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The Effect of AI-Based Instruction on Vocabulary Retention and Learner Motivation in Higher Education

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Abstract

This study investigated the effects of Artificial Intelligence (AI) model, Grok 5, on the students' motivation level and vocabulary knowledge. To collect the required data, 66 Omani English as a Foreign Language (EFL) students were split into two groups: the experimental group, which received traditional instructions plus Grok 5 exposure, and the control group, which received conventional instructions only. The number of students in each group was 33. A motivation questionnaire, created by the researchers and piloted appropriately to guarantee the validity and reliability of the questions, as well as vocabulary pretests, posttests, and delayed posttests, were used thoroughly. Although the experimental group's results were significantly better than the control group's after five weeks of treatment, the study's findings validated both groups' initial improvement in the posttests. The experimental group continued to make considerable improvement, but the control group's performance did not significantly vary in the delayed posttest results. The research findings bring advantages to teachers, students, and all institutions that offer higher education.

Keywords: AI technologies; higher education; motivation; vocabulary retention

Introduction

The acquisition of new vocabulary is the essential basis for the enhancement of linguistic ability and foreign language fluency (Schmitt & Carter, 2000). The ability to understand vocabulary serves as the fundamental requirement for learning any foreign language (Macis & Schmitt, 2017). Nation (1990) explains that vocabulary stands as an independent language component since it operates independently from other linguistic elements. Therefore, the process of learning a language is limited when students do not have enough vocabulary knowledge. This stops them from achieving desired proficiency goals (Macis & Schmitt, 2017).

The value of learning new words is widely accepted; however, many students face multiple obstacles that block their progress in vocabulary learning. Students struggle to understand the meanings of new words and remember them (Altyari, 2017; Farjami & Aidinlou, 2013). There are problems with pronunciation since spoken and written English are different, and languages have different stress and intonation patterns (Rohmatillah, 2017). Students experience pronunciation challenges because written text presentation makes it difficult to identify sound patterns from letter combinations (Rohmatillah, 2017). Students encounter difficulties when learning prefixes and suffixes because vocabulary memorization is challenging (Baniabdelrahman & Al-shumaimeri, 2014). Students face problems when they try to use the new language properly through writing and speaking (Pignot-Shahov, 2012).

The implementation of technology serves as a solution to address vocabulary acquisition problems that students encounter during the language learning process (Radhakrishnan, 2017). Tseng (2019) found technology helpful for various language learning domains such as grammar learning, vocabulary development, and assessment. Groot (2000) asserts that Technology-Enhanced Language Learning (TELL) technologies may facilitate a more efficient acquisition of vocabulary among learners. TELL provides learners with systematic vocabulary practice through repetition, which helps them learn and use words effectively in their studies (Tran, 2020; Tran & Vo, 2019).

Artificial Intelligence functions as a modern educational technology that institutions implement throughout their operations (Roos, 2018). Such advanced technology works to support language learners who want to improve their reading, writing, vocabulary, grammar, and oral communication abilities (De la Vall & Araya, 2023; Maghsoudi, 2025). The AI models serve as a personal assistant, an educational tool, and an evaluation system for those who wish to increase their vocabulary. They may also convert traditional educational methods into more creative and efficient approaches (Kessler, 2018). This technology enables personalized learning experiences, which helps students develop their vocabulary skills (Liu & Chen, 2023). AI technology integration into vocabulary learning allows educators to create innovative teaching approaches that replace conventional teaching methods (Chen et al., 2021; Semerikov et al., 2021).

The learners` use of technology depends on the motivation (Du & Mo, 2022), as it determines their willingness to adopt specific technologies. Motivation creates a connection between their beliefs and attitudes about technology use (Kazu & Kuvvetli, 2023). Carpio Cañada et al. (2015) demonstrated that the use of AI technology in language acquisition enhanced students` motivation. The research by Ebadi and Amini (2024) found that AI tools create substantial effects on student motivation (Behforouz & Al Ghaithi, 2025) and commitment. Yang (2024) found that AI technology in English education helps students by increasing their motivation and self-directed learning, leading to better academic results.

