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Artificial Intelligence in Arabic Language Education: Opportunities, Challenges and Future Directions

الذكاء الاصطناعي في تعليم اللغة العربية: الفرص والتحديات والاتجاهات المستقبلية

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ABSTRACT

Artificial Intelligence (AI) is increasingly reshaping language education through adaptive learning, intelligent tutoring, automated assessment, speech technologies, natural language processing, and generative AI. This narrative review examines how these developments are being applied to Arabic language education, with particular attention to educational opportunities, Arabic-specific constraints, implementation conditions, and future research needs. The review used an iterative narrative search of academic databases and supplementary scholarly sources, focusing primarily on publications from 2019 to 2026 and retaining earlier foundational works where conceptually necessary. A structured literature-extraction matrix was used to record study focus, context, AI application, educational purpose, principal findings, limitations, and implications. The final synthesis comprised 28 sources and was analysed through thematic comparison and mapping to four research questions. The evidence shows that AI can support personalization, feedback, writing, pronunciation, assessment, learner autonomy, and teacher productivity, but its educational value is conditional on teacher competence, Arabic linguistic resources, infrastructure, cultural responsiveness, and ethical governance. The review's principal conceptual contribution is the Human-Centered AI for Arabic Language Education (HCAI-ALE) framework, which integrates six mutually dependent dimensions: human-centered pedagogy, Arabic linguistic intelligence, personalized learning, ethical AI governance, teacher and learner AI literacy, and continuous evaluation. The review argues that responsible Arabic AI education should be understood not as technology adoption alone but as the alignment of AI affordances with pedagogical purpose, linguistic context, human agency, and institutional safeguards.

Keywords: Artificial Intelligence; Arabic Language Education; AI-Supported Language Learning

مستخلص البحث

يتناول هذا البحث مراجعة سردية لتوظيف الذكاء الاصطناعي في تعليم اللغة العربية، مع التركيز على التطبيقات التعليمية، والفرص والتحديات اللغوية والتربوية والتقنية والأخلاقية، والاتجاهات المستقبلية. اعتمدت الدراسة على بحث سردي تكراري في المصادر الأكاديمية، مع التركيز على الدراسات المنشورة بين عامي 2019 و2026، والاستفادة من بعض المصادر التأسيسية الأقدم عند الحاجة. واستخدمت الدراسة مصفوفة لاستخراج البيانات شملت موضوع الدراسة وسياقها وتطبيق الذكاء الاصطناعي وأبرز النتائج والقيود والآثار التعليمية. وتكوّنت العينة التحليلية النهائية من 30 مصدرًا، وحُللت موضوعيًا وربطت بأسئلة البحث الأربعة. وتشير النتائج إلى قدرة الذكاء الاصطناعي على دعم التعلم الشخصي، والتغذية الراجعة، والكتابة، والنطق، والتقويم، واستقلالية المتعلم، وكفاءة المعلم، مع استمرار تحديات تتعلق بتعقيد العربية، ونقص الموارد اللغوية الرقمية، والبنية التحتية، والاستعداد المهني، والخصوصية، والنزاهة الأكاديمية، والملاءمة الثقافية. وتتمثل الإضافة المفاهيمية للدراسة في إطار الذكاء الاصطناعي المتمحور حول الإنسان لتعليم اللغة العربية (HCAI-ALE)، الذي يجمع بين التربية المتمحورة حول الإنسان، والذكاء اللغوي العربي، والتعلم الشخصي، والحوكمة الأخلاقية، ومحو الأمية بالذكاء الاصطناعي، والتقويم المستمر.

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الكلمات المفتاحية: الذكاء الاصطناعي؛ تعليم اللغة العربية؛ تعلم اللغة المدعوم بالذكاء الاصطناعي.

