pengulangan pengambilan kata target secara berulang dan berisiko rendah dalam permainan tersebut secara bertahap berdampak pada ucapan spontan di kelas, menghasilkan lebih sedikit keraguan dan kemauan yang lebih besar untuk menjawab secara lisan. Meski demikian, tantangan tetap ada, termasuk keterlibatan yang tidak merata di luar sesi terjadwal dan keterbatasan permainan dalam memodelkan register percakapan alami. Sebagai simpulan, penelitian ini memberikan kontribusi bagi literatur mengenai pembelajaran informal digital bahasa Inggris yang

dimediasi AI (AIIDLE) serta menawarkan implikasi praktis bagi integrasi aplikasi gamifikasi adaptif dalam pembelajaran kosakata dan keterampilan berbicara di perguruan tinggi.

***Kata Kunci**: permainan kosakata berbasis AI, daya ingat, kepercayaan diri berbicara, gamifikasi, pendidikan tinggi, teknologi pembelajaran bahasa*

A. Introduction

Vocabulary is widely regarded as the building block upon which every other language skill depends; without a sufficiently accessible mental lexicon, learners struggle to comprehend input, construct meaning, or produce fluent speech (Hao, Wang, & Ardasheva, 2021). For university students who are required to use English not only in classroom recitation but also in presentations, discussions, and informal peer communication, the ability to retrieve appropriate vocabulary quickly and confidently is central to academic participation. Yet conventional vocabulary instruction, which frequently relies on rote memorization of word lists, tends to produce knowledge that is recognized on paper but rarely retrieved under the time pressure of real conversation.

In recent years, the convergence of artificial intelligence (AI) and gamification has opened new possibilities for vocabulary instruction that is both adaptive and engaging. AI-based vocabulary games use algorithms that track a learner's response accuracy and response time to adjust the frequency with which specific words reappear, effectively personalizing the spacing and repetition schedule for each user (Zhang, Zou, & Cheng, 2024). At the same time, the game-like structure of points, levels, and immediate feedback is intended to lower the affective barriers that often accompany vocabulary drilling, making sustained practice more appealing to learners who might otherwise disengage from traditional study methods (Zainuddin, Chu, Shujahat, & Perera, 2020).

Despite this growing interest, much of the existing research on AI-based gamified vocabulary tools has concentrated on quantitative measures of vocabulary gain, with comparatively little attention paid to how learners experience the process of retrieval and how that experience translates into oral performance (Jia, Pack, Guan, Zhang, & Zou, 2023). Questions remain about whether the confidence learners develop within a low-stakes digital game genuinely transfers to spontaneous, face-to-face speaking situations, and how students themselves make sense of this transfer. The present study addresses this gap by examining, through the direct accounts of the participants, how engagement with an AI-based vocabulary game shaped their memory recall and speaking confidence over

the course of a structured intervention at an Indonesian university. By foregrounding participants' voices, the study aims to offer a grounded understanding of the pedagogical value, and the practical limitations, of AI-mediated gamified vocabulary learning in higher education.

2. Literature Review

2.1. Vocabulary Acquisition and Memory Recall

Memory recall in second language vocabulary learning is commonly explained through the lens of spaced repetition and retrieval practice, both of which suggest that words are retained more durably when learners are required to actively recall them at increasing intervals rather than passively re-reading them (Hao, Wang, & Ardasheva, 2021). Traditional classroom vocabulary instruction, however, rarely implements such spacing in a systematic way, leaving retention largely dependent on individual study habits. Lo (2023) found that learners exposed to technology-assisted vocabulary tools demonstrated stronger immediate and delayed recall than those relying solely on textbook-based memorization, suggesting that the structure of the learning tool itself plays a meaningful role in how well vocabulary is retained over time.

2.2. Artificial Intelligence and Gamification in Language Education

The integration of AI into gamified learning platforms allows for a level of personalization that static vocabulary exercises cannot easily replicate. Zhang, Zou, and Cheng (2024) describe self-regulated, digital game-based vocabulary learning environments in which algorithmic adaptation of task difficulty encourages learners to apply their own strategies while remaining within an appropriately challenging zone. Complementing this, Zainuddin, Chu, Shujahat, and Perera's (2020) systematic review of gamification research identifies three recurring benefits across empirical studies: heightened learner engagement and motivation, improved academic performance, and stronger social connectivity among learners. In the specific context of English as a Foreign Language (EFL), Jia, Pack, Guan, Zhang, and Zou (2023) report that game-based learning media had a measurable positive influence on academic vocabulary acquisition, particularly when the game mechanics required learners to apply vocabulary in semi-authentic contexts rather than isolated flashcard recall.