Despite the existence of certain studies examining the application of AI tools, such as interactive chatbots, in language education (Al Ghaithi et al., 2025; Fathali & Mohajeri, 2025; Ng et al., 2025),

the current English language learning research lacks sufficient empirical evidence about advanced technological teaching methods because scientists remain uncertain about the technological potentials to improve language acquisition (Kim, 2020). AI systems produce their highest performance with students who possess solid language skills, but their effectiveness depends on language abilities, which make them inappropriate for students who are at the elementary levels of language proficiency (Fryer & Carpenter, 2006). The educational sector needs further research to determine the full worth and operational behavior of interactive AI systems used in academic settings (Liu et al., 2019; Maroengsit et al., 2019; Saydazimova & Saydazimova, 2025; Yin et al., 2021).

Literature Review

Grok AI and Students Learning Vocabulary

Behforouz et al. (2025) investigated the role of an interactive AI-based tool on vocabulary learning among 60 Omani students. The research employed a quasi-experimental design, which included two groups: experimental and control. The experimental group received face-to-face instruction and used an AI chatbot for additional practice, while the control group received only face-to-face instruction. The experimental group outperformed the control group in vocabulary learning. The research benefitted from its detailed planning process, which included delayed posttest assessments and verification of all equipment. The two weaknesses of the study were the small sample size, with only 60 students, and the trial period, which lasted four weeks.

Siswanto et al. (2025) investigated the influence of AI on the vocabulary acquisition of Indonesian high school learners. The treatment group learned new vocabulary through ChatGPT activities, which included dialogues, customized vocabulary lists, and prompt feedback. The control group acquired vocabulary knowledge with teachers conducting the courses and employing conventional teaching techniques. The posttest results showed that participants in the treatment group achieved better results than the control group. Students showed better motivation, interest, and developed independent learning skills through AI integration in their language education programs. Although the investigation was restricted to a particular educational environment within Catholic institutions, it employed statistical analytic methodologies and a quasi-experimental design.

Similarly, Abril et al. (2025) conducted a study to examine the impact of AI technology on the development of vocabulary. The quasi-experimental research study assigned 60 first-year students to the treatment and control groups. The treatment group participated in 12 ChatGPT sessions, which spanned the entire four-week period. The control group received its instructions through standard teaching methods. The control group acquired languages at a slower pace than the treatment group. The students in the treatment group provided positive feedback because the approach engaged them more while helping them understand technical terms. The research combined qualitative and quantitative methods, but its four-week study period represented a significant limitation.

Aldowsari and Aljebreen (2024) conducted a study on the influence of AI on the acquisition of language skills among secondary school students in Saudi Arabia. The research used 57 female students with random assignment to either the treatment group or the control group. The “Learn With AI” program ran an eight-week intervention for the treatment group while the control group was exposed to the traditional pen-and-paper work and vocabulary lists. The experimental group exhibited superior vocabulary learning outcomes in comparison to the control group. The research followed an experimental design to execute validated testing methods. The primary issue was the restricted sample size with a focus on female students.

Al Ghaithi et al. (2024) investigated the impact of AI on vocabulary acquisition among Omani EFL students. The research involved 150 students who were divided into three competency groups, which comprised of elementary, pre-intermediate, and intermediate proficiency levels. The study included both control and treatment groups throughout all stages of the research. The control group received conventional instruction, whereas the treatment group used an interactive educational chatbot for vocabulary acquisition. The research results showed that students who received treatment via the interactive chatbot, at both primary and intermediate levels, achieved better vocabulary learning results than students who received no treatment. Students showed moderate to high positive sentiments on the use of the chatbots. The research design included three competency levels, which required different evaluation periods. However, the study's conclusions could not be generalized because it was conducted at one institution.