INTRODUCTION

Artificial Intelligence (AI) has moved from an emerging educational technology to a significant component of contemporary teaching and learning. Machine learning, natural language processing (NLP), speech recognition, adaptive systems, and large language models now support activities that were traditionally performed by teachers or language-learning software. Across education, the strongest potential of AI lies in its capacity to provide timely feedback, personalize learning pathways, generate learning materials, and support data-informed decisions. At the same time, recent research emphasizes that these affordances do not automatically produce better learning; educational value depends on how technologies are aligned with pedagogy, teacher expertise, learner agency, and institutional conditions (Crompton & Burke, 2023; Fu & Weng, 2024; Topali et al., 2024).

Arabic language education presents a distinctive case for AI-supported learning because Arabic combines rich morphology, flexible syntax, multiple varieties, diglossia, and substantial differences between Modern Standard Arabic, Classical Arabic, and regional dialects. These characteristics create opportunities for AI-supported personalization and language practice, but they also increase the risk of inaccurate grammatical explanations, inappropriate dialect handling, and culturally weak outputs. Research on Arabic AI has therefore emphasized both the promise of intelligent language support and the need for Arabic-specific linguistic resources and culturally responsive design (Hanandeh et al., 2024; Fahmi & Adhimah, 2024).

The recent state of the art shows a field that is expanding but still fragmented. Azwir et al. (2024) synthesized broad opportunities and challenges of AI in Arabic learning, while Faqeeh et al. (2024) examined students' awareness of AI effectiveness using a survey of 175 students. Hanandeh et al. (2024) reviewed the wider Arabic linguistic landscape and highlighted the shortage of Arabic-specific AI applications and the continuing difficulties of linguistic processing. These studies establish the relevance of AI but differ in scope and emphasis.

More recent empirical work has begun to clarify user experience and implementation conditions. Amadi and Hikmah (2025) examined university students' perceptions of AI use in Arabic learning, emphasizing perceived usefulness and the need for appropriate pedagogical integration. Ridho et al. (2025) used qualitative interviews with students and

teachers and found that AI can increase flexibility and interactivity, while teacher training, infrastructure, and cultural-contextual understanding remain important constraints. Alkaabi and Almaamari (2025), based on interviews with 15 instructors, reported that generative AI can support material creation, assessment, and personalized planning, but accuracy across dialects, cultural authenticity, assessment reliability, and institutional guidance remain problematic. Akmal et al. (2026) further examined AI usage patterns, purposes, benefits, and perceptions among 89 students, while Noer et al. (2026) reported positive student perceptions alongside concerns about dependence and reduced teacher interaction. Baity et al. (2026), using data from 98 Arabic language education students, showed that AI may support analysis, evaluation, and creative language work, but its effect on critical thinking depends on reflective and guided use.

Taken together, the existing literature points to an important limitation in the current knowledge base. Research to date has predominantly examined particular dimensions of AI-supported Arabic language education in isolation, including general opportunities and challenges, student perceptions, teacher experiences, generative AI applications, or specific learning outcomes. What remains comparatively underdeveloped is an integrated synthesis that brings these strands of evidence together, compares their findings systematically, identifies converging and diverging patterns, and explains how pedagogical, linguistic, technological, ethical, and institutional factors interact in shaping the educational value of AI. Addressing this gap requires moving beyond the question of whether AI is beneficial or problematic toward a more critical examination of the conditions under which AI can be meaningfully and responsibly integrated into Arabic language education. To provide such an analysis, this review draws on Technological Pedagogical Content Knowledge (TPACK) as a lens for examining pedagogical and content alignment and incorporates a human-centered AI perspective to address learner agency, trust, safety, contextual responsibility, and the role of human oversight (Mishra & Koehler, 2006; Fu & Weng, 2024).

Accordingly, this review examines four interconnected questions: what major AI applications have been reported in Arabic language education; what educational opportunities these applications provide for teaching and learning; what technological, pedagogical, ethical, and institutional challenges constrain their responsible implementation; and what future research directions and policy priorities may strengthen their integration. The objective is not merely to catalogue existing applications or reiterate

the established benefits and challenges of AI, but to critically synthesize contemporary evidence and identify the conditions that determine whether AI can become educationally meaningful in Arabic language contexts. On this basis, the review develops a conceptual contribution termed the Human-Centered AI for Arabic Language Education (HCAI-ALE) framework, which organizes the synthesized evidence into six mutually reinforcing dimensions. The framework is intended to provide a conceptual basis for future empirical research, pedagogical practice, AI technology development, and institutional policy concerning the responsible integration of AI into Arabic language education.

