

The Role of Artificial Intelligence in Enhancing Arabic Grammar Learning among University Students

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ABSTRACT

The integration of Artificial Intelligence (AI) into higher education has created new opportunities for language learning, particularly through interactive explanations, personalized practice, and immediate feedback. This study aims to examine the role of AI-assisted instruction in enhancing Arabic grammar learning among university students. A quantitative quasi-experimental design with a pre-test–post-test control group was employed. The participants consisted of university students who were divided into an experimental group receiving AI-assisted Arabic grammar instruction and a control group receiving conventional instruction. Data were collected using an Arabic grammar achievement test measuring students' understanding and application of grammatical rules, identification and correction of grammatical errors, and sentence construction. The data were analyzed using descriptive statistics, paired-samples t-test, independent-samples t-test, and normalized gain analysis. The findings indicate that students who participated in AI-assisted learning demonstrated greater improvement in Arabic grammar achievement than those who received conventional instruction. AI provided students with opportunities to obtain explanations, generate contextualized examples, practice grammatical structures, identify errors, and receive immediate feedback. However, the findings also indicate that AI-generated grammatical information requires critical evaluation and lecturer guidance because AI may produce inaccurate or incomplete explanations. The study concludes that AI can function as a complementary learning technology that supports Arabic grammar learning when integrated through structured pedagogical activities and responsible use. AI should therefore complement rather than replace the role of lecturers in university-level Arabic grammar instruction.

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Introduction

Artificial Intelligence (AI) has rapidly emerged as an important technology in higher education, particularly following the widespread adoption of generative AI applications such as ChatGPT. AI-powered tools provide students with opportunities to obtain explanations, generate examples, receive feedback, translate texts, and engage in interactive learning activities. In higher education, the use of ChatGPT has expanded across various academic activities and has attracted considerable attention because of its potential to support students' learning processes. Systematic reviews indicate that research on ChatGPT in higher education has grown rapidly, with applications involving students, lecturers, researchers, and other academic users (Abdallah et al., 2025; Ansari et al., 2024; Imran & Almusharraf, 2023).

In language education, the potential of AI is particularly significant because language learning requires continuous practice, immediate feedback, and opportunities for interaction. Generative AI can provide learners with explanations, examples, corrections, and personalized responses according to their learning needs. A systematic review of research on ChatGPT and language education found that AI has been used for self-directed learning, content generation, and various teaching activities, although further research is needed regarding feedback quality, learner perceptions, and longer-term learning outcomes (Mohebbi, 2025; Zhang et al., 2025). Similarly, research on ChatGPT-assisted second-language learning shows that studies have increasingly examined its contribution to language learning, particularly through customized interaction and learner-oriented activities (Ahn, 2025; Ocaktan-Çeliktürk, 2026; Wibowo, 2026).

Arabic language learning presents particular challenges because students must master grammatical structures, sentence formation, morphological patterns, and grammatical analysis. Arabic grammar, particularly *nahwu* and *i'rab*, requires students not only to memorize

grammatical rules but also to apply those rules in different linguistic contexts. Recent research indicates that AI-based applications can provide useful support in Arabic grammar learning. For example, a study involving university students found that AI applications were perceived to contribute positively to grammatical skills, particularly in *i'rab*, grammatical application, and identifying and correcting grammatical errors (Abdellatif, 2025). This suggests that AI may have particular potential in areas of Arabic grammar that require repeated practice and immediate feedback.

Recent studies in Indonesia also demonstrate the growing use of AI in Arabic language education. Research involving students in Islamic higher education has reported that students use AI tools for various Arabic learning purposes, including obtaining explanations, translating texts, expanding vocabulary, and supporting independent learning. In a study of students learning *nahwu*, AI-supported resources were found to facilitate students' awareness of digital learning resources, autonomous learning, and learning motivation (Abdellatif, 2025). Other research has examined ChatGPT in Arabic learning and reported its usefulness in supporting students' receptive language skills and learning activities (Fredlina et al., 2025). These findings indicate that AI is becoming increasingly relevant to Arabic language learning within Indonesian higher education contexts.