The Impact of AI on Students' Motivation

Yuan and Liu (2025) studied the effects of AI technology on Chinese students' levels of engagement and motivation. The study included 383 university students who participated in two groups: 197 students used Duolingo with feedback, and 186 students received traditional teacher-based instruction from textbooks and lectures. The research findings showed that participants in the experimental group achieved significant improvements in their motivation and engagement levels, but the control group members showed no changes. The research achieved its strength through its strict quasi-experimental design, which employed standardized assessment instruments, yet its findings remained limited to Chinese university settings.

Salleh et al. (2025) investigated the impact of AI adoption on the learning motivation of students in Malaysian higher education. The study included a single sample of 208 students from UiTM Kelantan. Students interacted with AI technologies by using them, assessing their perceived relevance, and sharing their perspectives on AI in education. The research results showed that motivation created positive relationships with three variables, which include potential for application, perceived relevance, and attitudes. The research achieved its strength through established, reliable methods with high reliability (Cronbach's alpha > .85). However, its limitation was in its inability to generalize data related to students in disciplines outside business management.

Suciati et al. (2024) examined the impact of AI systems on students` motivation and willingness to participate in English writing classes. The study included 72 Indonesian university students who were assigned to a control group and an experimental group. The control group utilized regular methods for collaborative learning, whereas the experimental group used ChatGPT-based collaborative learning to receive feedback. The results showed that the experimental group was more motivated and engaged in all areas. The research design employed proven methodologies within a quasi-experimental framework; nonetheless, its principal limitation arose from the examination at a single institution.

Wei (2023) investigated the effects of AI-based language education systems on English learning achievements, student motivation, and self-directed learning abilities of Chinese EFL students. Mixed methods were implemented to investigate 60 university students who were assigned to experimental and control groups. The experimental group acquired knowledge through interactive activities and assessments on Duolingo during the 10-week period, which provided quick feedback. Regular instructional materials were distributed to the control group in lieu of Duolingo. The experimental group exhibited superior motivation, self-control abilities, and achieved higher test scores. The research benefited from its exceptional mixed-methods design, which effectively combined quantitative and qualitative approaches such as test analysis and semi-structured interviews. The study's limitation was that it only evaluated one institution and employed a small sample size.

Therefore, this study seeks to examine the influence of Grok 5 on the vocabulary proficiency and motivation level of Omani EFL learners, addressing some gaps noted in the literature. Grok 5 allows for a more controlled environment for gameplay and faster response generation. Additionally, task-specific vocabulary prompts focused learners on producing the target lexical items. In doing so, learners could produce learner-friendly output, as Grok 5 is presented in a simplified interface that an intermediate-level learner could manage, rather than the more advanced generative interface of other chatbots. The study also included actual data from a relatively unexamined English language-learning environment in Oman, where research on the use of AI technologies for language acquisition is limited.

The research investigates two essential questions that form the basis of this study:

1. How does Grok 5 affect the vocabulary knowledge of Omani pre-intermediate EFL learners?
2. How does Grok 5 affect the motivation level of Omani pre-intermediate EFL learners?

Method

This study was developed using a quasi-experimental methodology. The following subsections provide supplementary information about research participants, data collection instruments, treatment procedures, and appropriate testing techniques for analyzing quantitative and qualitative data.

Participants

The research cohort was composed of 66 Omani English language learners who were enrolled in the foundation program and possessed pre-intermediate English skills as determined by the placement test and college academic assessment results. The students, with an age range of 19 to 21, were native Arabic speakers. The classes had a combination of both male and female participants.

It is essential to consider that the Foundation Department is a preparatory program designed to prepare students for higher education departments and specializations. This program is based on the Oman national curriculum. The duration of this program at institutions ranges from one year to two years while students take general English, information technology, mathematics, and science classes.

The students in this study were divided into two groups: a control group and an experimental group, each consisting of 33 students. The control group was provided with conventional in-class training that did not expose them to any AI tools. Conversely, the experimental group was provided with the same training, plus Grok 5 as the learning facilitator.

