

Research Article

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Behavioral Determinants of AI-Driven Arabic Language Learning: Insights from the Extended UTAUT2 Model

Sana Al-Jamali , Suliman Zakaria Suliman Abdalla

Abstract

Background/purpose. Artificial Intelligence (AI) is transforming education through adaptive learning systems, intelligent tutoring, and personalized instruction. Although AI has become increasingly prominent in language education, its specific impact on enhancing Arabic proficiency has not been adequately explored, especially in terms of student engagement, linguistic development, and sustained adoption. This study examines the behavioral factors influencing the use of Generative AI (GenAI) in Arabic language learning by applying the Extended Unified Theory of Acceptance and Use of Technology (UTAUT2) framework.

Materials/methods. To achieve this, quantitative data were collected from students at Sultan Qaboos University in Oman, including both Arabic majors and students from other disciplines. This study utilizes ordinal logistic regression to examine the key factors influencing students' adoption of AI in Arabic language learning. It explores how performance expectancy, effort expectancy, facilitating conditions, social influence, hedonic motivation, and habit shape students' engagement with AI-driven tools.

Results. Findings indicate that performance expectancy and social influence are the strongest drivers of adoption, while effort expectancy and facilitating conditions play a key role in sustained engagement. Despite AI's potential to enhance pronunciation, grammar, and vocabulary acquisition, adoption remains inconsistent due to usability issues, content accuracy concerns, and varying levels of AI literacy.

Conclusion. The study highlights the need for structured AI integration, improved digital literacy, and interactive AI-driven learning environments to enhance Arabic language acquisition in higher education.

1. Introduction

Artificial Intelligence (AI) is revolutionizing education by redefining learning methodologies through intelligent automation, real-time feedback, and adaptive instructional systems, fundamentally shifting the role of educators and learners alike (Guan et al., 2020; Yu, 2024). AI-powered tools, particularly Generative AI (GenAI), have demonstrated immense potential in enhancing student engagement, fostering self-regulated learning, and promoting linguistic competence (Chiu et al., 2024; Popenici & Kerr, 2017). Notably, GenAI adoption in education has surged, with studies reporting a substantial increase in AI-assisted learning in higher education institutions worldwide (Hwang et al., 2020). However, concerns surrounding accuracy, ethics, and academic integrity remain key challenges. While AI-generated content sometimes lacks precision, ongoing advancements have mitigated many sporadic accuracy deficiencies. In response, leading universities are establishing AI governance frameworks and digital literacy programs to ensure ethical AI usage while leveraging its pedagogical benefits (Strzelecki, 2024).

Rather than rejecting AI outright, institutions are now strategically integrating AI-assisted tools into structured curricula to maximize learning outcomes while mitigating risks. At Sultan Qaboos University (SQU), this institutional commitment is exemplified through the introduction of "Amazing Applications of Artificial Intelligence" (COMP1007), a newly launched university elective open to all enrolled students across all academic disciplines. This course provides an interdisciplinary overview of AI's transformative applications across diverse fields such as medicine, finance, engineering, education, and social sciences while also addressing ethical and societal considerations. Equipping students with foundational AI literacy fosters a deeper understanding of AI's role in modern education and its practical implications across multiple disciplines.

Among the domains most impacted by AI-driven instruction, language education stands out as a field where adaptive learning technologies offer unparalleled potential to enhance learning experiences and proficiency development (Law, 2024; Tafazoli, 2024). AI-powered language models are increasingly being incorporated into curricula, offering intelligent support in pronunciation correction, grammatical analysis, and vocabulary expansion. These innovations are particularly relevant in Arabic language instruction, where AI-driven approaches can complement traditional methods and provide more dynamic, personalized, and interactive learning pathways. The integration of AI into Arabic language education aligns with broader efforts to modernize curricula and teaching methodologies, ensuring that students gain exposure to AI-enhanced learning environments that improve linguistic accuracy and engagement. As AI adoption in education continues to evolve, institutions like SQU are playing a pivotal role in equipping students with the necessary digital skills to navigate AI-driven learning ecosystems effectively.

Despite AI's potential to enhance Arabic language instruction, its adoption remains inconsistent and influenced by multiple factors. While some students seamlessly integrate AI-driven platforms into their learning routines, others struggle with usability challenges, perceive limited benefits, or discontinue their use altogether. These variations highlight key barriers to adoption, including technical constraints, lack of adequate training, and concerns over the accuracy and reliability of AI-generated content. Additionally, the effectiveness of AI tools in fostering long-term language retention and deep cognitive engagement remains a critical concern. Therefore, understanding the factors that drive or inhibit students' adoption of AI tools becomes essential for ensuring the effective integration of these technologies into Arabic language education.

By applying the Extended UTAUT2 framework, this research investigates how key factors—such as performance expectancy, effort expectancy, facilitating conditions, social influence, hedonic motivation, and habit—shape students' willingness to adopt Generative AI in Arabic learning (Venkatesh et al., 2012). The UTAUT2 model has been widely utilized to examine technology

acceptance across various educational and professional contexts, demonstrating its robustness in predicting behavioral intentions and technology adoption patterns (Acosta-Enriquez et al., 2024; Faqih & Jaradat, 2021; Shaqrah & Almars, 2022). Given the evolving landscape of AI in language learning, the framework offers a structured approach to assessing not only the direct determinants of adoption but also the moderating effects of individual differences, such as prior exposure to AI tools and perceived ease of integration into existing learning routines (Abdalla, 2025). By leveraging this model, the study offers a comprehensive understanding of how motivational and contextual factors influence the adoption of AI-driven Arabic language instruction.

To capture potential differences in AI adoption, the study includes two student cohorts at Sultan Qaboos University (SQU): Arabic Language and Literature majors and students from other disciplines within the College of Arts and Social Sciences. This distinction enables the investigation of how variations in linguistic background may influence students' adoption of AI tools in Arabic language learning. Ordinal logistic regression (OLR) is employed to examine behavioral intentions and adoption patterns across different levels of learner engagement and proficiency to address the study objectives.

2. Literature Review

Arabic language learning, in particular, presents significant cognitive and linguistic challenges due to its root-based morphology, phonetic intricacies, and syntactic variability (Aladeemy et al., 2024; Alafnan, 2025; Essam et al., 2024). Traditional pedagogical methods, which rely heavily on rote memorization and instructor-led drills, reinforce foundational skills but often fail to accommodate diverse learner needs or foster deep linguistic engagement. In contrast, AI-driven solutions provide a transformative alternative by offering real-time corrective feedback, intelligent phonetic modeling, and context-aware linguistic scaffolding. These capabilities enable learners to refine pronunciation through AI-driven phonetic analysis, develop grammatical proficiency using advanced syntactic modeling, and expand their vocabulary through adaptive, context-sensitive recommendations (Doohee, 2024). The growing recognition of these AI-driven benefits has led many higher education institutions to explore their integration into Arabic instruction, aiming to modernize teaching methodologies and enhance student outcomes.