However, the use of AI in Arabic grammar learning should not be viewed only from the perspective of technological convenience. The accuracy of AI-generated explanations and grammatical analyses remains an important issue because AI systems can produce inaccurate or contextually inappropriate answers. Research comparing AI tools in Arabic grammar analysis has specifically examined the ability of ChatGPT and Gemini to analyze *i'rab* and other grammatical elements, demonstrating the importance of evaluating AI outputs rather than accepting them uncritically (Robbani, 2026). Furthermore, UNESCO (2023) emphasizes that

the integration of generative AI into education should remain human-centered and should consider issues of accuracy, ethics, privacy, and the development of learners' human agency. Therefore, the educational value of AI depends not simply on its availability but on how students use it as a learning support tool.

Despite the growing literature on AI and Arabic language learning, there remains a need for empirical studies focusing specifically on Arabic grammar learning among university students, particularly in Islamic higher education institutions in Indonesia. Existing studies have explored general Arabic learning, writing skills, AI usage patterns, or the technical accuracy of AI in grammatical analysis, but contextual evidence concerning how AI contributes to students' learning of Arabic grammar in specific university environments remains limited. This study therefore aims to examine the role of Artificial Intelligence in enhancing Arabic grammar learning among university students, with particular attention to students' experiences, perceived benefits, and the ways AI tools support their understanding and application of Arabic grammatical rules. Such evidence can contribute to the development of more effective and responsible AI-assisted approaches to Arabic language instruction in higher education.

Literature Review

Artificial Intelligence (AI) refers broadly to computational systems designed to perform tasks associated with human intelligence, such as problem solving, language processing, learning, and reasoning. In education, AI applications have increasingly been explored as learning and teaching support technologies. Recent research on ChatGPT indicates that students use generative AI for learning assistance, explanations, feedback, content generation, and more individualized learning support. In higher education, systematic reviews have documented the expanding applications of ChatGPT across teaching and learning activities, while also emphasizing the need for appropriate guidance

and critical evaluation of AI-generated information (Bhullar et al., 2024; Robbani, 2026).

The application of generative AI is particularly relevant to language learning because learners require opportunities to interact with language input, practice language production, receive feedback, and revise their understanding. Recent systematic research shows that ChatGPT has been used in language education for self-directed learning, content generation, feedback, and instructional support. Li et al., (2024) found that research on ChatGPT in language education has expanded rapidly, with higher education representing an important research context. Similarly, Y. Li, (2024) reviewed studies on ChatGPT in second-language learning and identified content generation, feedback, and teaching support among its most common roles. These findings suggest that generative AI may provide additional opportunities for language practice and learning support beyond scheduled classroom activities.

Arabic language learning has particular characteristics because students need to understand linguistic forms as well as grammatical relationships. Arabic grammar includes areas such as *naḥwu*, *i'rab*, sentence structure, grammatical functions, and agreement among linguistic elements. Consequently, learning Arabic grammar requires students not only to remember grammatical rules but also to identify grammatical structures and apply those rules in different sentence contexts. In this context, learning activities that provide repeated practice, examples, and feedback may be useful in supporting students' development of grammatical competence.

AI-assisted learning offers several potential functions that are relevant to Arabic grammar. Students can use generative AI to request explanations of grammatical rules, generate sentence examples, analyze grammatical structures, identify possible errors, and obtain additional exercises. Empirical research specifically examining AI and Arabic grammar provides support for the relevance of these

functions. Kamila et al., (2026), for example, compared ChatGPT and Gemini in analyzing *i'rab* of *Marfū'at al-Asmā'* and found differences in their analytical performance. Their findings also emphasized the need for manual verification and correction of AI-generated grammatical analyses.

Research by Alshehri et al., (2025) further demonstrates the relevance of AI applications to Arabic grammar learning at the university level. The study examined students' perceptions of AI applications in developing Arabic grammatical skills, including sentence construction, *i'rab*, grammatical application, and identifying and correcting grammatical errors. The findings indicate that AI applications are perceived as relevant to several dimensions of Arabic grammar learning. However, because the study used a descriptive survey approach, its findings should be interpreted as evidence of students' perceptions rather than direct experimental evidence of learning improvement.

One important concept associated with AI-assisted learning is learner autonomy. Generative AI can provide students with opportunities to seek additional explanations, examples, and practice according to their immediate learning needs. The systematic review by (Z. Li et al., 2024) identified self-directed language learning as one of the roles associated with ChatGPT in language education. (Monib et al., 2024) likewise reported that learners used ChatGPT to support directed and personalized learning, including understanding concepts, completing learning tasks, and obtaining explanations. Nevertheless, learner autonomy should not be regarded as an automatic consequence of AI use. It depends on how students engage with the technology and how learning activities are structured.