Instruments

To collect the required data on vocabulary knowledge and motivation, two tools were developed with the following details:

Vocabulary Package

Since the focus of this study was on vocabulary learning through Grok 5 on Platform X, the researchers developed three different tests of vocabulary to be conducted as pretests, posttests, and delayed posttests based on the book named “English for the 21st Century,” which was the ordinary training book for students in the college.

In each test, there were 20 items, including five matching exercises, five multiple-choice exercises, five word-formation exercises, and five cloze test exercises. Each correct answer was worth one point, totaling 20 points, and each incorrect answer did not incur any penalty. The pretest, posttest, and delayed posttest measures were equivalent in terms of item scoring, difficulty, format, and order; therefore, they were fully comparable measures. In addition, the control and experimental group individuals were administered the same pretest, posttest, and delayed posttest to avoid differential group test-form contamination.

To ensure the reliability of these questions, the tests were piloted with a different group of Omani English language learners in the same English proficiency level within the same learning institutions, and the results of the reliability index showed the Cronbach Alpha for pretest, posttest, and the delayed posttest as .78, .81, .79, respectively, which shows high consistency between the items. Additionally, the questions were validated by two Omani PhD holders in Applied Linguistics from the same institution, with experience ranging from 10 to 15 years.

Table 1 *The Reliability Index for Pretest, Posttest, and Delayed Posttest*

Test	Cronbach's Alpha	*N*
Pretest	.78	33
Posttest	.81	33
Delayed Posttest	.79	33

Motivation Questionnaire

The second instrument used to assess students' motivation level after using Grok 5 was a researcher-made motivation questionnaire. There were 10 statements in the questionnaire, and a Likert Scale was used as the rubric, with 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, and 1 = strongly disagree.

Since the tool was developed by the researchers in the study, it was necessary to assess the index's reliability and to validate the statements against the cultural and academic norms of the Omani English-learning context. Therefore, the questionnaire was piloted with a group of 30 Omani individuals with pre-intermediate English proficiency from the Foundation Department within the same institution. The questionnaire also provided an Arabic translation to ensure better student understanding. The results of Cronbach's Alpha revealed a score of .90 (see Table 2), indicating higher reliability. In addition, three Omani EFL teachers investigated the statements thoroughly to ensure their consistency with the cultural and academic standards for Omani students.

Table 2 *The Reliability Index for the Motivation Questionnaire*

Cronbach's Alpha	*k*
.90	10

Procedures

The research took place during the 2025–2026 academic year after receiving institutional ethical approval from the university authorities and signed consent forms from the participants. The study

continued for five weeks. Before starting the treatment, both groups performed the same vocabulary pretest in week 1. The researchers led a training session for the experimental group on how to use the Grok 5 platform via X social media to ask questions and learn new words. The experimental group was split into six groups. Researchers set up an X platform account for each group to utilize in the classroom and for the teacher to monitor post-treatment.

The treatment group studied 10 new words per week over four days in the classroom by utilizing Grok 5 on the X platform. Students studied five new words on days 1 and 3. After learning the five words, they spent days 2 and 4 evaluating their work from the day before. There were two parts in each session: Stage One (40 minutes): In the first 10 minutes, the teacher sent five tweets from a researcher-created account, each about a different vocabulary word. The teacher led a discussion with the students to explain the meanings of words for another 10 minutes. After that, the researcher told each group to study the terms for 10 minutes in English and to come up with an example phrase for each term. For the next 10 minutes, students wrote their sentence examples under each word and tagged Grok 5 to review and correct them. After Grok 5 corrected their answers, students responded with additional replies and tagged Grok 5 in their tweets. Students repeated this for all five words. Stage two (20 minutes): The researcher used guided practice with gap-fill exercises, word transformation tasks, and comprehension activities from the university textbook and other institution-owned materials. The exact process was followed till the end of week 4.