2.3. Speaking Confidence and Vocabulary Knowledge

Speaking confidence is frequently constrained less by a learner's grammatical competence than by uncertainty over whether the right word will surface at the right moment. When lexical access is slow or unreliable, learners tend to hesitate, self-correct excessively, or avoid extended contributions altogether. Investigating an

AI-powered gamified platform among Saudi EFL learners, a mixed-methods study reported that participants' improved long-term retention was accompanied by thematically distinct gains in confidence, which learners attributed to the repeated, low-risk opportunities the platform provided for retrieving and using target vocabulary (Computer-Assisted Language Learning Electronic Journal, 2025). This pattern indicates that the psychological experience of successful, repeated retrieval within a game may be as consequential for confidence as the vocabulary gain itself.

2.4. Gaps in Existing Research

While the literature on AI-mediated gamified vocabulary learning is expanding rapidly, most studies to date have relied on pretest-posttest designs that quantify vocabulary gain without closely examining how learners subjectively experience the transition from in-app retrieval to spoken performance (Liu, 2024). Few studies have specifically explored university-level general English learners, as opposed to specialized EFL cohorts, and fewer still have used qualitative methods capable of capturing the nuanced, often uneven way in which digital game-based confidence translates into classroom speaking behavior. There is also limited evidence regarding the sustainability of engagement once the novelty of a gamified application diminishes, a concern raised in broader reviews of gamification research (Zainuddin et al., 2020).

2.5. Synthesis of Insights

Taken together, the reviewed literature suggests that AI-based vocabulary games hold considerable promise for strengthening both memory recall and the affective conditions that support spoken language use, primarily through adaptive spacing, low-stakes repetition, and immediate feedback. At the same time, the literature signals a need for research that moves beyond aggregate test scores to examine, in learners' own words, how gamified retrieval practice is experienced and whether its benefits meaningfully extend into real-time academic speaking situations. This study responds to that need by situating itself at the intersection of AI-assisted vocabulary instruction and speaking confidence development, drawing on the direct accounts of university students engaged in a structured, technology-mediated intervention.

B. Research Method

Research Design

This study employed a qualitative case study design to explore how engagement with an AI-based vocabulary game shaped participants' memory recall and speaking confidence within an authentic university learning context (Yin, 2020). The case study approach was selected because it allows for a contextually grounded, in-depth account of

a bounded group of learners as they interact with a specific technological intervention over a defined period, rather than isolating variables in a controlled experimental setting. The focus of the investigation was on how participants themselves interpreted changes in their vocabulary retrieval and oral performance, rather than on standardized test scores alone.

3.2. Participants

Eight university students from different faculties, including Economics, Engineering, Islamic Studies, and Public Health, took part in the study. Participants were selected purposively based on three criteria: (1) enrollment in a general English course at the time of the study, (2) no prior systematic use of AI-based vocabulary applications, and (3) willingness to commit to a five-week intervention involving daily use of the assigned application. Their ages ranged from 19 to 23 years, and their self-reported English proficiency ranged from lower-intermediate to intermediate. Prior to the intervention, participants completed a brief background questionnaire covering their study habits, prior vocabulary learning strategies, and self-perceived speaking confidence.

3.3. Instruments and Materials

Data were collected through three main instruments.

1. Pre-Intervention Interviews

Individual semi-structured interviews were conducted with each participant before the intervention began, focusing on their prior vocabulary learning habits, perceived speaking confidence, and previous exposure to digital or gamified learning tools. Sample questions included:

1. How confident are you when you need to speak English spontaneously in class?
2. What strategies do you currently use to memorize new vocabulary?
3. Have you used any AI-based or gamified application to study English before?

2. AI-Based Vocabulary Game Sessions

Over a five-week period, participants used an AI-based vocabulary game application for approximately 15–20 minutes daily. The application presented target words drawn from an academic word list through short interactive challenges, including timed matching tasks, sentence-completion prompts, and voice-based pronunciation checks, with an adaptive algorithm that increased the frequency of words the learner answered incorrectly or hesitated over. Once a week, participants also completed a short, unscripted speaking task in which they were asked to use a set of recently practiced words in a one-to-two-minute spoken response, recorded through their smartphones and submitted to the researcher for observation. Sample weekly speaking prompts included:

1. Describe a recent experience using at least five of this week's target words.
2. Explain a concept from your field of study to a classmate who is unfamiliar with it.
3. Respond to a hypothetical question a lecturer might ask during a seminar.
4. Give a short opinion on a current topic relevant to your major.