Another relevant dimension is feedback. Feedback is important in language learning because learners need information about their performance and opportunities to revise their responses. Generative AI can provide responses to questions and learning tasks and can be used to generate explanations or comments on students' language production. Muñoz et al.,

(2025) identified feedback as one of the most prevalent roles of ChatGPT in L2 learning. However, the quality and accuracy of AI-generated feedback cannot always be assumed. (Banihashem et al., 2024) specifically identified the quality of AI-generated feedback as an area requiring further research. Therefore, in Arabic grammar learning, AI-generated feedback should be treated as supplementary learning support and should be critically evaluated.

The literature therefore suggests several potential dimensions through which AI may support Arabic grammar learning: access to learning resources, interactive explanation, content generation, grammar practice, feedback, and opportunities for self-directed learning. These functions may provide additional learning opportunities and support students in understanding and applying grammatical rules. At the same time, the effectiveness of AI-assisted learning is likely to depend on the quality of interaction, students' ability to formulate appropriate prompts, their critical evaluation skills, and lecturer guidance. The existing literature does not justify assuming that AI automatically improves learning outcomes; rather, it indicates a promising educational role that requires empirical examination.

Based on the literature, this study conceptualizes AI-assisted Arabic grammar learning as a learning process in which AI provides additional opportunities for explanation, practice, content generation, and feedback. These functions may support students' engagement with Arabic grammar and contribute to their understanding and application of grammatical rules.

The conceptual relationship can be represented as:

AI-Assisted Learning → Interactive Explanation and Practice → Feedback and Revision → Understanding of Arabic Grammar → Arabic Grammar Learning Achievement

At the empirical level, this framework is examined among university students at IAIN Parepare. Rather than focusing only on students'

perceptions of AI, the present study examines whether AI-assisted Arabic grammar instruction is associated with greater improvement in learning achievement through a pre-test–post-test comparison between an experimental group and a control group.

The framework therefore connects the technological dimension of AI with the pedagogical process of explanation, practice, feedback, and revision, while maintaining the lecturer's role in guiding students and verifying AI-generated information. This approach allows AI to be examined as a complementary educational technology rather than as a replacement for conventional Arabic grammar instruction.

Research Methods

This study employed a quasi-experimental quantitative research design using a pre-test–post-test control group design. This design was selected because the study aimed to examine whether the use of Artificial Intelligence (AI) could enhance students' Arabic grammar learning achievement. Rather than merely examining students' perceptions of AI, the study compared changes in students' Arabic grammar performance before and after the learning intervention. The participants were divided into two groups: an experimental group that received AI-assisted Arabic grammar instruction and a control group that received conventional Arabic grammar instruction. Both groups completed the same pre-test before the intervention and the same post-test after the intervention. The comparison between pre-test and post-test scores was used to determine changes in students' Arabic grammar learning achievement.

The research design can be represented as follows:

Group	Pre-test	Treatment	Post-test
Experimental	O ₁	X	O ₂
Control	O ₃	–	O ₄

Where **O₁** and **O₃** represent the pre-test scores, **O₂** and **O₄** represent the post-test scores, and **X** represents AI-assisted Arabic grammar learning.

The study involved 100 university students who were studying Arabic as part of their university learning program. The participants were divided into two groups consisting of 50 students in the experimental group and 50 students in the control group. The participants were selected using purposive sampling based on several criteria: (1) students were actively enrolled in an Arabic language course, (2) students had received basic Arabic grammar instruction, (3) students were able to access digital learning technologies, and (4) students were willing to participate in the pre-test, learning intervention, and post-test. The use of students with comparable learning backgrounds was intended to reduce differences in initial Arabic grammar competence between the two groups.

The research was conducted in the context of Arabic grammar learning at the university level. The intervention focused on the application of AI as a learning assistant in Arabic grammar instruction. The experimental group participated in AI-assisted learning sessions, in which students used generative AI to support several learning activities. These activities included:

1. requesting explanations of difficult Arabic grammar concepts;
2. obtaining examples of grammatical rules in sentences;
3. practicing Arabic sentence construction;
4. identifying grammatical errors;
5. receiving explanations of why particular grammatical forms were incorrect;
6. asking AI to provide additional exercises; and
7. comparing students' answers with AI-generated feedback.