Recent research at Sultan Qaboos University (SQU) highlights the increasing role of AI in addressing these challenges. Al-Jamali et al. (2024) emphasize that AI integration can improve pronunciation accuracy, enhance students' ability to analyze literary texts, and complement traditional instruction with dynamic, interactive learning experiences tailored to individual needs. Their findings suggest that AI-driven tools not only enhance Arabic proficiency but also provide more engaging and personalized learning environments. As AI adoption in language education expands, there is a growing need to examine specific tools and their impact on various aspects of Arabic learning.

Building on these findings, various AI-powered tools have been developed to enhance Arabic language instruction by addressing pronunciation, grammar accuracy, and fluency through advanced learning models. Intelligent speech recognition systems and interactive grammar tutors have demonstrated significant improvements in pronunciation accuracy and grammatical fluency across different language-learning contexts (Fathi et al., 2024; Lai & Lee, 2024; Zhai & Wibowo, 2023). Adapting these innovations for Arabic instruction could facilitate more effective acquisition of Modern Standard Arabic (MSA) while integrating dialectal variations to enhance real-world language application. Furthermore, AI-driven speech synthesis models specifically designed for Arabic phonetics could mitigate pronunciation challenges by offering precise articulation guidance, automated accent correction, and adaptive feedback. This study builds on Al-Jamali et al. (2024) by further exploring how AI adoption can be optimized to support both specialized and non-specialized

learners in Arabic language acquisition, ensuring that AI-driven instruction enhances rather than replaces human-led learning.

3. Theoretical framework and hypotheses

The integration of Generative AI (GenAI) for enhancing Arabic language skills has the potential to transform traditional language learning practices. By offering interactive, personalized, and adaptive learning experiences, GenAI tools such as ChatGPT and GPT-4 can address individual learner needs and overcome conventional challenges in language acquisition. To explore the factors influencing the adoption of GenAI for Arabic language learning, this study employs the Extended Unified Theory of Acceptance and Use of Technology (UTAUT2), which provides a robust and validated framework for examining technology adoption in various contexts (Venkatesh et al., 2012). The UTAUT2 framework, an enhancement of the original UTAUT model (Venkatesh et al., 2003), incorporates constructs that address both utilitarian and hedonic dimensions of technology use, making it particularly suitable for studying GenAI adoption in education. Constructs examined in this study include performance expectancy, effort expectancy, facilitating conditions, hedonic motivation, and habit. These constructs are crucial for understanding behavioral intention (BI) and the actual usage behavior of learners adopting GenAI to improve Arabic language skills.

The UTAUT2 framework has been widely used in educational technology research to analyze factors influencing the adoption of tools like e-learning platforms, virtual classrooms, and AI-driven technologies (Faqih & Jaradat, 2021; Mehta et al., 2019; Nikolopoulou et al., 2021; Suhail et al., 2024). Its applicability to education lies in its ability to encompass both cognitive and motivational elements of technology adoption. In the context of GenAI, UTAUT2 provides a comprehensive structure to examine how technical usability and emotional engagement impact learners' intentions and usage behaviors. By focusing on core constructs such as performance expectancy and effort expectancy, the model assesses how learners perceive the utility and ease of using GenAI tools. At the same time, constructs like hedonic motivation and habit evaluate intrinsic enjoyment and routine use, which are critical for sustained engagement with AI technologies in learning environments.

3.1. Performance Expectancy (PE)

Performance expectancy is a key determinant of technology adoption, referring to the degree to which individuals believe that using a specific technology will enhance their performance (Venkatesh et al., 2003). In the context of Arabic language learning, GenAI offers functionalities such as real-time grammar correction, vocabulary suggestions, pronunciation feedback, and contextual language usage examples, which significantly enhance learning outcomes. Research has consistently demonstrated the strong influence of PE on behavioral intention in adopting innovative technologies (Das & Datta, 2024; Kabra et al., 2017; Schniederjans et al., 2016). Learners who perceive tangible benefits from using GenAI tools are more likely to adopt and integrate them into their study routines. Thus, the following hypothesis is proposed:

H1: Performance expectancy has a statistically significant positive effect on learners' behavioral intention to use GenAI for enhancing Arabic language skills.

3.2. Effort Expectancy (EE)

Effort expectancy refers to the perceived ease of use associated with a particular technology (Venkatesh et al., 2012). GenAI tools designed with user-friendly interfaces, intuitive navigation, and minimal learning curves can significantly reduce cognitive effort and encourage adoption. Features like voice recognition for Arabic pronunciation practice and guided feedback systems further enhance usability, making the technology accessible even to novice users. Numerous educational technology studies have validated EE's role in driving behavioral intention, particularly for tools that involve

complex linguistic structures (Abdalla et al., 2024; Tamilmani et al., 2021). Based on these findings, the following hypothesis is proposed:

H2: Effort expectancy has a statistically significant positive effect on learners' behavioral intention to use GenAI for enhancing Arabic language skills.

3.3. Facilitating Conditions (FC)

Facilitating conditions encompass the availability of resources, technical infrastructure, and institutional support that enable the effective adoption of a technology (Venkatesh et al., 2003). For GenAI adoption in Arabic language learning, facilitating conditions include access to stable internet connections, AI-compatible devices, training programs for learners and educators, and supportive policies from educational institutions. Robust facilitating conditions have been shown to reduce adoption barriers and foster user confidence, particularly in under-resourced educational settings (Nikolopoulou et al., 2021; Strzelecki, 2024). Hence, we propose the following hypothesis:

H3: Facilitating conditions have a statistically significant positive effect on learners' behavioral intention to use GenAI for enhancing Arabic language skills.

3.4. Social Influence (SI)

Social influence refers to the degree to which individuals perceive that important others (e.g., peers, teachers, family, or social groups) believe they should use a particular technology (Venkatesh et al., 2003). In the context of adopting Generative AI (GenAI) to enhance Arabic language skills, social influence can play a pivotal role in shaping learners' behavioral intentions. This construct highlights the importance of external pressures, recommendations, and societal norms in encouraging technology adoption. In educational settings, the influence of teachers, classmates, and family members often guides students' decisions to adopt innovative learning tools. For instance, educators' endorsement of GenAI for language learning and peers sharing positive experiences with tools like ChatGPT can significantly increase learners' motivation to adopt these technologies. Similarly, institutional initiatives promoting AI-driven tools as essential for modern education can further reinforce this influence. Research has consistently shown that social influence strongly impacts behavioral intention, particularly in collectivist cultures where group dynamics and societal expectations hold considerable weight (Hoque & Sorwar, 2017; Mehta et al., 2019). Based on this discussion, the following hypothesis is proposed:

H4: Social influence has a statistically significant positive effect on learners' behavioral intention to use GenAI for enhancing Arabic language skills.

3.5. Hedonic Motivation (HM)

Hedonic motivation is defined as the enjoyment and satisfaction derived from using a technology (Venkatesh et al., 2012). GenAI tools, with their interactive and engaging learning modules, gamified exercises, and conversational interfaces, provide a pleasurable learning experience that keeps learners motivated and engaged. Prior studies have emphasized the importance of HM in driving technology adoption, especially in educational contexts where intrinsic motivation plays a critical role in learning success (Al-Azawei & Aloyayr, 2020; Nikolopoulou et al., 2021). Based on this, the following hypothesis is formulated:

H5: Hedonic motivation has a statistically significant positive effect on learners' behavioral intention to use GenAI for enhancing Arabic language skills.