RESEARCH METHOD

This study employed a narrative review design. A narrative approach was selected because the literature on AI and Arabic language education includes empirical studies, literature reviews, conceptual analyses, technology-oriented studies, and policy documents that cannot be meaningfully reduced to a single intervention effect. The approach therefore prioritized critical comparison, thematic synthesis, and interpretation across diverse forms of evidence rather than statistical aggregation.

Search Strategy and Publication Period

The review primarily considered publications from 2019 to 2026, a period that captures the rapid development of generative AI and its growing educational use. Earlier foundational publications were retained when they provided essential theoretical grounding. Searches were conducted across major academic databases and scholarly platforms represented in the original review, including Scopus, Web of Science, ERIC, Google Scholar, ScienceDirect, SpringerLink, IEEE Xplore, Taylor & Francis Online, Wiley Online Library, and SAGE Journals. Supplementary searching was used to identify relevant Arabic-language studies and recent publications that were not readily visible through a single database.

Search strings combined terms such as "Artificial Intelligence" OR "AI in Education" with "Arabic Language Education" OR "Arabic Language Learning" OR "Arabic Language Teaching", and with application terms including "Natural Language Processing", "Generative AI", "ChatGPT", "Intelligent Tutoring Systems", "adaptive learning", "speech recognition", "automated assessment", and "AI-supported language learning".

Eligibility and Selection Criteria

Publications were considered eligible when they: (1) addressed AI, intelligent educational technologies, or closely related computational language technologies; (2) had a clear connection to language education or Arabic language learning/teaching; (3) contributed empirical, theoretical, methodological, or policy evidence; (4) were available in English or Arabic; and (5) provided sufficient information for interpretation. Duplicate records, purely promotional materials, publications unrelated to education or Arabic/language learning, and sources without a substantive scholarly contribution were excluded.

Because this was a narrative rather than a systematic review, the search process was iterative and was not conducted as a PRISMA-style fixed-count screening exercise. To avoid introducing unsupported numbers retrospectively, the revised manuscript does not invent an initial-record count. Instead, it transparently reports the final analytical corpus of 28 sources and documents the stages of searching, screening, extraction, thematic coding, and synthesis in Figure 1.