The control group learned new words in the usual methods, without any help from AI. Over the course of four days, students learned 10 new terms each week. On day 1 and day 3, students studied five new words each day. On day 2 and day 4, they reviewed the work they had done the day before after learning the five new words. Every session had two stages: stage one with a duration of 40 minutes teaching in the classroom that included vocabulary demonstration with contextual uses presented on the whiteboard, and stage two (20 minutes) comprised of semi-controlled practice that included teamwork on vocabulary tasks demonstrated by the teacher, and planned practice consisting of gap-fill tasks and word transformation tasks. The exact process was implemented until the end of week 4.

At the end of week 4, the researcher administered the identical vocabulary posttest to both groups. After that, they administered a motivation scale to the treatment group. At the end of week 5, the researcher administered the identical delayed vocabulary posttest to both groups.

Data Analysis

This section analyses the quantitative and qualitative data from the vocabulary tests and the motivation scale using SPSS 27.0. The first part of this section focuses on the within-group analysis of the experimental and control groups across all tests, as shown in Table 3 below.

Table 3 *Vocabulary Test Score Variations within the Control and Experimental Groups*

Comparison	*n*	Mean	*SD*	*t*	*p*	Cohen's *d*
Control: Post − Pre	33	2.58	2.97	–4.98	.002	0.87
Control: Delayed − Post	33	-0.24	2.25	0.62	.540	–0.11
Experimental: Post − Pre	33	3.91	2.95	–7.61	< .001	1.33
Experimental: Delayed − Post	33	1.97	2.82	–4.01	< .001	0.70

Table 3 demonstrated that the control group gained a mean score of 2.58 points from pretest to posttest (SD = 2.97), supported by a t = –4.98, p = .002, and a large effect size of 0.87, signaling substantial enhancement. The mean difference from posttest to delayed posttest was –0.24 (SD = 2.25), t = 0.62, p = 0.540, indicating no significant change in performance. In the experimental group, the mean improvement from pretest to posttest was 3.91 points (SD = 2.95), t = –7.61, p < .001, with a large effect size of 1.333, indicating substantial advancement. Between the posttest and the delayed posttest, performance improved with a mean gain of 1.97 points (SD = 2.82), t = –4.01, p < .001, and a medium-to-large effect size of 0.70, indicating further enhancement after the primary treatment. To compare the results of the groups in the pretest, a one-way ANOVA was conducted, and the results are shown in Table 4 below.

Table 4 *The Comparison of Control and Experimental Groups in Pretest*

	Sum of Squares	*df*	Mean Square	*F*	Sig.
Between Groups	4.91	1	4.91	1.38	.250
Within Groups	228.55	64	3.57		
Total	233.46	65			

Table 4 demonstrated that the performance of both groups in the pretest was similar to each other, and no statistically significant differences were observed (F (1, 64) = 1.38, p = .250). This shows that the knowledge level of students in both groups was comparable before the treatment. In addition, to compare the performance of both groups in the posttest and delayed posttest, a test of ANCOVA was conducted, and the results can be seen in Tables 5 and 6 below.

Table 5 *The Comparison of Both Groups in the Posttest*

Source	Type III sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Corrected Model	65.21	2	32.61	8.37	.001	.21
Intercept	494.63	1	494.63	126.95	. < .001	.67
Pretest	6.97	1	6.97	1.79	.190	.03
Groups	62.95	1	62.95	16.16	< .001	.20
Error	245.46	63	3.90			
Total	12044.00	66				
Corrected Total	310.67	65				

Table 5 revealed that the experimental group had a considerably different and higher mean score on the posttest than the control group, F (1, 63) = 16.16, p < .001, with a large effect size (partial η^2 = .20). Given that the pretest was not found to influence the posttest (p = .190), the comparison between the two groups can now be seen to be valid. The same procedure was run to compare the performance of both groups in the delayed posttest.