3.6. Habit (H)

Habit refers to the degree to which technology usage becomes automatic or routine through repeated interactions (Venkatesh et al., 2012). In language learning, the habitual use of GenAI tools

for tasks like writing practice, vocabulary building, and real-time conversation simulations fosters skill improvement over time. Studies highlight that habit predicts behavioral intention and influences continued technology use (Strzelecki, 2024). Accordingly, we hypothesize:

H6: Habit has a statistically significant positive effect on learners' behavioral intention to use GenAI for enhancing Arabic language skills.

4. Methods

4.1. Study design

This study aimed to achieve two primary objectives: (1) to examine learners' engagement with Generative AI (GenAI) tools for enhancing Arabic language skills and (2) to identify the key factors influencing their adoption decisions. Accordingly, the study adopted a descriptive design with causal-comparative elements. Quantitative data were collected using structured surveys and analyzed through a combination of descriptive statistics, Cronbach's Alpha for reliability assessment, and ordinal logistic regression. Descriptive statistics—including frequencies, percentages, means, and standard deviations—were used to capture GenAI usage patterns and the motivating factors for adoption. Cronbach's Alpha ensured the internal consistency of survey items, while ordinal logistic regression highlighted significant predictors of learners' behavioral intentions. This comprehensive design facilitated a detailed exploration of the factors driving the adoption of GenAI in Arabic language education.

4.2. Development of measurement framework

The questionnaire was meticulously designed, in alignment with the study's objectives, to evaluate both students' engagement with Generative AI (GenAI) tools and the factors shaping their adoption decisions for Arabic language learning. It consisted of two primary sections, supplemented by demographic information. The first section focused on capturing students' interactions with GenAI, emphasizing its practical applications in enhancing language skills. Participants provided insights into their use of GenAI for tasks such as grammar correction, vocabulary development, pronunciation practice, reading comprehension, and writing. This section aimed to reveal the extent of GenAI's integration into students' learning practices and its transformative potential for language acquisition.

The second section assessed students' perceptions of the factors influencing their adoption of GenAI and was divided into two subsections: the dependent variable and the six independent variables. The dependent variable examined students' motivations and intentions to adopt GenAI, while the independent variables were drawn from the UTAUT2 framework, encompassing constructs such as performance expectancy, effort expectancy, facilitating conditions, social influence, hedonic motivation, and habit. These constructs captured two essential dimensions: actual adoption of GenAI tools and perceived attitudes toward their use. To evaluate actual adoption, participants responded to items such as, "Using GenAI has significantly improved my Arabic language proficiency," representing performance expectancy. Perceived attitudes were assessed through items such as, "I believe using GenAI tools will make Arabic language learning enjoyable and engaging," and "I think the gamified exercises and features of GenAI will enrich my learning experience." reflecting hedonic motivation.

These constructs captured two essential dimensions: actual adoption of GenAI tools and perceived attitudes toward their use. To evaluate actual adoption, participants responded to items such as, "Using GenAI has significantly improved my Arabic language proficiency," reflecting performance expectancy. Perceived attitudes were assessed through items representing Hedonic Motivation, such as, "I believe using GenAI tools will make Arabic language learning enjoyable and engaging," and "I think the gamified exercises and features of GenAI will enrich my learning

experience.” Together, these sections provided a comprehensive framework for understanding the behavioral drivers and practical integration of GenAI in Arabic language education.

4.2.1. *Dependent variable*

The dependent variable, "Adoption of GenAI for Arabic language learning," was evaluated using a composite score derived from four key dimensions: willingness to use, perceived commitment, planned integration, and expected regularity of use. These dimensions were designed to comprehensively assess students' internal motivations and intentions to adopt GenAI tools, each addressing distinct aspects of their behavioral intention. Each dimension was measured using a single-item statement designed to ensure clarity and precision, as presented in Table 1. A 10-point Likert scale, ranging from 1 (Strongly Disagree) to 10 (Strongly Agree), was used to capture students' responses. The composite score derived from the four dimensions was categorized into three levels of behavioral intention: low intention (1.0–4.0), moderate intention (4.01–7.0), and high intention (7.01–10.0).

Table 1. Dimensions and measurement of GenAI adoption for Arabic language learning

Dimension	Definition	Measurement item
Willingness to use	The level of students' readiness and motivation to incorporate GenAI into their regular learning activities.	I am motivated to use GenAI tools to improve my Arabic language skills.
Perceived commitment	The degree to which students are prepared to invest time and effort in using GenAI for improving their Arabic language skills.	I am ready to dedicate significant time and effort to using GenAI tools for learning.
Planned integration	The extent to which students intend to incorporate GenAI into their routine study practices and language learning strategies.	I intend to integrate GenAI tools into my regular study routine for learning Arabic.
Expected regularity of Use	The frequency with which students anticipate using GenAI for various language learning tasks.	I plan to use GenAI tools frequently for learning Arabic.

4.2.2. *Independent variables*

As described in Section 2, the independent variables were developed based on the UTAUT2 framework, which includes six key constructs: performance expectancy, effort expectancy, facilitating conditions, social influence, hedonic motivation, and habit. Each construct was measured using four carefully designed items on a 10-point Likert scale ranging from 1 (Strongly Disagree) to 10 (Strongly Agree). Table 2 presents a detailed list of the measurement items associated with each variable, ensuring precise alignment with the UTAUT2 framework and clearly illustrating the constructs under investigation in this study.

Table 2. Independent variables and their measurement items

1. Performance expectancy
1.1 Using GenAI has significantly improved my Arabic language proficiency.
1.2 Using GenAI has helped me achieve my language learning goals more efficiently.
1.3 I believe using GenAI will enhance my Arabic language proficiency more effectively than traditional methods.
1.4 I believe adopting GenAI will accelerate my achievement of language learning goals.

2. Effort expectancy

- 2.1 I find using GenAI tools for Arabic language learning straightforward and easy.
- 2.2 The interface of GenAI tools has made it simple for me to navigate language tasks.
- 2.3 I believe learning to use GenAI tools will be straightforward and uncomplicated.
- 2.4 I think the interface of GenAI tools is intuitive and designed for seamless use.

3. Facilitating conditions

- 3.1 I have access to the necessary resources to use GenAI effectively for learning Arabic.
- 3.2 I use the training and guidance available to integrate GenAI into my Arabic learning.
- 3.3 I believe my educational institution provides adequate support for integrating GenAI into my studies.
- 3.4 I think the technological infrastructure supports my use of GenAI for Arabic language learning.

4. Social influence

- 4.1 I adopted GenAI for learning Arabic because of recommendations from peers and instructors.
- 4.2 The encouragement from my instructors has motivated me to use GenAI for language learning.
- 4.3 I believe my peers' recommendations encourage me to use GenAI to improve my Arabic language skills.
- 4.4 I think educational institutions emphasize the value of adopting GenAI for language studies.

5. Hedonic motivation

- 5.1 Using GenAI tools has made my Arabic learning process enjoyable and engaging.
- 5.2 Interacting with GenAI has made learning Arabic more fun and less stressful.
- 5.3 I believe using GenAI tools will make Arabic language learning enjoyable and engaging.
- 5.4 I think the gamified exercises and features of GenAI will enrich my learning experience.