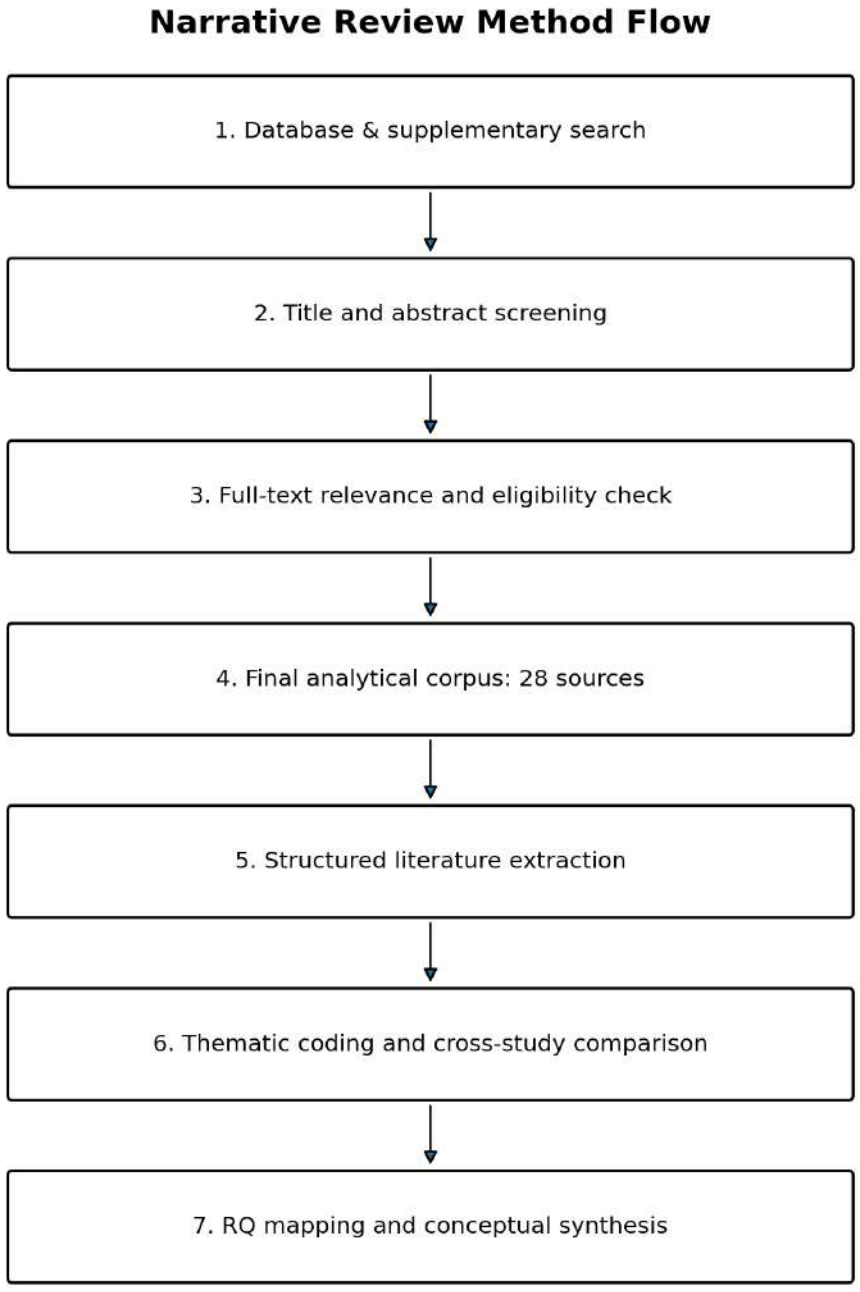

Figure 1. Research method flowchart for the narrative review.

Literature Extraction Instrument

A structured literature-extraction matrix served as the review instrument. For each included source, the reviewer recorded: author and year; research purpose; study design or source type; educational context; participant or evidence context where applicable; AI technology or application; Arabic language skill or educational function addressed; principal findings; limitations; and implications for Arabic language education. This matrix enabled cross-study comparison and reduced reliance on impressionistic narrative description.

Extraction field	Purpose
Author/year and source type	Identify publication recency and evidence category.
Research purpose and design	Distinguish empirical, review, conceptual, technical, and policy evidence.
Context and participants	Record educational level, setting, and sample where reported.
AI technology/application	Identify the technological affordance being examined.
Language skill/function	Map evidence to grammar, vocabulary, reading, writing, speaking, assessment, etc.
Main findings and limitations	Capture both reported benefits and constraints.
Implications	Identify pedagogical, technological, institutional, policy, and research implications.

Table 1. Literature-extraction matrix used in the review.

Screening, Appraisal, and Thematic Analysis

Potentially relevant publications were screened first by title and abstract and then by full-text relevance. The selected sources were critically appraised for transparency of purpose, appropriateness of method, clarity of context, alignment between claims and evidence, and acknowledgement of limitations. The analysis followed six iterative stages: familiarization with the extracted evidence; initial coding; grouping of related codes; comparison across studies and contexts; mapping of themes to the four research questions; and higher-order conceptual synthesis. Thematic codes included AI applications, personalization, feedback, language skills, teacher support, Arabic linguistic constraints, infrastructure, AI literacy, ethics, academic integrity, human agency, governance, and future research.

The thematic synthesis was then interpreted through TPACK and a human-centered AI perspective. TPACK was used to examine whether AI affordances were pedagogically and linguistically aligned with teaching goals, while the human-centered perspective was used to assess agency, safety, trust, transparency, contextual fit, and the continuing role of teachers and learners. This combination allowed the review to move from a list of technologies toward an explanation of the conditions required for meaningful implementation.