Table 6 *The Comparison of Both Groups in the Delayed Posttest*

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Corrected Model	280.34	2	140.17	40.49	< .001	.56
Intercept	357.21	1	357.21	103.18	< .001	.62
Pretest	4.21	1	4.21	1.22	.280	.02
Groups	260.64	1	260.64	75.29	< .001	.54
Error	218.10	63	3.46			
Total	13801.00	66				
Corrected Total	498.44	65				

Table 6 reveals that the difference between the two groups was statistically meaningful and significant; therefore, there was a meaningful difference between the experimental and control group (F (1, 63) = 75.29, $p < .001$, partial $\eta^2 = .54$). Since the impact of the pretest did not confound the delayed posttest ($p = .280$), the adjusted comparison could be reliably conducted.

The second part of the data analysis focuses on the thorough analysis of the motivation questionnaire. Table 7 below shows the results of descriptive analysis for the 10-item motivation questionnaire.

Table 7 *The Descriptive Analysis of the Motivation Questionnaire*

	N	Min.	Max.	Mean	Std. Dev.
Grok 5 makes me more interested in learning new words	33	4.00	5.00	4.51	0.51
Grok 5 ensures that I can learn new words	33	4.00	5.00	4.63	0.49
Grok 5 makes learning new words more fun	33	4.00	5.00	4.45	0.51
Grok 5 increases the time needed to learn vocabulary	33	4.00	5.00	4.45	0.51
Grok 5 makes me feel I am progressing in learning words	33	4.00	5.00	4.48	0.51
I prefer vocabulary assignments using Grok 5	33	4.00	5.00	4.48	0.51
Grok 5 increases the responsibility for learning new words	33	4.00	5.00	4.42	0.50
I plan to keep using Grok 5 to learn new words	33	4.00	5.00	4.51	0.51
Grok 5 motivates me to learn new words on my own	33	4.00	5.00	4.51	0.51
Grok 5 motivates me to improve my overall language skills	33	4.00	5.00	4.51	0.51
Valid *N* (listwise)	33				

Table 7 reveals consistently high levels of agreement across all 10 statements, indicating strong support for the tool's effectiveness and motivating importance. A close inspection of the items suggests that these findings were consistent for student enjoyment, perceptions of effectiveness, autonomy, and continuance, with the sole exception being when students were asked about responsibility items.

The first statement, "Grok 5 makes me more interested in learning new words" with a mean score of 4.51 (*SD* = 0.51), showed that the students were more interested in learning vocabulary using Grok 5. In this item, framed as enjoyment, a high mean corresponds to positive convergent beliefs. The survey results indicated that the second statement, "Grok 5 ensures that I can learn new words," had a mean score of 4.63 (*SD* = 0.49), proving the Grok 5's effectiveness in vocabulary learning. This appears to be reflective of perceived efficacy and convergent agreement on the tool. The third statement, "Grok 5 makes learning new words more fun," with a mean score of 4.45 (*SD* = 0.51), found that Grok 5 made learning new words more enjoyable because users found it pleasurable to use the platform. The results of the fourth statement (*M* = 4.45, *SD* = 0.51) "Grok 5 increases the time needed to learn vocabulary" showed that students needed a longer time to learn new words because they understood the value of extended learning time. That took time and effort, and that score would seem to reflect convergence with the positive condition. The fifth statement, "Grok 5 makes me feel I am progressing in learning words" with the mean score of 4.48 (*SD* = 0.51), suggested that learners saw a distinct improvement, hence enhanced their self-efficacy and motivation. This matches subjective effectiveness, showing convergent agreement with other measures of effectiveness. The sixth statement, "I prefer vocabulary assignments using Grok 5" (*M* = 4.48, *SD* = 0.51), showed students` preferences for interactive educational settings with technology through their selection of Grok 5 vocabulary assignments. This is consistent with the theme of preference/user acceptance, as the students had explicit positive attitudes. Statement 7, "Grok 5 increases the responsibility for learning new words" (*M* = 4.42, *SD* = 0.50) revealed that using Grok 5 for learning new words required more work, but the mean score remained high because they understood the value of extra effort for developing their independence. The item indicates that learners accepted responsibility but were more cautious about it than the rest of the items. Statement 8, "I plan to keep using Grok 5 to learn new words" with a mean of 4.51 (*SD* = 51) indicated a firm intention to continue using Grok 5. It may foreshadow future use, consistent with students' preferences for using such a tool for their work. The results of statement 9, "Grok 5 motivates me to learn new words on my own" were *M* = 4.51, *SD* = 0.51. Statement 10, "Grok 5 motivates me to improve my overall language skills" (*M* = 4.51, *SD* = 0.51) showed that Grok 5 produced significant positive effects on vocabulary learning and language development because students displayed unique patterns of satisfaction, engagement, and motivation.