6. Habit

- 6.1 Using GenAI tools has become a regular part of my study routine.
 - 6.2 I frequently rely on GenAI tools for tasks related to Arabic language learning.
 - 6.3 I think over time, using GenAI tools will become second nature in my Arabic language studies.
 - 6.4 I believe I will consistently use GenAI tools for Arabic language learning tasks.
-

4.3. Data analysis procedure

The analysis of this study is structured to address its two primary objectives. Descriptive statistics are utilized to examine learners' engagement with Generative AI (GenAI) tools for enhancing Arabic language skills, aligning with the first objective. Ordinal logistic regression (OLR) analysis is employed for the second objective to identify the key factors influencing students' adoption decisions. This dual approach ensures a comprehensive understanding of engagement patterns and GenAI adoption's

behavioral drivers. OLR is specifically designed for analyzing ordinal outcomes, where response categories follow a natural order but lack equal intervals, such as levels of adoption or satisfaction ratings (Agresti, 2010). This method is particularly suited to accommodate diverse predictor variables, including both continuous and categorical types, ensuring its applicability to the multifaceted dynamics of adoption behaviors (Liu & Koirala, 2012). The primary objective of ordinal logistic regression (OLR) is to estimate the likelihood that the dependent variable falls into specific ranked categories. A fundamental requirement of OLR is the proportional odds assumption, which posits that the association between predictor variables and the log odds of the outcome is uniform across all levels of the dependent variable. This assumption facilitates interpretation by allowing a single set of coefficients to apply across all thresholds. Coefficients with positive values signify an increased likelihood of the outcome aligning with a higher category, whereas negative coefficients indicate a decreased likelihood (Pohlmann & Leitner, 2003).

OLR coefficients are transformed into odds ratios (OR) to provide meaningful insights, offering an intuitive measure of the effect size. An OR greater than 1 indicates increased odds of a higher outcome category, while an OR below 1 signifies decreased odds. For example, an OR of 1.25 suggests a 25% increase in the likelihood of higher adoption, whereas an OR of 0.8 implies a 20% decrease. This transformation allows for clear communication of results, particularly in applied educational research (Hosmer & Lemeshow, 2013). The analysis follows a structured approach, beginning with testing the proportional odds assumption. The parallel lines test is employed, with a non-significant p-value supporting the validity of this assumption and confirming the model's appropriateness (Murad et al., 2003). Upon validation, the analysis focuses on interpreting predictor coefficients, odds ratios, and model thresholds to identify the most significant drivers of behavioral intention. Lastly, the model's overall fit and explanatory power are evaluated using metrics such as the Likelihood Ratio (LR) Test and pseudo-R-square values. The LR Test determines whether the inclusion of predictors substantially improves the model compared to the baseline (null) model. Meanwhile, Nagelkerke and McFadden's Pseudo R-square values offer an estimate of the variance explained by the model, providing an overall measure of its effectiveness (Kook et al., 2022).

4.4. Study participants

The study sample comprises students enrolled in various Arabic language courses at Sultan Qaboos University (SQU), including both Arabic language majors and students from diverse social science disciplines. The sampling frame was obtained from the Deanship of Admission and Registration, which provided full enrollment lists for the selected courses. All students enrolled in these courses were invited to participate, allowing for complete coverage of the target student groups relevant to the study objectives. Specifically, data were collected from Arabic majors enrolled in Syntax and Morphology I (ARAB2116), Rhetoric I (ARAB3683), Oman and Gulf Literature (ARAB3350), and Contemporary Literature (ARAB4352). Additionally, students from various social science disciplines participated through Arabic Language Skills I (ARAB2031) and Arabic Language Skills II (ARAB2032), which are required Arabic courses for both specialized and non-specialized students.

Students were eligible to participate if they were enrolled in one of the selected courses and had exposure to Generative AI tools for Arabic language learning. Students with no AI experience were excluded from the analysis. This approach ensured the inclusion of students with varying levels of Arabic language proficiency and AI usage experience, facilitating a comparative analysis of AI adoption patterns between advanced and foundational learners. While the sample is limited to specific course enrollments, it provides an appropriate representation for addressing the study's research objectives. Table 3 illustrates the demographic distribution of participants, capturing their diverse gender, academic disciplines, and year of study.

Table 3. Demographic profile of study participants

Variable	Categories	N	(%)
Gender	Female	201	51.3
	Male	191	48.7
Discipline	Mass Communication	33	8.4
	Sociology and Social Work	41	10.5
	History	37	9.4
	Tourism	31	7.9
	Information Studies	30	7.7
	Geography	29	7.4
	Music	21	5.4
	English Language and Literature	32	8.2
	Arabic Language and Literature	138	35.1
Academic Year	First Year	63	16.1
	Second Year	92	23.5
	Third Year	87	22.2
	Fourth Year	97	24.7
	Fifth Year	53	13.5

5. Results

5.1. Descriptive analysis of student engagement with Generative AI in Arabic learning

This study analyzed students' engagement with Generative AI (GenAI) tools to evaluate their effectiveness in enhancing six critical aspects of Arabic language acquisition. Table 4 summarizes descriptive statistics on student perceptions, focusing on grammar correction, vocabulary expansion, pronunciation practice, reading comprehension, writing skills, and listening comprehension. Grammar correction emerged as the highest-rated aspect, with a mean score of 9.23 and relatively low variability ($SD = 0.945$). This highlights GenAI's strong performance in offering accurate feedback for structural language challenges. Writing skills followed closely with a mean score of 9.01 and showed comparable variability, reflecting students' positive views on GenAI's support for sentence construction and coherence in composition tasks.

Vocabulary expansion and reading comprehension achieved mean scores of 8.67 and 8.15, respectively, demonstrating GenAI's effectiveness in aiding lexical development and improving text comprehension through context-aware suggestions. Pronunciation practice recorded a mean score of 7.66, with variability in responses indicating mixed perceptions of its utility across students. Listening comprehension received the lowest mean score of 5.19, reflecting limited perceived effectiveness in meeting auditory learning needs. Notably, the highest variability was observed in listening comprehension, vocabulary expansion, and pronunciation practice, suggesting inconsistent experiences among students in these areas.

Table 4. Effectiveness of ChatGPT in Arabic language learning aspects

Learning aspect	Mean	Mean score (	Min.	Max.	SD
Writing skills	9.01	90.1	6	10	.987
Reading comprehension	8.15	81.5	5	10	1.052
Pronunciation practice	7.66	76.6	3	9	1.295
Grammar correction	9.23	92.3	6	10	.945
Vocabulary expansion	8.67	86.7	4	10	1.356
Listening comprehension	5.19	51.9	1	8	1.827

The ranking of these language skills reflects students' priorities, which are based on their academic performance and written communication needs. Since Arabic grammar is essential for forming correct sentences, mastering it is paramount. Writing skills are also highly valued, as they enable students to articulate their ideas clearly and precisely. Vocabulary acquisition is next of importance because a broad vocabulary strengthens both writing and comprehension. Reading comprehension follows, as it aids in understanding and analyzing texts, which contributes to overall language proficiency. In contrast, pronunciation and listening comprehension are ranked lower in priority, as they are less directly linked to writing skills. While these skills are important for spoken communication, students tend to focus more on those that enhance their writing and academic success.