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RESULTS AND DISCUSSION

State-of-the-Art Synthesis

Study	Evidence/focus	What it established	What remains underexplored
Azwir et al. (2024)	Literature-based discussion of Arabic AI learning	Identified broad opportunities and challenges.	Limited integration of empirical user evidence and a unifying implementation framework.
Faqeeh et al. (2024)	Survey; 175 students	Showed student awareness of AI effectiveness in Arabic learning.	Did not synthesize teacher, infrastructure, governance, and technology-design dimensions together.
Hanandeh et al. (2024)	Literature review of AI and Arabic linguistic landscape	Highlighted Arabic-specific processing challenges and limited applications.	Educational implications were broader than a focused synthesis of learning and teaching conditions.
Amadi & Hikmah (2025)	University student perceptions	Reported positive perceptions and perceived usefulness of AI in Arabic learning.	Perception evidence alone cannot explain system design, teacher practice, or governance.
Ridho et al. (2025)	Qualitative interviews with students and	Identified flexibility and interactivity alongside training, infrastructure,	Need for cross-study synthesis linking these factors to pedagogical

	teachers	and cultural constraints.	alignment.
Alkaabi & Almaamari (2025)	15 instructor interviews	Showed GenAI use for materials, assessment, and personalized planning, with accuracy and cultural concerns.	Need to integrate generative AI evidence with broader Arabic AI applications.
Akmal et al. (2026)	Survey of 89 students	Examined usage patterns, purposes, benefits, and perceptions.	User-level evidence still needs synthesis with institutional and linguistic conditions.
Baity et al. (2026)	98 Arabic language education students	Linked AI use with analysis, evaluation, creativity, and critical-thinking concerns.	Need for a broader framework connecting cognition, pedagogy, language, ethics, and governance.

Table 2. State-of-the-art comparison of recent studies on AI and Arabic language education.

The state of the art indicates that the field has progressed from general claims about digital innovation toward more specific evidence about student perceptions, teacher practice, generative AI, and critical thinking. However, the studies remain distributed across different levels of analysis. Student-centered studies foreground usefulness and engagement; teacher-centered studies emphasize training, assessment, and cultural accuracy; linguistic studies emphasize data and language-processing limitations; and policy-oriented work emphasizes governance and equity. The central analytical insight from the synthesis is therefore that AI effectiveness is conditional rather than intrinsic: the same technology may produce useful personalization in one context while producing weak or misleading learning in another when linguistic resources, teacher mediation, or institutional safeguards are insufficient.

Major Applications of AI in Arabic Language Education

The evidence supports six broad application clusters. First, adaptive and personalized learning systems can tailor practice to learner progress, especially in vocabulary, grammar, reading, and writing. Second, intelligent and conversational systems provide interactive explanation, question answering, dialogue practice, and individualized feedback. Third, NLP-based tools support spelling, grammar checking, semantic processing, summarization, and automated question generation. Fourth, speech technologies support pronunciation and speaking practice. Fifth, generative AI supports lesson planning, content generation, writing assistance, translation, and assessment

preparation. Sixth, learning analytics can assist teachers and institutions in monitoring patterns of performance and engagement. These applications should be distinguished from opportunities: applications describe what AI does, whereas opportunities describe the educational value that may emerge when those functions are pedagogically aligned.

Recent Arabic-specific evidence illustrates this distinction. Alkaabi and Almaamari (2025) found that instructors used generative AI for material creation, assessment, and personalized planning, but also encountered dialectal accuracy and cultural-authenticity problems. Tami et al. (2024) demonstrated the potential of Arabic NLP for automated question generation while reporting errors associated with parsing, named entities, and long sentences. Such findings show that application capability and educational reliability are not identical.

