

Revolutionizing Arabic Language Learning: The Transformation of Artificial Intelligence (AI)-Based and Multimedia Cognitive Methods

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Abstract

The rapid development of information technology in the Society 5.0 era requires Arabic language education to move beyond conventional, one-size-fits-all instruction. This study analyzes the effectiveness, prospects, and challenges of integrating Artificial Intelligence (AI) with the Cognitive Theory of Multimedia Learning in Arabic language education. A qualitative, PRISMA-informed systematic literature review and thematic meta-synthesis were conducted using ten core studies, supported by additional theoretical and contextual references. The synthesis shows that generative AI, chatbots, automatic speech recognition, Android-based applications, augmented reality, and Lectora Inspire multimedia can support vocabulary (*mufradat*), grammar (*nahwu* and *sharaf*), speaking, reading, and listening skills by enabling feedback, practice, visualization, and flexible access. However, the evidence is heterogeneous and includes development and qualitative studies; AI-generated Arabic materials may also contain linguistic, dialectal, and transcription errors. The study concludes that these technologies are most effective when cognitive-load principles, teacher mediation, infrastructure readiness, digital literacy, and human verification are integrated into their design and use. The findings imply that AI should function as a pedagogical support system rather than a substitute for educators, and that future research should prioritize controlled, longitudinal, and transparently reported evaluations.

Keywords: Arabic Language Learning, Artificial Intelligence (AI), Cognitive Theory of Multimedia Learning, Digital Literacy, Personalized Learning

1. Introduction

In today's era of digital transformation, education is undergoing rapid technological change, and information and communication technology increasingly shapes how knowledge is accessed, presented, and evaluated (Zawacki-Richter et al., 2019). Foreign-language education is part of this shift because digital tools can extend practice beyond classroom time, support immediate feedback, and diversify learning resources. In Arabic language education, AI-assisted and multimedia-based approaches have therefore become increasingly relevant to learners who require flexible and interactive forms of instruction (Asfar et al., 2024).

Arabic, as an international language taught in many Indonesian educational institutions, occupies a distinctive strategic position. Its historical and theological importance is closely connected with Indonesia's Muslim communities, while its contemporary functions also extend to professional communication, diplomacy, international relations, translation, and economic cooperation (Asfar et al., 2024). Consequently, effective Arabic teaching is not limited to religious literacy; it also contributes to broader academic and professional competence, making instructional innovation an important educational concern (Nasaruddin, 2024).

Within Society 5.0, where physical and digital environments are increasingly interconnected, Artificial Intelligence (AI) and cognitively designed multimedia offer practical alternatives to



exclusively conventional instruction. AI can support material generation, dialogue practice, and adaptive feedback (Nasaruddin, 2024; Yatri et al., 2023), while Android applications, augmented reality, and interactive multimedia can improve access, visualization, and learner engagement (Halisah et al., 2025; Masriah & Kusnawati, 2024; Robi'ah et al., 2023). These technologies can reduce constraints of time and place, but their educational value depends on purposeful design rather than the mere transfer of printed content into digital form.

Current literature often discusses AI systems and multimedia design as separate domains. Studies of AI emphasize automation, personalization, and generative capacity, whereas the Cognitive Theory of Multimedia Learning emphasizes limited working-memory capacity and the careful coordination of words, images, and sound (Mayer, 2021, 2024). This separation creates a practical gap: AI may be adopted without adequate verification of Arabic linguistic accuracy (Allaithy & Zaki, 2025), while multimedia may be visually attractive without using AI's potential for responsive feedback. This article therefore synthesizes both domains to examine how AI-based and cognitive-multimedia approaches can support adaptive, personalized, and student-centered Arabic learning, while also identifying the pedagogical, technical, and ethical conditions required for responsible implementation.

2. Literature Review

2.1. Multimedia Cognitive Theory in Visual Media

Multimedia Cognitive Theory provides a scientific foundation for developing learning media that are compatible with the limits of human cognitive processing. Learners process verbal and visual information through partly separate channels, but each channel has limited working-memory capacity; excessive or irrelevant elements can therefore create extraneous cognitive load and hinder retention (Mayer, 2021, 2024).

The Cognitive Theory of Multimedia Learning (CTML), developed by Richard E. Mayer, proposes that learners generally understand material more effectively when relevant words and pictures are coordinated than when words are presented alone. This advantage is conditional: multimedia must be organized according to principles such as coherence, signaling, segmenting, modality, and spatial-temporal contiguity so that presentation supports, rather than overloads, cognitive processing (Mayer, 2021, 2024).

The spatial- and temporal-contiguity principles require related verbal and visual information to be presented close together and at the appropriate time. In Arabic vocabulary instruction, for example, a written noun can be paired with a relevant image and accurate pronunciation, while unnecessary decorative material is removed. Android-based and interactive multimedia studies indicate that this type of coordinated presentation can increase feasibility, attractiveness, and access to independent practice (Halisah et al., 2025; Robi'ah et al., 2023). The aim is not to maximize the number of media elements, but to optimize how learners select, organize, and integrate linguistic information.

2.2. Digital Literacy and Integrating AI Usage Ethics

The learning revolution requires stronger digital literacy. Critical AI use includes understanding technical limitations, formulating effective prompts, comparing outputs with reliable linguistic sources, and validating diacritics, morphology, syntax, and contextual meaning. Evaluations of AI-generated Arabic materials show that fluent output is not necessarily accurate, so learners and educators must treat AI responses as provisional rather than authoritative (Akasheh et al., 2024; Allaithy & Zaki, 2025).