The study explored students' qualitative interactions with Generative AI (GenAI), shedding light on frequent tasks, challenges, and the nature of their engagement across six critical language learning aspects. Commonly reported queries reflected a strong emphasis on improving sentence structure, mastering intricate grammatical rules, and expanding contextually appropriate vocabulary. For instance, students frequently asked, "Can you correct the grammar in this paragraph?" or "How can I rewrite this sentence to make it more concise and clear?" These examples highlight GenAI's role in helping learners refine their writing precision and clarity. Pronunciation practice was another area of frequent interaction, with queries like, "How do I pronounce this word correctly in Modern Standard Arabic?" or "Can you provide phonetic guidance for these sentences?" This demonstrates the importance of GenAI in oral language learning, particularly for students striving to perfect their spoken Arabic.

In reading comprehension, students sought assistance in deciphering complex texts, often posing questions such as, "Can you summarize this article for me?" or "What does this phrase mean in context?" These interactions demonstrate the tool's utility in helping students break down and understand nuanced literary and informational texts. Similarly, for vocabulary expansion, students often asked, "Can you suggest synonyms for this word in Arabic?" or "What are the common usages of this term in everyday language?"

The study also highlighted students' reliance on GenAI for advanced tasks like essay drafting and text analysis. Typical queries included, "Can you help me draft an introduction for this topic?" or "What are the key themes in this passage?" These examples reflect GenAI's effectiveness in supporting critical thinking and contextual learning. Despite its utility, some challenges were noted in students' interactions with GenAI. Queries such as, "Why is this grammatical rule applied here?" or "Can you explain the cultural context of this phrase?" reveal gaps in GenAI's ability to provide deeper cultural and linguistic insights, which are particularly important for advanced learners and culturally rich language settings.

To gain deeper insights into how Generative AI (GenAI) is utilized across different learner profiles, this study compares engagement patterns and perceived effectiveness among Arabic majors and students from other disciplines. Figure 1 presents a breakdown of GenAI's impact on both groups. The results indicate that Arabic majors consistently reported higher effectiveness across most language learning aspects. Grammar correction received the highest ratings from both groups, with Arabic majors scoring 93.9% and non-Arabic majors 90.7%, reflecting GenAI's strong role in providing structural language feedback. Writing skills (90.3% vs. 89.9%) and vocabulary expansion (90.2% vs. 83.1%) also showed similar patterns, with Arabic majors slightly ahead. Pronunciation practice and reading comprehension demonstrated the most notable differences, with Arabic majors rating pronunciation support at 84.5% compared to 68.7% among non-majors and reading comprehension at 86.1% versus 76.9%, indicating that those with stronger linguistic foundations benefit more from AI-driven refinements in these areas. Interestingly, listening comprehension was the only skill where non-Arabic majors (53.2%) outperformed Arabic majors (50.5%), suggesting that learners from other disciplines may rely more on AI-generated auditory inputs. These variations highlight distinct engagement patterns, with Arabic majors leveraging AI primarily for language refinement, while non-majors utilize it more for foundational support.

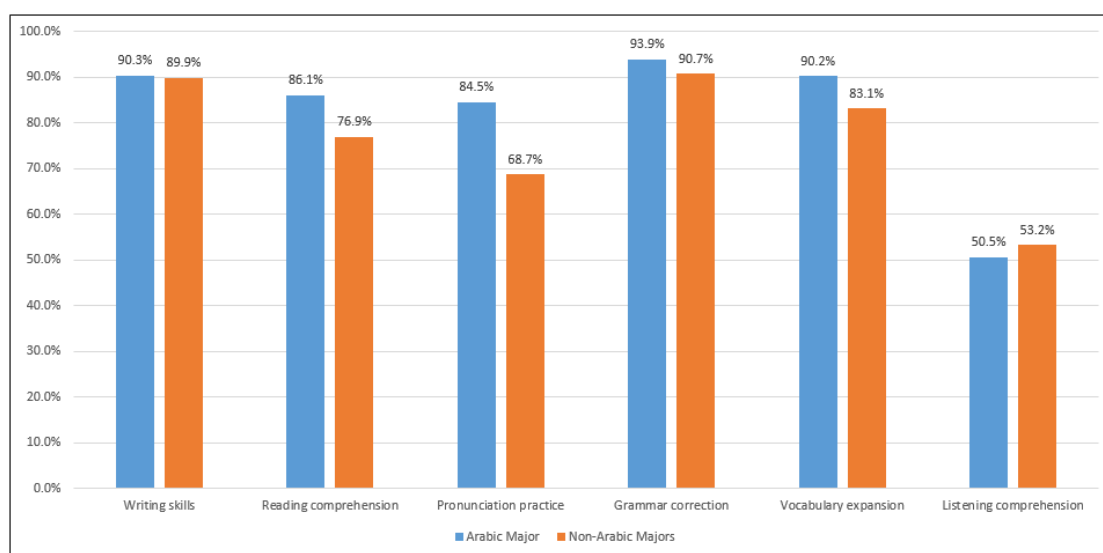


Figure 1. Comparison of GenAI effectiveness in Arabic learning (Arabic major vs. non-Arabic majors)

5.2. Descriptive analysis of students' adoption of GenAI for Arabic language learning

The dependent variable, "adoption of GenAI for Arabic language learning," was assessed across three adoption levels: high (77.3%), moderate (18.4%), and low (4.3%). Table 5 summarizes the descriptive statistics for each dimension and the overall composite score, ranked from the highest to the lowest mean. The dimension of willingness to use recorded the highest mean score of 8.81 (SD = 1.200), indicating strong readiness and motivation among students to incorporate GenAI tools into their language learning activities. This reflects widespread enthusiasm for adopting these tools as part of their educational practices.

Planned integration followed with a mean score of 8.14 (SD = 1.570), showing significant intention among students to include GenAI in their regular learning routines. Despite the high mean, the variability suggests that some students may require additional support to fully integrate these tools. Perceived commitment had a moderate mean score of 7.04 (SD = 1.299), reflecting varying levels of preparedness among students to dedicate time and effort to using GenAI to improve their Arabic language skills. Finally, expected regularity of use recorded the lowest mean score of 6.10 (SD = 1.383). This suggests that while students generally recognize the value of GenAI, there is less certainty regarding the frequency of its usage in their learning practices.

The overall composite score had a mean of 7.55 (SD = 1.231), indicating that most students exhibit moderate to high levels of adoption of GenAI for Arabic language learning. These findings highlight the dimensions contributing to students' behavioral intention to adopt these tools, with notable variation across specific aspects.