Discussion

The research examined the impact of Grok 5 AI on students' vocabulary knowledge and motivation. Although both groups showed initial progress in the vocabulary tests, the experimental group showed significantly better scores than the control group, which proved that AI technology implementation in educational settings produces positive results. AI tools serve as essential educational resources that enable students to succeed in their learning process from start to end throughout their academic years. Additionally, the mean values of all statements were high, as indicated by the motivation scale results showing that AI technology implementation through interactive classroom approaches leads to significant educational advantages.

The experimental group made substantial progress through Grok 5's interactive system, which offered ongoing feedback and motivational support for active participation and individualized language learning. Grok 5 improved the learners' capacity to comprehend words and retain information. The control group did not receive enough personalized help, which led to their poor academic achievement. The experimental group may have been more motivated because of the increased autonomy and choice they had in their learning process with Grok 5. Students gained independence through the instrument, which provided them with instant personalized feedback, additional explanations, and immediate progress tracking. The teaching approach enabled students to develop self-motivation

skills, which standard educational approaches would not have achieved. The learning experience became more effective through Grok 5, which added an adaptive feedback system and gamification features.

The experimental group's learning and motivation levels were significantly improved, as shown by the study's results, which may be linked to numerous theoretical frameworks. The interactive and multimodal elements of Grok 5 follow the principles of the Cognitive Theory of Multimedia Learning (Mayer, 2001), which states that learning becomes most effective when using both verbal and visual information channels. The system characteristics enable users to manage information better while they learn linguistic rules, which are stored in their memory for extended periods. The findings of the study validate Sociocultural Theory (Vygotsky, 1978) by demonstrating that learning occurs via facilitated social interactions within the zone of proximal development. The digital architecture of Grok 5 functioned as a digital system that provided immediate feedback and guidance to ease the transition of students from dependent to autonomous language acquisition. Self-Determination Theory (Deci & Ryan, 2000) shows that people develop intrinsic motivation through their experiences of autonomy and social connection and their ability to master their skills. The interactive features of Grok 5, which include self-directed learning, feedback systems, and user interaction, help users fulfill their psychological needs, thus extending their period of engagement. The study findings may be analyzed using Constructivist Theory (Piaget, 1970) since Grok 5 facilitates active knowledge construction via term exploration, outcome evaluation, and interactive learning activities. The findings of the research may be elucidated using Dual-Coding Theory (Paivio, 1986), which asserts that the integration of textual and visual elements in Grok 5 enhances memory encoding and retrieval. The Grok 5 features support cognitive processing, social mediation, learner autonomy, and active involvement, which result in better language learning and increased student motivation.