The AI was therefore positioned as an interactive learning assistant, rather than as a replacement for the lecturer. The lecturer remained responsible for explaining the learning objectives,

monitoring students' activities, verifying AI-generated information, and providing clarification when AI responses were inaccurate or incomplete. The control group studied the same Arabic grammar topics using conventional learning activities, including lecturer explanations, textbooks, exercises, and classroom discussion, without systematic use of generative AI.

The main research instrument was an Arabic grammar achievement test administered as both a pre-test and a post-test. The test was designed to measure students' ability to understand and apply Arabic grammatical rules. The instrument covered several dimensions of Arabic grammar learning:

Dimension	Indicator
Understanding grammatical rules	Students can explain basic Arabic grammatical rules competencies.
Identification of grammatical forms	Students can identify appropriate grammatical structures
Error identification	Students can identify grammatical errors in Arabic sentences
Error correction	Students can correct incorrect grammatical constructions
Application of grammar	Students can apply grammatical rules appropriately in writing and speaking
Sentence construction	Students can construct grammatically appropriate Arabic sentences

The same assessment framework was used for the pre-test and post-test, while the order and presentation of questions could be adjusted to minimize the possibility of students simply memorizing previous answers.

Before being used in the main study, the Arabic grammar achievement test was evaluated to ensure that it adequately measured the intended learning outcomes. Content validity was established through expert judgment involving lecturers with expertise in Arabic language and Arabic grammar instruction. The instrument was reviewed in terms of the relevance of each item to the learning objectives, clarity of language,

appropriateness of difficulty, and alignment with the Arabic grammar competencies being measured. Instrument reliability was assessed using an internal consistency procedure. A reliability coefficient of Cronbach's $\alpha \geq 0.70$ was considered acceptable for research purposes. Items that did not adequately represent the intended construct or showed weaknesses during the validation process were revised before the instrument was administered to the research participants.

The research was conducted through several stages.

First, the researcher prepared the Arabic grammar learning materials, research instruments, and AI-assisted learning activities.

Second, both groups completed the pre-test to determine their initial level of Arabic grammar competence. The pre-test results were used as the baseline for assessing subsequent changes. Third, the experimental group received AI-assisted Arabic grammar learning. During the intervention, students used AI to obtain explanations, examples, exercises, and feedback related to Arabic grammar. The lecturer monitored the process and verified AI-generated responses.

Fourth, the control group received conventional Arabic grammar instruction covering the same learning objectives and comparable learning content.

Fifth, after completion of the learning intervention, both groups completed the post-test. The post-test measured students' Arabic grammar achievement after the respective learning treatments. The research procedure can be summarized as:

Pre-test → Learning Intervention → Post-test → Statistical Analysis

For the experimental group:

Pre-test → AI-Assisted Arabic Grammar Learning → Post-test

For the control group:

Pre-test → Conventional Arabic Grammar Learning → Post-test

The quantitative data were analyzed using descriptive and inferential statistical techniques.

First, descriptive statistics were used to summarize the students' Arabic grammar achievement. The analysis included the mean and standard deviation of pre-test and post-test scores for both groups.

Second, the data were examined for normality using the Shapiro–Wilk test. A significance value greater than 0.05 was interpreted as indicating that the data did not significantly deviate from a normal distribution.

Third, a paired-samples t-test was used to examine whether there was a significant difference between students' pre-test and post-test scores within each group. This analysis determined whether students' Arabic grammar achievement significantly improved following the learning process.

Fourth, an independent-samples t-test was conducted to compare the post-test scores of the experimental and control groups. This analysis was used to determine whether students who received AI-assisted learning achieved significantly different Arabic grammar outcomes from those who received conventional instruction.

The level of statistical significance was set at $\alpha = 0.05$. A p-value below 0.05 was interpreted as indicating a statistically significant difference. In addition, the N-Gain score was calculated to examine the magnitude of learning improvement in each group. The normalized gain was calculated using the following formula:

$$[N\backslash \text{ text \{-} \} \text{ Gain} = \backslash \text{ frac \{Posttest-Pretest\} \{Maximum\backslash Score-Pretest\}}]$$

The N-Gain interpretation followed these categories:

N-Gain Score	Interpretation
$g \geq 0.70$	High
$0.30 \leq g < 0.70$	Moderate
$g < 0.30$	Low

The combination of the t-test and N-Gain analysis enabled the study to examine both the statistical significance and the magnitude of improvement in Arabic grammar learning.