Table 5. Summary statistics for dimensions and composite score of the dependent variable

Dimension	Min.	Max.	Mean	SD	Ordinal categories of the DV	N	%
Willingness to use	6	10	8.81	1.200	Low adoption	17	4.3
Perceived commitment	3	8	7.04	1.299	Moderate adoption	72	18.4
Planned integration	4	10	8.14	1.570	High adoption	303	77.3
Expected regularity of use	2	7	6.10	1.383			
Composite score	3.6	8.8	7.549	1.231			

5.3. Descriptive analysis of GenAI adoption factors in Arabic learning

The descriptive statistics for the independent variables influencing the adoption of Generative AI (GenAI) in Arabic language learning are summarized in Table 6. These statistics highlight key trends in how students perceive various factors associated with GenAI adoption, including their central tendencies and variations. Performance expectancy recorded the highest mean score of 36.66 (SD = 3.041), equivalent to 91.6% of the maximum score. This indicates that students largely view GenAI as an effective tool for improving their Arabic language skills, especially in terms of enhancing learning outcomes and performance. Effort expectancy followed with a mean of 35.42 (SD = 2.562), representing 88.5% of the maximum score. This suggests that students find GenAI tools to be user-friendly and accessible, requiring minimal effort to integrate into their learning processes.

Hedonic motivation achieved a mean score of 34.66 (SD = 2.912), accounting for 86.6% of the maximum score. Students reported significant enjoyment and satisfaction in using GenAI tools for Arabic learning, demonstrating its appeal as an engaging and interactive resource. Facilitating conditions had a mean score of 33.34 (SD = 2.992), corresponding to 83.4% of the maximum score. This reflects the presence of resources, infrastructure, and institutional support that enable students to effectively use GenAI in their academic activities.

Social influence displayed a mean of 32.98 (SD = 5.261), representing 82.4% of the maximum score. The higher standard deviation suggests greater variability in how students perceive the role of peers, instructors, or institutional endorsements in shaping their decision to adopt GenAI tools. Lastly, habit reported the lowest mean score of 30.09 (SD = 4.425), equivalent to 75.2% of the maximum score. This indicates that, compared to other factors, the habitual integration of GenAI into students' learning routines is less consistent, with variability in the degree to which students regularly rely on the tool.

Table 6. Summary of descriptive statistics for independent variables

Variable	Min.	Max.	Mean	Std. Dev.	Mean (%)
Performance expectancy	20	40	36.66	3.041	91.6
Effort expectancy	22	38	35.42	2.562	88.5
Facilitating conditions	14	38	33.34	2.992	83.4
Social influence	14	40	32.98	5.261	82.4
Hedonic motivation	24	38	34.66	2.912	86.6
Habit	13	35	30.09	4.425	75.2

To gain deeper insights into how Generative AI (GenAI) adoption varies between Arabic majors and students from other disciplines, Figure 2 presents a comparative breakdown of the six adoption factors. Performance expectancy was the most influential construct for both groups, with Arabic majors rating it higher (95.0%) compared to non-Arabic majors (88.3%), indicating stronger confidence in GenAI's effectiveness in enhancing Arabic language proficiency. Similarly, effort expectancy was slightly higher among Arabic majors (90.3%) than non-Arabic majors (86.8%), suggesting that students specializing in Arabic found AI tools easier to use and integrate into their learning processes. Facilitating conditions showed minimal variation between groups (83.5% vs. 83.2%), indicating that both student groups had comparable access to institutional resources and technical support for GenAI adoption. However, social influence was slightly more prominent among non-Arabic majors (83.0%) compared to Arabic majors (81.9%), suggesting that external encouragement from peers and instructors played a more critical role in AI adoption among non-specialized learners. Hedonic motivation, which reflects the enjoyment and engagement associated with GenAI use, remained high for both groups, with Arabic majors (87.5%) reporting slightly greater motivation than non-Arabic majors (85.8%). Lastly, habit recorded the lowest scores across both groups but was more established among Arabic majors (77.6%) than non-Arabic majors (72.9%), indicating a stronger tendency among Arabic specialists to integrate AI into their regular study routines.

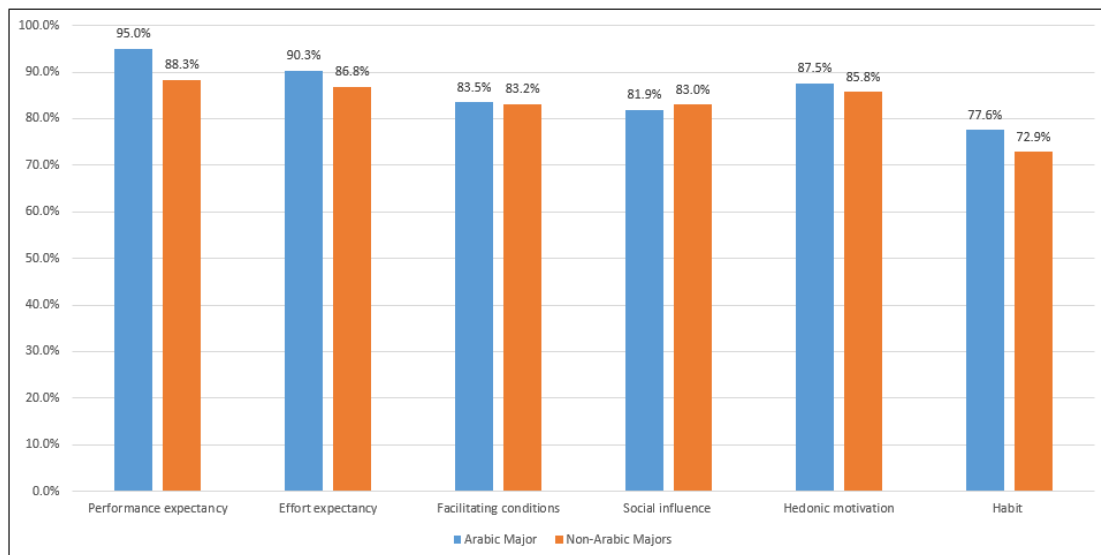


Figure 2. Comparison analysis of GenAI adoption factors across student groups

5.4. Results of OLR analysis

5.4.1. Model validation results

The validation of the OLR model confirmed its robustness and reliability in analyzing students' adoption of Generative AI (GenAI) tools for Arabic skills learning. Key metrics demonstrated the model's goodness of fit, adherence to assumptions, and strong explanatory power. The Likelihood Ratio Chi-Square test ($\chi^2 = 406.668$, $P\text{-value} < 0.001$) confirmed that the model significantly improves over the null model, indicating that the included predictors meaningfully explain the variance in the adoption of GenAI for Arabic skills learning. This highlights the relevance of the independent variables in predicting behavioral intentions. The proportional odds assumption, a fundamental requirement for OLR, was validated using the parallel lines test. The non-significant result ($P\text{-value} = 0.147$) indicates that the assumption holds, ensuring that the relationship between predictors and the dependent variable remains consistent across thresholds. The model demonstrated substantial explanatory power, reflected in the Pseudo R-square values. The Nagelkerke Pseudo R-square of

0.890 and McFadden Pseudo R-square of 0.802 confirm that the model captures a large proportion of the variance in students’ adoption of GenAI tools for Arabic skills learning, reinforcing its reliability and predictive capability.