The findings on vocabulary acquisition corroborate the results from Kambam et al. (2025), which demonstrated that AI technology enables students to build their abilities for learning new vocabulary. In a similar study, Abdelhalim and Alsehibany (2025) demonstrated that AI training methods lead to superior vocabulary results. Similarly, Mugableh (2024) showed that Saudi EFL students who participated in AI-generated activities achieved better results in their language learning process. In another study, Ramlan and Aziz (2025) showed that ESL students acquired vocabulary at an advanced level with the deployment of AI technology. And finally, Saab and Abu Melhem (2025) found that educational technology tools lead to better student achievement results, particularly in vocabulary learning. However, several prior studies that questioned the effectiveness of AI for vocabulary learning contradict the current study's conclusions. Machin-Mastromatteo (2023) found that although AI can aid in language acquisition, it frequently falls short in encouraging deeper retention or significant vocabulary growth for particular learner groups.

The findings of the current study on the motivation of learners in using AI tools align with the results of some studies, such as Song and Song (2023), who investigated the impact of AI language learning on the motivation of Chinese EFL students and identified a significant increase in motivation. Similarly, Yıldız (2023) showed that AI technology enhanced language learning and led to better student participation and academic results. In another study with similar findings, Ali et al. (2023) found that AI systems increased the motivation level of the learners, which enabled them to enhance their English language skills. The study by Afkarin and Asmara (2024) demonstrated that AI tools boosted student motivation and led to academic achievement. In another study, Anjum et al. (2024) showed that AI technology improved communication systems through instant feedback delivery and personalized learning paths, which increased student motivation.

Conclusion

The research investigated how Grok 5 affects students` vocabulary knowledge and motivation. The research results showed that Grok 5 AI technology made students more interested in their learning process and helped them improve their language abilities. The research findings are beneficial to teachers, students, and higher education institutions.

The research findings indicate that Grok 5 AI technology assists students in the acquisition of new vocabulary and the maintenance of motivation. Educators can use this system to create interactive teaching methods that combine data-based assessment with feedback. The adaptable system of Grok 5 allows teachers to develop personalized educational materials for students while monitoring their academic development. The learning environment of Grok 5 provides students with an independent and comfortable area to participate in immediate communication while working on tasks and getting customized feedback. The teaching method allows students to study independently, while also promoting their natural enthusiasm for learning and ensuring that they maintain their language proficiency from year to year. Students who take part in their educational work build self-assurance, which enables them to lead their own learning journey. The research findings demonstrated that AI technology serves as a fundamental educational resource for English language programs that operate in university and college settings. The AI technology of Grok 5 supports digital education practices that follow current market standards across the world. The system would enhance the school's learning environment. The program would teach students the necessary technological skills that they require for their professional development.

Limitations and Future Directions

There are some educational limitations in this study. The five-week treatment period in this study was insufficient to evaluate the long-term effects of Grok 5 on vocabulary development and student motivation. Secondly, the focus group in this research included Omani pre-intermediate learners from a single higher education institution in Oman, hence limiting the generalizability of the findings to other educational institutions and to students with diverse levels of English proficiency. This research was limited by the exclusive use of a single AI tool, Grok 5, focusing just on vocabulary acquisition and motivation, so neglecting other language abilities at both micro and macro levels, including reading, writing, and grammar. Furthermore, the data analysis in this research used vocabulary exams together with a motivation questionnaire to gather data instead of interviews or classroom observations for a better student attitude and learning experience. Ultimately, other variables, such as individual variations, learners' technical proficiency, and students' age and gender, were excluded, potentially influencing the study's outcomes.

Nevertheless, there are recommendations for further research on a related topic. To ascertain the extent to which AI technology influences educational environments over more extended periods of time, research must examine protracted treatment periods. The study would be more generalizable if it were conducted with a larger participant group that encompasses students from a variety of educational institutions and cultural backgrounds, as well as those with variable English proficiency. Further research could be designed using qualitative methods, which combine interviews with focus groups and classroom observations to study student engagement, AI technology difficulties, and individual student viewpoints. The results of future research studies could be conducted on student characteristics, including their age, gender, and computer skills level.

Use of Generative AI

This manuscript made use of Grammarly to assist in the proofreading of the text. No AI tools were used for the generation of research hypotheses or the writing of conclusions. The final manuscript was authored and reviewed by the listed authors without additional AI input.

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