The study followed basic ethical principles for educational research. Participation was voluntary, and students were informed about the purpose and procedures of the study. Students' identities and individual test results were kept confidential and were used only for research purposes.

In the experimental group, students were also informed that AI-generated answers could contain errors. Therefore, AI outputs were treated as learning resources that required critical evaluation rather than as unquestionable sources of information. The lecturer maintained an important role in validating explanations and correcting potentially inaccurate AI-generated grammatical information. The overall analytical framework of the study was structured as follows:

AI-Assisted Learning → Interactive Explanation → Grammar Practice → Immediate Feedback → Error Correction → Improved Understanding → Arabic Grammar Learning Achievement

Empirically, the effectiveness of the intervention was examined through:

Pre-test → AI Treatment → Post-test → Paired t-test → Independent t-test → N-Gain

This methodological structure allowed the study to determine whether AI-assisted Arabic grammar learning was associated with greater improvement in students' Arabic grammar achievement than conventional learning.

Results and Discussion

Results

The results of the study provide an overview of the role of Artificial Intelligence (AI) in Arabic grammar learning among university students. The study involved 100 students who were divided into an experimental group and a control group, with 50 students in each group. The experimental group received Arabic grammar instruction supported by AI-powered tools, particularly generative AI applications, while the control group received conventional Arabic grammar

instruction. Both groups completed a pre-test before the intervention and a post-test after the learning process. The AI tools were used to support several learning activities, including obtaining explanations of Arabic grammatical rules, requesting examples, completing exercises, identifying grammatical errors, and clarifying learning materials that students did not fully understand during classroom instruction.

Table 1. Distribution of Participants

Group	Number of Students	Percentage
Experimental Group	50	50%
Control Group	50	50%
Total	100	100%

The descriptive results demonstrate an improvement in Arabic grammar achievement in both groups, although the improvement was greater in the experimental group.

Table 2. Descriptive Statistics of Pre-test and Post-test Scores

Group	N	Pre-test Mean	SD	Post-test Mean	SD	Improvement
Experimental	50	62.40	7.21	82.60	6.48	20.20
Control	50	61.80	7.35	72.40	7.02	10.60

The experimental group obtained a mean pre-test score of 62.40 and increased to 82.60 in the post-test, representing an average improvement of 20.20 points. Meanwhile, the control group improved from 61.80 to 72.40, representing an improvement of 10.60 points. These findings indicate that both instructional approaches contributed to learning progress, but the improvement observed in the AI-assisted group was substantially greater.

The descriptive findings also indicate that students used AI for several important learning

activities. The most common activities included asking AI to explain difficult grammatical concepts, providing examples of sentence structures, correcting grammatical errors, and generating additional exercises. This pattern suggests that students tended to utilize AI as an interactive learning assistant rather than merely as a source of information. The ability to ask repeated questions and request alternative explanations provided students with greater flexibility in studying Arabic grammar according to their individual learning needs.

Table 3. Paired-Samples t-Test

Group	Mean Difference	t	df	Sig.
Experimental	20.20	16.87	49	<0.001

Control	10.60	11.24	49	<0.001
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The paired-samples t-test showed a statistically significant difference between pre-test and post-test scores in the experimental group ($t = 16.87$, $p < 0.001$). A significant difference was also found in the control group ($t = 11.24$, $p < 0.001$).

Therefore, both groups demonstrated significant learning progress. However, the experimental group showed a considerably larger mean improvement than the control group.

Table 4. Independent-Samples t-Test of Post-test Scores

Group	N	Mean	SD	Mean Difference	t	Sig.
Experimental	50	82.60	6.48	10.20	7.55	<0.001
Control	50	72.40	7.02			

The independent-samples t-test revealed a statistically significant difference between the experimental and control groups ($t = 7.55$, $p < 0.001$). The experimental group achieved a higher post-test mean score (82.60) than the control

group (72.40). This result provides empirical evidence that students who participated in AI-assisted Arabic grammar instruction achieved better learning outcomes than students who received conventional instruction.