Table 7. Validation results for the OLR model

Validation Metric	Value
Likelihood Ratio (LR) Test Chi-square	Chi-square (df=6)= 406.668 (P-value = 0.000)
Proportional Odds Assumption (Parallel Lines Test)	Chi-square (df=6)= 9.503 (P-value = 0.147)
Nagelkerke Pseudo R-square	0.890
McFadden Pseudo R-square	0.802

5.4.2. Results of OLR model estimates

The results in Table 8 detail the ordinal logistic regression analysis for factors predicting students’ adoption of Generative AI (GenAI) for Arabic language learning. Each predictor variable's effect is evaluated using its coefficient (β), standard error (SE), odds ratio (OR), 95% confidence interval (CI), and p-value. Performance expectancy emerged as the most significant predictor, with a coefficient (β) of 0.520 and an odds ratio (OR) of 1.681. This indicates that for every one-unit increase in students' belief that GenAI enhances their Arabic proficiency, the odds of adopting the technology increase by 68.1%. The confidence interval for this variable (1.339–2.111) exceeds 1, affirming its strong and consistent effect across the sample. Similarly, effort expectancy was a substantial predictor, with a coefficient (β) of 0.513 and an OR of 1.671. This finding demonstrates that for each unit increase in students’ perception of the ease of using GenAI tools, the odds of adoption rise by 67.1%. The confidence interval (1.328–2.101) reinforces this variable's reliability as a predictor of adoption.

Facilitating conditions also played a significant role in influencing adoption decisions, as reflected by a coefficient (β) of 0.452 and an OR of 1.571. This suggests a 57.1% increase in the odds of adoption for each one-unit improvement in the availability of resources, infrastructure, and institutional support. The confidence interval (1.320–1.870) further validates the importance of this factor. Hedonic motivation, with a coefficient (β) of 0.483 and an OR of 1.621, indicates that students who perceive GenAI as enjoyable and engaging are 62.1% more likely to adopt it. The confidence interval (1.267–2.073) highlights the consistent influence of enjoyment and satisfaction on adoption decisions.

Social influence showed a smaller but still significant effect, with a coefficient (β) of 0.227 and an OR of 1.255. This result suggests that encouragement from peers, instructors, and educational institutions increases the odds of adoption by 25.5% for each unit increase in perceived social support. The confidence interval (1.125–1.399) confirms the robustness of this variable. In contrast, habit did not emerge as a significant predictor of GenAI adoption. Its coefficient (β) of 0.070 and OR of 1.072 indicate a small 7.2% increase in adoption likelihood for each unit increase in habitual use. However, the confidence interval (0.953–1.207) includes 1, suggesting that the effect is not consistent across the sample.

Table 8. OLR results for factors predicting GenAI adoption in Arabic learning

Predictor Variables	Coefficient (β)	S.E(β)	Wald	Odds Ratio (OR=Exp(β))	95% Confidence Interval for OR	p-value
Performance expectancy	.520	.116	20.023	1.681	1.339 – 2.111	.000
Effort expectancy	.513	.117	19.240	1.671	1.328 – 2.101	.000
Facilitating conditions	.452	.089	25.838	1.571	1.320 – 1.870	.000
Social influence	.227	.056	16.534	1.255	1.125 – 1.399	.000
Hedonic motivation	.483	.126	14.760	1.621	1.267 – 2.073	.000
Habit	.070	.060	1.355	1.072	0.953 – 1.207	.244

In summary, Table 8 results indicate that performance expectancy, effort expectancy, facilitating conditions, hedonic motivation, and social influence all significantly increase the likelihood of adopting Generative AI for Arabic language learning. Performance expectancy showed the strongest effect. Habit did not significantly influence adoption in this study.

6. Discussion and implications

6.1. Pedagogical and technological implications for Arabic language learning

The findings underscore the transformative impact of Generative AI (GenAI) in Arabic language education, with students demonstrating strong adoption intentions. AI-powered tools provide instant feedback, personalized learning experiences, and adaptive linguistic support, aligning with contemporary pedagogical models that emphasize self-regulated learning and technology-enhanced instruction. Chang and Sun (2024) highlight that AI should not merely function as an instructional tool but as a scaffold for developing self-regulated learning strategies (SRLL), enabling learners to engage in metacognitive processes, enhance linguistic competence, and refine strategic learning techniques through cyclical improvement. The present study contributes to this evolving body of work by providing empirical evidence from Arabic language learning contexts, where such AI-supported self-regulation is still underexplored.

The present study's findings align with this perspective, particularly in Arabic grammar correction and vocabulary expansion, where students demonstrate strong engagement but require AI-driven adaptive scaffolding to ensure deeper learning retention. Additionally, AI-driven self-regulation empowers Arabic learners to manage their learning pace more effectively, offering tailored linguistic support that adapts to their proficiency levels. This adaptability ensures that students not only receive corrective feedback but also actively engage with AI tools in a way that fosters long-term language acquisition and cognitive development.

Moreover, Wang et al. (2024) emphasize the broader landscape of AI applications in education, noting that adaptive learning, intelligent tutoring, and personalized assessment systems significantly enhance language instruction. Their systematic review supports the argument that AI-driven tools enhance engagement and optimize learning outcomes, particularly in structured reinforcement areas such as grammar correction, vocabulary expansion, and writing skills. Consistent with these findings, this study identifies grammar correction, writing development, and vocabulary building as the domains where students most actively engage with GenAI for Arabic language acquisition.

Notably, the strongest areas of AI adoption—grammar correction, writing skills, and vocabulary expansion—reflect students' reliance on GenAI for structured linguistic reinforcement in Arabic

language learning. Ranalli (2021) highlights how AI-powered writing assistants enhance composition skills by providing real-time syntactic and semantic corrections, yet students often approach AI feedback as mere proofreading rather than actively engaging with grammatical rules to internalize learning. Similarly, Zhao et al. (2024) emphasize the role of AI in self-directed vocabulary acquisition, demonstrating how context-aware suggestions and automated feedback in real-life linguistic tasks significantly improve students' lexical expansion. This study extends these observations into Arabic language learning, where such integration remains relatively underrepresented in the current literature.

Despite these advantages, inconsistencies in students' experiences with pronunciation and listening comprehension highlight the challenges associated with AI-driven phonetic learning. The intricate nature of Arabic phonology—including emphatic consonants, long-short vowel distinctions, and diverse regional dialects—presents substantial obstacles to automated speech recognition and pronunciation training. Abdellatif et al. (2024) demonstrated that AI-powered listening assessments significantly improve learners' auditory skills, self-competence, and resilience. Their findings highlight the potential of AI-driven listening tools tailored to Arabic learners, particularly those designed to accommodate dialectal diversity and real-time phonetic analysis, in bridging this gap. In line with these studies, our findings reveal that while students recognize the value of AI for receptive skills (listening, pronunciation), adoption remains less consistent in these areas compared to grammar and writing.

6.2. Institutional and curriculum integration

The study highlights the crucial role of institutional support in fostering the adoption of Generative AI (GenAI) for Arabic language learning. Universities and language centers must proactively integrate AI-assisted tools into structured curricula, ensuring that students receive systematic exposure to AI-driven instruction. Faculty training is equally essential, as instructors play a pivotal role in guiding students toward effective AI utilization for linguistic development. Wang et al. (2024) emphasize that AI's role in education extends beyond individual adoption, requiring strategic incorporation into institutional teaching methodologies to maximize its pedagogical impact. Additionally, Zaim et al. (2024) stress the importance of balancing technological efficiency with pedagogical relevance, highlighting that performance expectancy and social influence significantly influence AI adoption among educators. The current study complements these insights by demonstrating that facilitating conditions and social influence significantly predict adoption behavior among Arabic language learners, suggesting that institutional interventions can directly shape student readiness.