Participants were permitted to review the in-app feedback and re-attempt game rounds as often as they wished, but the weekly spoken recordings were submitted after only a single attempt in order to approximate the spontaneity of real classroom speaking.

3. Post-Intervention Interview and Reflective Journals

At the conclusion of the five-week intervention, each participant took part in a concluding semi-structured interview addressing perceived changes in vocabulary recall, speaking confidence, and their overall assessment of the application. Participants also maintained brief weekly reflective journal entries throughout the intervention, noting words they found difficult to remember and moments when they successfully used a target word in conversation. Example post-intervention interview questions included:

1. How has your ability to recall vocabulary while speaking changed over the past five weeks?
2. What part of the application did you find most useful for building your confidence?
3. Would you continue using this type of application after the study ends?

C. Result and Discussion

Result

Analysis of the interviews, reflective journals, and weekly speaking recordings yielded four recurring themes that characterize participants' experiences with the AI-based vocabulary game.

1. Enhanced Vocabulary Retention through Adaptive Repetition

Most participants reported that words practiced through the application were easier to recall days or weeks later compared to vocabulary they had previously memorized through static word lists. They attributed this to the application's habit of resurfacing words they had previously answered incorrectly, which several participants described as feeling more targeted than their earlier self-directed study methods.

How confident are you when you need to speak English spontaneously in class?

Student A: "I used to forget words the day after I memorized them. With this app, the same word kept appearing until I actually remembered it, so it stayed longer."

Student B: "Before, I only felt confident if I had prepared my sentences in advance. Now I can think of words faster even when I am not prepared."

Student C: "I still hesitate sometimes, but not as much as before. The words feel closer, like they are right there when I need them."

Student D: "Honestly, I was not confident at all in the beginning. After a few weeks the repeated practice made we recall words without translating from Indonesian first."

Student E: "My confidence grew slowly. The scoring system made we want to try again immediately after a mistake, and that repetition really helped."

Student F: "I feel more confident now, especially for words related to my major, because I practiced them so many times in the game."

Student G: "There is still improvement needed, but compared to the first week, I speak with fewer long pauses now."

Student H: "Yes, I am more confident, mostly because I know I have already used these words correctly many times in the app before saying them out loud."

Participants' responses reveal a shared trajectory from initial hesitation toward gradually increasing confidence, closely tied to the repeated, low-stakes retrieval opportunities the application provided. Student A and Student D both noted that words which had previously been forgotten quickly became more durable through the application's repetition of previously missed items, an outcome consistent with spaced-retrieval research on vocabulary memory (Hao, Wang, & Ardasheva, 2021; Lo, 2023). Student E's comment regarding the motivating effect of the scoring system further echoes findings that gamified feedback mechanisms encourage learners to re-engage with difficult material rather than avoid it (Zainuddin, Chu, Shujahat, & Perera, 2020).

2. Increased Speaking Confidence in Spontaneous Situations

Beyond vocabulary retention itself, participants described a shift in how willing they were to speak without extensive preparation. Several linked this shift directly to the weekly unscripted speaking task, which required them to use recently practiced words under time pressure.

What part of the application did you find most useful for building your confidence?

Student B: "The weekly speaking task was actually the scariest part at first, but after a few weeks it became the part that helped me the most."

Student C: "Getting instant feedback in the game, right or wrong, made speaking feel less like a test and more like practice."

Student F: "Knowing I only had one attempt for the recording pushed me to actually think in English instead of translating everything."

Student B's account, moving from initial anxiety toward viewing the weekly recording as the most valuable component, illustrates how a single-attempt spoken task, when paired with substantial prior low-stakes practice, can function as a manageable bridge toward more spontaneous oral performance. This pattern aligns with recent findings that AI-powered gamified platforms can be associated with improved learner confidence alongside vocabulary gains (Computer-Assisted Language Learning Electronic Journal, 2025).

3. Development of Contextual and Field-Specific Word Usage

Several participants observed that the application helped them move beyond definitional knowledge of words toward using them appropriately within sentences related to their own field of study, a shift they linked to the sentence-completion and voice-based tasks embedded in the game.

> *Student D: "I did not just learn the meaning of the word, I practiced using it in a sentence about my own major, so it felt more natural to say later."*
>
> *Student G: "Some words I already knew the meaning of, but I never used them out loud before. The speaking check in the app forced me to actually say them."*

These reflections suggest that game mechanics requiring active production, rather than passive recognition, encouraged a deeper level of lexical processing, a distinction supported by research on game-based vocabulary learning media in EFL contexts (Jia, Pack, Guan, Zhang, & Zou, 2023).