Table 5. N-Gain Analysis

Group	Pre-test	Post-test	N-Gain	Interpretation
Experimental	62.40	82.60	0.54	Moderate
Control	61.80	72.40	0.28	Low

The N-Gain analysis further confirms the difference in learning improvement. The experimental group achieved an N-Gain score of 0.54, categorized as moderate improvement, whereas the control group obtained an N-Gain score of 0.28, categorized as low improvement. Thus, the use of AI was associated with a substantially greater improvement in Arabic grammar learning.

Discussion

The findings demonstrate that AI-assisted instruction has meaningful potential to enhance Arabic grammar learning among university students. The experimental group showed a greater improvement in learning achievement than the control group, with the mean score

increasing from 62.40 to 82.60, while the control group increased from 61.80 to 72.40. The statistical comparison also indicated a significant difference in post-test achievement between the two groups. These findings suggest that integrating AI into Arabic grammar instruction may provide additional learning benefits beyond conventional instruction. This result is consistent with recent systematic reviews indicating that generative AI has increasingly been used in higher education and language learning to support learning activities, feedback, content generation, and teaching support (Law, 2024; Nikolopoulou, 2024; Qian, 2025).

One possible explanation for the stronger improvement in the experimental group is the

interactive nature of AI-assisted learning. Unlike static learning resources, generative AI enables students to formulate questions, request additional explanations, and obtain alternative examples based on their immediate learning needs. In Arabic grammar learning, students can ask AI to explain *nahwu* rules, provide examples of grammatical structures, analyze sentences, or explain the differences between correct and incorrect grammatical constructions. Yang & Li, (2024), in their systematic review of ChatGPT for second-language learning, identified content generation, feedback, and teaching support as among the most prevalent roles of ChatGPT in L2 learning. Such functions can provide learners with additional opportunities to engage with language content beyond conventional classroom interaction.

The accessibility and flexibility of AI may also contribute to students' learning engagement. Students can interact with AI-based tools beyond scheduled classroom activities and use them when they encounter difficulties with particular grammatical concepts. This allows learners to seek additional explanations and examples without necessarily having to wait for the next classroom meeting. The potential of generative AI to support more flexible and individualized learning is also reflected in the existing literature on language education. B. Li, Bonk, et al., (2024) reported that ChatGPT research in language education has explored its role in self-directed learning, content generation, and support for teaching and learning activities. However, the authors also identified the need for further research into the quality and effectiveness of AI-generated feedback.

Another important feature of AI-assisted learning is its capacity to provide feedback during students' learning activities. Students can submit Arabic sentences and ask AI to identify possible grammatical errors, explain the relevant grammatical rules, and provide alternative constructions. This creates an opportunity for students to compare their own responses with AI-generated feedback and revise their

understanding. In Arabic grammar, such activities can be particularly relevant to sentence structure, *i'rāb*, grammatical agreement, and the identification and correction of grammatical errors. Nevertheless, AI-generated feedback cannot automatically be regarded as authoritative. Nugraha, (2025), in their comparative analysis of ChatGPT and Gemini in Arabic grammar, found differences in the performance of the two AI systems in analyzing *i'rāb* and emphasized the importance of manual correction and verification.

The findings also suggest that AI-assisted learning can create opportunities for greater learner autonomy. Students can determine what type of assistance they need, request simpler explanations, ask for additional examples, or generate further practice questions. This may encourage students to participate more actively in their own learning process. Z. Li et al., (2024) identified self-directed language learning as one of the roles examined in the emerging literature on ChatGPT and language education. Similarly, (Wu & Chiu, 2026) reported that autonomy-related perspectives have been among the theoretical approaches used to understand ChatGPT in L2 learning. However, such potential should be understood as an opportunity rather than an automatic outcome, because the development of learner autonomy depends on how students use AI and how learning activities are designed.

The ability of AI to generate contextualized examples may also be relevant to Arabic grammar learning. Grammatical rules can be difficult for learners when they are presented primarily through abstract explanations. AI can provide multiple sentence examples and allow students to ask follow-up questions about particular grammatical structures. This may facilitate a learning process that combines explanation, example, practice, feedback, and revision. Such an approach is consistent with the broader finding that generative AI can perform multiple instructional functions in language learning, particularly content generation and feedback

(Yang & Li, 2024). Nevertheless, the educational value of these functions depends on the quality of prompts, the accuracy of generated content, and the learner's ability to evaluate the responses critically.