While previous sections discussed student engagement with AI, institutional frameworks remain a critical determinant of sustained adoption. Recent research has identified critical challenges that must be addressed for successful AI integration. Ali et al. (2024) examined the implications of AI adoption in education and identified key barriers, including technological, operational, and ethical concerns. Their findings suggest that while AI models such as ChatGPT provide valuable instructional support, their effectiveness depends on structured pedagogical integration, tailored faculty training, and continuous refinement of AI-driven learning systems. These concerns parallel findings from the present study, where variations in habitual AI use suggest that while students are motivated, sustained engagement may require clearer institutional scaffolding and supportive learning environments.

Moreover, while students express strong intentions to incorporate GenAI into their learning routines, its habitual use remains inconsistent. This suggests that GenAI is still viewed as a supplementary rather than a primary learning tool. Higher education institutions must move beyond sporadic implementation to ensure sustained AI adoption, embedding AI-assisted activities within

curriculum design and structured coursework. A structured integration of AI-driven writing assessments, interactive exercises, and adaptive learning tasks could reinforce consistent usage patterns, improving learning outcomes over time. Dwivedi et al. (2023) stress that AI's impact on education extends beyond individual student engagement to institutional policy decisions governing ethical AI use and structured learning integration. These observations highlight an ongoing research gap regarding the long-term institutional strategies necessary to foster habitual AI use in Arabic language education—a gap this study helps to address.

6.3. Policy implications for technology-enhanced language education

The findings hold important implications for policymakers seeking to modernize Arabic language education through AI integration. Given the significant influence of facilitating conditions, investments in digital infrastructure, access to AI tools, and training programs are necessary to enhance technology adoption among students and educators. Wang et al. (2024) emphasize that successful AI adoption in education depends on robust institutional policies that promote access, equity, and responsible AI implementation. Establishing standardized frameworks for AI-assisted Arabic instruction can ensure quality control, optimize learning outcomes, and minimize disparities in technological accessibility.

Moreover, policymakers must prioritize equitable access to AI-driven Arabic language learning by ensuring that AI-powered educational resources are available to all student populations, particularly those in underprivileged regions with limited technological infrastructure (Alqahtani et al., 2023; Law, 2024; Zhai et al., 2024). The rapid integration of AI in Arabic education risks widening the digital divide, as students with stronger digital literacy may benefit disproportionately from AI-enhanced tools for grammar correction, vocabulary expansion, and pronunciation training, while those with limited access to technology may struggle to engage effectively.

The present study's emphasis on these equity concerns reinforces calls for targeted AI literacy programs and regulatory frameworks to ensure inclusive, pedagogically sound integration of GenAI tools in Arabic education. AI literacy programs should include hands-on training in AI-assisted writing, pronunciation analysis, and critical engagement with AI-generated content to ensure learners develop comprehensive AI literacy skills applicable to Arabic education. Additionally, regulatory guidelines must be established to standardize best practices for AI-assisted Arabic instruction, ensuring ethical AI use and mitigating biases in AI-generated text and speech. These policies should define clear parameters for AI integration in Arabic education, preventing over-reliance on automated tools while reinforcing independent writing, reading, and speaking skills. By embedding these frameworks into educational policies, institutions can optimize AI's potential to support Arabic language acquisition while maintaining an inclusive and pedagogically sound learning environment.

7. Conclusion and future research directions

7.1. Conclusion

This study provides an in-depth analysis of Generative AI (GenAI) adoption in Arabic language learning, integrating the UTAUT2 framework to examine the key determinants influencing student engagement with AI-driven educational tools. The findings confirm that performance expectancy, effort expectancy, facilitating conditions, social influence, and hedonic motivation significantly impact the behavioral intention to adopt GenAI, while habit did not emerge as a significant predictor. The strong explanatory power of the Ordinal Logistic Regression (OLR) model validates the robustness of these relationships, reinforcing the role of AI in supporting structured linguistic reinforcement, self-regulated learning, and adaptive learning strategies.

Descriptive analysis highlights that students engage most strongly with GenAI for grammar correction, writing skills, and vocabulary expansion, leveraging AI for structured feedback and

linguistic accuracy. However, pronunciation practice and listening comprehension remain challenging areas, reflecting the limitations of AI-driven phonetic modeling and speech recognition in Arabic. Institutional and curriculum integration emerges as a critical factor in ensuring systematic and sustainable AI adoption, highlighting the need for faculty training, structured pedagogical frameworks, and institutional support to embed AI into Arabic language education effectively.

From a policy perspective, the findings emphasize the necessity for AI literacy programs, equitable access initiatives, and regulatory frameworks to govern AI-assisted language learning. Policymakers must ensure that AI tools enhance rather than replace traditional instruction, balancing technological efficiency with pedagogical relevance. These findings underscore the transformative potential of GenAI in Arabic language learning, provided that institutional, technological, and pedagogical challenges are systematically addressed.

7.2. Future research directions

While this study provides valuable insights into GenAI adoption in Arabic language learning, several areas require further exploration. First, future research should examine the longitudinal impact of AI on language retention, assessing whether AI-driven grammar correction, vocabulary expansion, and writing assistance foster deep linguistic understanding or create short-term dependency. Long-term studies will clarify AI's role in sustaining independent language proficiency and cognitive engagement. Second, addressing AI-driven pronunciation and listening comprehension challenges is crucial. Given Arabic's complex phonology and dialectal variations, future research should enhance speech recognition technologies, interactive phonetic feedback, and real-time accent analysis to support spoken Arabic proficiency effectively.

Third, while GenAI strengthens structural language skills, its role in critical thinking, discourse structuring, and rhetorical development remains underexplored. Future studies should refine AI-assisted writing tools to support argumentative reasoning and creative expression in Arabic, ensuring deeper engagement with higher-order language skills. Finally, ethical concerns in AI-assisted Arabic learning demand attention. Biases in AI-generated content may misrepresent linguistic norms and cultural context, requiring bias-aware AI models and ethical frameworks to ensure academic integrity, responsible AI use, and culturally inclusive language learning. Addressing these areas will enhance AI's pedagogical effectiveness while maintaining the authenticity of Arabic education.

Declarations

Author Contributions. S.A.: Literature review, conceptualization, review-editing, and writing, original manuscript preparation. S.Z.S.A: methodology, data analysis, review-editing, and writing, original manuscript preparation. All authors have read and approved the final version of the article.

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Ethical Approval. This research was conducted in accordance with Sultan Qaboos University's ethical standards. Informed consent was obtained from all participants.

Data Availability Statement. The data used in this study can be obtained by sending a request e-mail to the corresponding author.

Declaration of generative AI and AI-assisted technologies in the writing process. During the preparation of this work, the authors used ChatGPT4o to assist with improving the language and readability of single sentences in the initial drafts. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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