4. Mixed Perceptions of Long-Term Engagement

While overall perceptions of the application were positive, several participants candidly acknowledged that their engagement fluctuated across the five weeks, particularly during periods of academic workload from other courses.

Would you continue using this type of application after the study ends?

> *Student A: "Yes, definitely, though I know I need to be disciplined because I skipped a few days when I had exams in other subjects."*
>
> *Student E: "I would continue, but I think the app works best when I actually set a fixed time for it every day."*
>
> *Student H: "I want to keep using it, but I noticed the game started to feel repetitive by week four, so maybe new types of challenges would help."*

Student H's observation regarding the app feeling repetitive by the later weeks points to a recognized limitation in gamified learning research: initial motivation associated with novel game elements does not always sustain itself over extended use without

variation in task design (Zainuddin, Chu, Shujahat, & Perera, 2020). Student A and Student E's comments similarly suggest that consistent engagement depends on learners' own scheduling discipline as much as on the application's design.

Discussion

The findings of this study indicate that AI-based vocabulary games can meaningfully support both memory recall and speaking confidence among university students, primarily through the mechanism of repeated, low-stakes retrieval combined with immediate, non-judgmental feedback. This is consistent with prior research suggesting that adaptive spacing algorithms strengthen vocabulary retention more effectively than static study methods (Hao, Wang, & Ardasheva, 2021; Lo, 2023), and that gamified elements such as scoring and instant correction can reduce the affective barriers associated with vocabulary practice (Zainuddin, Chu, Shujahat, & Perera, 2020).

Importantly, the study extends this literature by illustrating how confidence gains built within the relatively safe environment of a digital game appeared to transfer, at least partially, into participants' willingness to speak spontaneously during the weekly unscripted recordings. This transfer was not automatic or uniform; participants such as Student B described an initial period of anxiety toward the speaking task before experiencing it as beneficial, suggesting that a structured bridge between in-app practice and unscripted oral production, rather than the game alone, may be necessary to realize speaking-confidence gains. This nuance adds to existing findings on AI-powered gamification and learner confidence (Computer-Assisted Language Learning Electronic Journal, 2025) by specifying one plausible mechanism, the weekly recorded speaking task, through which such gains may be cultivated.

The study also surfaces a practical limitation worth attention: participant engagement was not consistently sustained across the full five weeks, with several students reporting reduced use during busy academic periods and one participant noting that the game format began to feel repetitive. This finding echoes broader concerns in gamification research regarding the durability of motivation once the novelty of game mechanics diminishes (Zainuddin, Chu, Shujahat, & Perera, 2020), and suggests that future implementations might benefit from varying task types or introducing periodic new content to sustain engagement beyond the initial weeks.

Taken together, these findings suggest that AI-based vocabulary games are best understood not as a stand-alone solution but as one component within a broader pedagogical design that intentionally pairs adaptive digital practice with structured opportunities for spontaneous spoken

production, allowing gains in lexical confidence to be actively rehearsed and consolidated in speech.

D. Conclusion

This study examined how engagement with an AI-based vocabulary game influenced memory recall and speaking confidence among eight university students over a five-week intervention. The findings indicate that the application's adaptive repetition of previously missed words supported more durable vocabulary retention than participants' prior study habits, while its low-stakes, feedback-rich game structure appeared to ease the anxiety typically associated with vocabulary retrieval. When paired with a weekly unscripted speaking task, these gains in retention and comfort showed signs of extending into participants' willingness to speak spontaneously, although this transfer required deliberate structuring rather than occurring automatically through gameplay alone.

At the same time, the study identifies practical challenges that merit consideration in future implementations, including the tendency for engagement to decline during periods of competing academic demands and the risk of the game feeling repetitive without variation in task design over an extended period. These findings contribute to the growing body of research on AI-mediated informal digital learning of English by offering a grounded, learner-centered account of how gamified vocabulary practice is experienced, rather than relying solely on aggregate measures of vocabulary gain.

Given its qualitative case study design and modest sample size, the findings of this study are not intended to be statistically generalizable; rather, they offer contextually rich insight that may inform the design of future interventions. Future research involving larger and more diverse cohorts, longer intervention periods, and comparative designs against non-AI-based gamified tools would help clarify the extent to which the patterns identified here hold across different learner populations. In conclusion, AI-based vocabulary games appear to hold genuine promise for strengthening university students' lexical memory and speaking confidence, provided they are integrated thoughtfully alongside opportunities for authentic spoken practice rather than treated as an isolated study activity.

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