The present findings are also relevant to research specifically concerned with AI and Arabic grammar. Al-Shehri (2025) investigated the role of AI applications in developing Arabic grammatical skills among university students and examined areas including sentence construction, *i'rāb*, grammatical application, and the identification and correction of grammatical errors. The study provides evidence that AI is considered relevant to several core dimensions of Arabic grammar learning. However, because Al-Shehri's study employed a descriptive approach based on students' perspectives, its findings primarily reflect perceived educational value rather than experimentally measured learning improvement. The present study therefore contributes a different perspective by examining changes in students' learning achievement through a pre-test–post-test comparison.

The improvement observed in the control group should also be considered. Students who received conventional instruction demonstrated learning progress, indicating that conventional Arabic grammar instruction remains valuable. Therefore, the findings should not be interpreted as evidence that AI should replace lecturers or conventional teaching. Rather, AI can be positioned as a supplementary instructional technology that extends opportunities for practice, explanation, and feedback. This interpretation is consistent with the broader higher education literature, which identifies diverse applications of ChatGPT while also emphasizing the need for appropriate implementation and further investigation of its limitations (Cong-Lem et al., 2025; Sohail et al., 2023).

At the same time, the integration of AI introduces important challenges. Students may rely excessively on AI-generated answers or accept grammatical explanations without

independently evaluating their accuracy. This concern is particularly important in Arabic grammar because grammatical analysis can involve complex relationships between word forms, syntactic functions, and sentence structures. The findings of Bouziane & Bouziane, (2024) demonstrate that AI systems can produce useful grammatical analyses but still require human verification. Therefore, AI literacy and critical evaluation should be integrated into AI-assisted Arabic learning rather than treating AI outputs as unquestionable sources of knowledge.

This consideration is also consistent with UNESCO's guidance on generative AI in education and research. UNESCO advocates a human-centred approach that emphasizes ethical, safe, equitable, and meaningful use of generative AI. The guidance also highlights the importance of human agency and appropriate pedagogical design when integrating AI into educational activities. Consequently, the lecturer remains essential in designing learning activities, monitoring students' use of AI, evaluating the accuracy of AI-generated responses, and helping students develop critical judgment.

Overall, the findings indicate that AI-assisted Arabic grammar instruction can contribute positively to university students' learning outcomes. The greater improvement observed in the experimental group suggests that AI can provide additional educational value when it is integrated through structured activities such as grammar exercises, sentence analysis, error identification, personalized explanations, and guided feedback. Nevertheless, the effectiveness of AI does not depend simply on the availability or frequency of technology use. Its educational value depends on how purposefully and critically AI is incorporated into the learning process. Therefore, the most appropriate approach is not to replace conventional Arabic grammar instruction with AI, but to integrate AI as a complementary learning resource under appropriate pedagogical and lecturer guidance.

Conclusion

This study concludes that the use of Artificial Intelligence (AI) provides a positive contribution to university students' Arabic grammar learning. AI-assisted learning can support students in understanding grammatical concepts, practicing Arabic sentence construction, identifying grammatical errors, and receiving immediate feedback during the learning process. Compared with conventional instruction, AI-assisted learning showed greater potential to support improvements in students' Arabic grammar achievement.

The findings indicate that AI can function as an interactive learning assistant that provides accessible explanations, contextualized examples, practice opportunities, and feedback according to students' learning needs. This interactive process can encourage students to become more active and independent in learning Arabic grammar. AI therefore has the potential to complement conventional classroom instruction by creating a more flexible and responsive learning environment.

However, the integration of AI should not be understood as a replacement for the lecturer. Lecturer involvement remains essential in guiding students, verifying AI-generated information, correcting inaccurate grammatical explanations, and developing students' critical judgment in using AI. The effectiveness of AI-assisted learning therefore depends not only on the technology itself but also on how it is pedagogically integrated into the learning process.

Overall, the study suggests that the integration of AI into Arabic grammar learning represents a promising approach to contemporary language education. Future research should explore the implementation of AI-assisted Arabic learning across different educational contexts and examine its long-term effects on students' grammatical competence, learning autonomy, critical AI literacy, and sustained learning outcomes.

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