Educational Opportunities

Opportunity	Evidence synthesis	Pedagogical condition
Personalization	AI can adapt practice and feedback to learner needs and progress.	Tasks must be aligned with proficiency level and curriculum goals.
Immediate formative feedback	Automated feedback can shorten the gap between performance and correction.	Teacher or learner verification is needed for linguistic accuracy.
Speaking and pronunciation practice	Speech tools can provide repeated practice and rapid feedback.	Arabic phonetic and dialect variation must be represented adequately.
Writing and language production	Generative and automated writing tools can support drafting, revision, vocabulary, and grammar work.	Students need critical evaluation rather than direct copying.
Engagement and autonomy	Interactive agents can increase flexibility and opportunities for self-directed practice.	Human interaction remains important for motivation and cultural interpretation.
Teacher productivity	AI can assist with planning, materials, assessment preparation, and routine analysis.	Teacher professional judgment must remain central.

Table 3. synthesis: educational opportunities and conditions for effective use.

Across these opportunities, the evidence supports a conditional rather than deterministic interpretation. TPACK provides a useful lens because effective AI integration requires the interaction of technological knowledge with pedagogical and Arabic content knowledge. A grammar generator, for example, becomes educationally useful only when the teacher can judge whether its explanation is appropriate for the target proficiency level and linguistic variety. Similarly, a chatbot may increase interaction

while still requiring teacher mediation when outputs contain culturally or linguistically inappropriate material. This explains why teacher readiness repeatedly appears in recent Arabic AI studies (Amadi & Hikmah, 2025; Alkaabi & Almaamari, 2025; Ridho et al., 2025).

Challenges and Constraints

Analytical dimension	Synthesis of evidence	Why it matters for Arabic
Linguistic and data constraints	Arabic morphology, orthography, diglossia, dialect diversity, and limited high-quality datasets can reduce system accuracy.	Errors can directly affect grammar explanations, translation, pronunciation, and assessment.
Pedagogical and human-capacity constraints	Teachers may lack AI literacy, assessment strategies, and confidence in evaluating AI outputs.	Technology can become poorly aligned with curriculum or be used as a substitute for teaching.
Infrastructure and equity constraints	Unequal internet access, device availability, and institutional resources limit participation.	AI may widen rather than reduce educational inequality.
Ethical, cultural, and governance constraints	Privacy, bias, transparency, academic integrity, cultural authenticity, and accountability remain central concerns.	Arabic education often carries religious, cultural, and identity-related meanings that require contextual oversight.

Table 4. synthesis: major challenge dimensions.

The challenge literature is better understood as an interconnected system than as a list of isolated problems. Linguistic limitations affect technological reliability; unreliable outputs increase the need for teacher expertise; teacher capacity is influenced by professional development and institutional support; and all of these conditions are shaped by infrastructure and governance. Human-centered AI research similarly emphasizes human control, safety, trustworthiness, and stakeholder participation in educational AI systems (Fu & Weng, 2024; Topali et al., 2024). For Arabic education, this means that responsible AI cannot be reduced to model accuracy alone. It requires alignment among language resources, pedagogical design, teacher judgment, learner agency, and institutional safeguards.

Academic integrity and critical thinking deserve particular attention. Baity et al. (2026) found that AI can support analytical, evaluative, and creative processes, but uncritical acceptance of AI outputs may weaken independent judgment. This suggests that the educational goal should not be to prevent all AI use; rather, curricula should teach students to verify, compare, critique, and reformulate AI-generated content. In this sense, AI literacy becomes part of Arabic language literacy rather than a separate technical skill.

Future Research and Policy Priorities

Priority	Key research questions
Empirical effectiveness	What learning gains occur when AI-supported Arabic instruction is compared with well-designed teacher-led instruction? Which skills improve, for whom, and under what conditions?
Arabic-specific AI and resources	How can high-quality corpora, morphology-aware models, speech systems, dialect resources, and Arabic educational LLMs be developed and evaluated?
Human capacity and responsible use	Which teacher-development models improve AI-TPACK, critical AI literacy, assessment competence, and ethical decision-making?
Equity, governance, and context	How do infrastructure, culture, privacy, academic integrity, and institutional policy shape responsible AI adoption across Arab and non-Arab educational contexts?

Table 5. synthesis: priority directions for research and policy.

Theoretical Interpretation

Two perspectives provide the interpretive structure for the review. The first is TPACK, which emphasizes the interaction of technological, pedagogical, and content knowledge (Mishra & Koehler, 2006). In Arabic language education, content knowledge cannot be treated as generic language knowledge: teachers must understand Arabic grammar, morphology, vocabulary, pronunciation, discourse, and the relevant variety of Arabic being taught. The evidence therefore suggests that AI integration is strongest when technology is selected because it serves a defined linguistic and pedagogical purpose rather than because it is technologically novel.

The second perspective is human-centered AI. Recent reviews argue that educational AI should preserve stakeholder agency, transparency, safety, reliability, and meaningful human participation (Fu & Weng, 2024; Topali et al., 2024). This perspective explains why the review repeatedly finds that AI should complement rather than replace teachers. It also provides a principled basis for addressing privacy, bias, cultural authenticity, and learner autonomy.

Conceptual Contribution: HCAI-ALE Framework

The thematic synthesis leads to a conceptual framework for responsible AI-supported Arabic language education: Human-Centered AI for Arabic Language Education (HCAI-ALE). The framework contains six mutually reinforcing dimensions. Human-centered pedagogy places learning goals and teacher judgment before technology. Arabic linguistic

intelligence requires models and datasets that reflect Arabic morphology, orthography, syntax, varieties, and educational contexts. Personalized learning uses AI to adapt tasks without removing learner agency. Ethical AI governance addresses privacy, bias, transparency, academic integrity, and accountability. Teacher and learner AI literacy provides the capacity to evaluate and use AI critically. Continuous evaluation requires ongoing monitoring of learning outcomes, accuracy, equity, user experience, and ethical compliance.

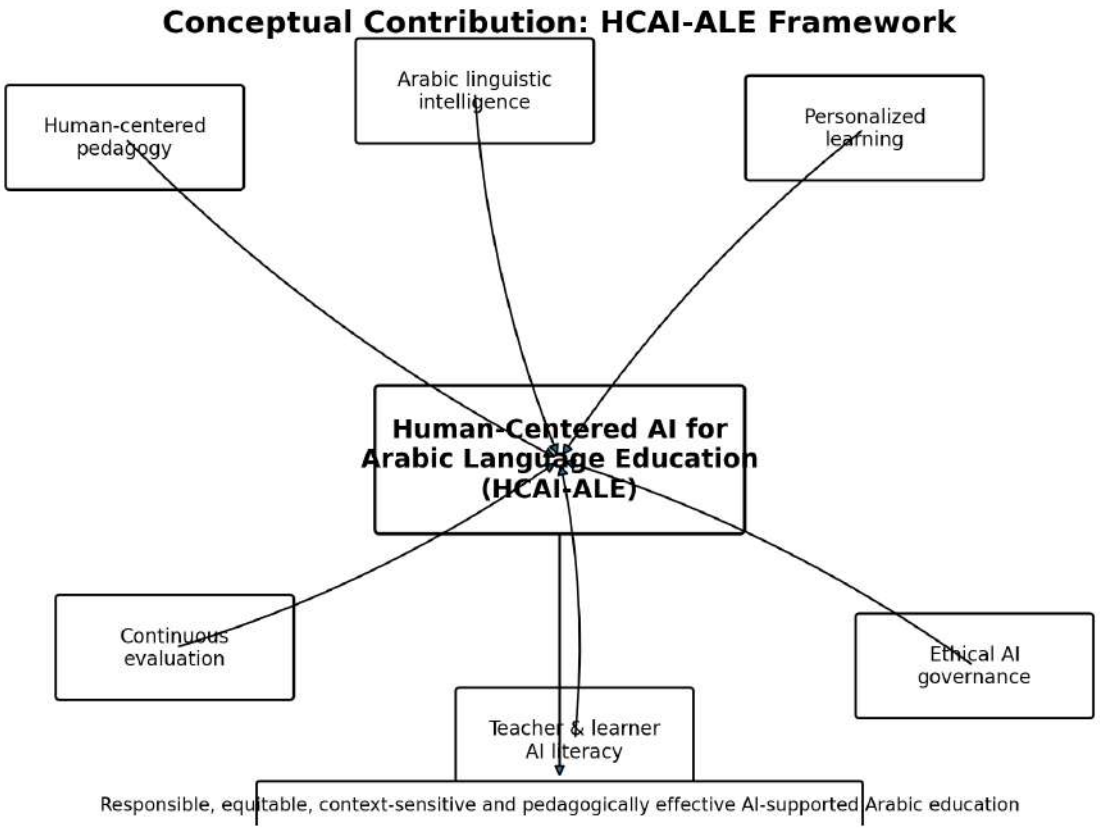

Figure 2. HCAI-ALE conceptual framework derived from the thematic synthesis.

The framework's novelty is relational: its six dimensions are not presented as independent recommendations but as a system. Weakness in one dimension can undermine the others. For example, an accurate Arabic model may still produce poor educational outcomes if teachers lack AI literacy; strong teacher training may still be insufficient if infrastructure excludes learners; and effective personalization may still be educationally harmful if privacy and human oversight are neglected. The framework therefore reframes AI integration in Arabic education as a coordinated socio-technical and pedagogical process.

Practical and Policy Implications

Category	Priority actions
Pedagogical	Embed AI-supported activities within curriculum goals; teach verification and critical evaluation; redesign assessment where appropriate; preserve teacher-led interaction and cultural mediation.
Technological	Invest in Arabic NLP, morphology-aware systems, speech recognition, high-quality corpora, dialect-sensitive resources, and Arabic educational LLMs; evaluate accuracy before classroom use.
Institutional and policy	Develop privacy, academic-integrity, transparency, procurement, quality-assurance, and human-oversight policies; improve infrastructure and equitable access.
Research	Prioritize empirical and longitudinal studies, comparative contexts, teacher-development research, inclusive AI, and interdisciplinary collaboration among linguists, educators, and AI researchers.

Table 6. Four-category recommendations for responsible implementation.

Limitations of the Review

This review has several limitations. First, the narrative search was iterative rather than a fixed PRISMA-style systematic search, so an exact initial-record count was not prospectively logged. Second, the final corpus depended on accessible scholarly sources and may not capture all Arabic-language studies published in local or less-indexed journals. Third, the evidence base contains substantial variation in research design, sample, context, and outcome measures, which limits direct comparison of effectiveness. Fourth, AI technologies and their educational uses are changing rapidly, so the synthesis may become incomplete as new evidence emerges. These limitations do not invalidate the synthesis but indicate that the HCAI-ALE framework should be treated as a conceptual proposition requiring empirical testing.

CONCLUSION

This review indicates that the central question for Arabic language education is no longer whether AI can perform useful educational functions, but under what conditions those functions become educationally valid, linguistically reliable, and socially responsible. The literature shows a consistent pattern: AI can expand opportunities for personalization, feedback, language production, assessment, and teacher support, yet these affordances are mediated by Arabic linguistic complexity, teacher capability, infrastructure, learner agency, and institutional governance.

The higher-order synthesis is therefore one of alignment. Technological capability must be aligned with Arabic linguistic knowledge; AI affordances must be aligned with pedagogy; learner use must be aligned with critical and ethical literacy; and institutional adoption must be aligned with equity, privacy, accountability, and human oversight. This alignment explains why similar AI tools can produce different educational value across contexts.

The principal conceptual contribution of the review is the HCAI-ALE framework, which brings these relationships together through six dimensions: human-centered pedagogy, Arabic linguistic intelligence, personalized learning, ethical AI governance, teacher and learner AI literacy, and continuous evaluation. The framework provides a basis for moving the field beyond technology-centered adoption toward a context-sensitive model of responsible Arabic AI education. Its next step should be empirical validation across different educational levels, Arabic varieties, learner populations, and institutional settings.

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