The ethics of AI use is equally important because automated systems can reproduce bias, generate errors, and encourage unacknowledged dependence. Digital-literacy instruction should therefore

address academic honesty, privacy, responsible disclosure, source checking, and the positioning of AI as a learning partner rather than a replacement for human judgment (Akgun & Greenhow, 2021). Integrating these principles allows technological innovation to support intellectual integrity and protects students from relying on outputs that have not been verified within the relevant Arabic linguistic context.

3. Methods

3.1. Type of Research

This study employed a qualitative, PRISMA-informed systematic literature review and thematic meta-synthesis. The review was focused rather than statistically exhaustive: ten core studies were selected to examine applications of Artificial Intelligence and cognitive multimedia in Arabic language learning, while additional references were retained as theoretical and contextual support. The unit of analysis was the published study. The review protocol specified the research focus, eligibility criteria, search terms, screening stages, and coding categories before the findings were synthesized.

To make the corpus traceable, the manuscript's search record and bibliography were reconstructed and verified through Google Scholar, Crossref, the Directory of Open Access Journals (DOAJ), and the relevant journal or publisher platforms. Search strings combined Arabic-learning terms ("Arabic language learning" OR "teaching Arabic" OR "Arabic as a foreign language") with AI terms ("artificial intelligence" OR ChatGPT OR chatbot OR "automatic speech recognition") and multimedia terms ("cognitive multimedia" OR "multimedia learning" OR "augmented reality" OR Android OR Lectora). Reference-list snowballing was also used to locate directly related studies. Eligible records were peer-reviewed articles published from 2020 to 2025, focused on Arabic language learning or Arabic-language technology with clear pedagogical relevance, and reported a traceable method and findings. Duplicates, non-scholarly promotional sources, general AI studies without language-learning relevance, and records without usable methodological or bibliographic information were excluded.

3.2. Data Sources, Study Selection, and Analysis

The PRISMA-informed screening flow was reconstructed from 29 unique candidate records in the manuscript's reference base. Nine records were excluded during title-and-abstract screening because they were books, organizational webpages, broad theoretical sources, or insufficiently specific to Arabic learning technology. Twenty records underwent full-text or extended-abstract assessment; ten were then excluded because they did not directly examine AI or multimedia in Arabic learning, or did not report findings suitable for thematic comparison. The final core corpus comprised ten studies, identified in Table 1, while the remaining relevant sources were used only as supporting literature. Each core study was coded for year, context, research design, sample or corpus, technology, target skill, principal findings, and limitations. Thematic synthesis produced six categories: personalized support, cognitive-multimedia design, linguistic accuracy, engagement and learner autonomy, infrastructure and teacher readiness, and ethics with human oversight. Because the studies used heterogeneous developmental, qualitative, comparative, and review designs, no statistical meta-analysis was attempted.

4. Results and Discussion

Table 1. Summary of the ten core studies included in the thematic meta-synthesis.

No.	Study	Design and corpus	Key findings and relevance
1.	Al-Ghadhban and Al-Twairesh (2020)	Chatbot development and user testing with Information Technology students; Saudi-Arabic dialect; Android, Twitter, and web access.	<i>Nabiha</i> enabled dialectal conversation and received moderately satisfactory testing results, while highlighting the difficulty of Arabic morphology and dialect processing.
2.	Robi'ah et al. (2023)	Research and development using ADDIE; Grade V Arabic vocabulary learning; expert validation and student-attractiveness testing.	Android multimedia was rated feasible by media and material experts and highly attractive by students, supporting flexible classroom and independent practice.
3.	Akasheh et al. (2024)	Mixed qualitative-quantitative error analysis of Veed.io automatic subtitles for Jordanian Arabic.	The word-error rate was 38.857%; deletions were the most frequent error, demonstrating that dialectal ASR requires human editing and supervision.
4.	Asfar et al. (2024)	Qualitative descriptive literature review of AI applications in Arabic vocabulary, grammar, translation, skills, communication, and assessment.	AI can broaden interactive and flexible learning, but the review calls for tools tailored to Arabic varieties and for evidence on long-term proficiency.
5.	Masriah and Kusnawati (2024)	ADDIE development study; 53 students in the needs survey and product trials involving 33 students and seven lecturers.	Augmented-reality video improved vocabulary and pronunciation and increased motivation; Android-only compatibility remained a practical limitation.
6.	Nasaruddin (2024)	Inductive descriptive study of ChatGPT use in teaching Arabic as a foreign language.	ChatGPT can assist teachers in producing texts, questions, images, and learning activities, but effective prompting and teacher verification remain essential.
7.	Triwibowo et al. (2024)	Qualitative observations and interviews with students and lecturers in the PKPBA program at UIN Malang.	Cognitively designed multimedia supported speaking skills, motivation, and active participation, indicating the value of meaningful rather than decorative media use.
8.	Ouali and Garouani (2024)	Systematic literature review of Arabic chatbot development and proposed solutions.	Recurring constraints include limited datasets, morphological and dialectal complexity, and limited empathy; hybrid and human-supervised approaches are recommended.
9.	Allaithy and Zaki (2025)	Comparative evaluation of Arabic reading-comprehension materials generated by ChatGPT, Gemini, Copilot, JAIS, and Diffit.	Output quality varied across systems and included linguistic weaknesses, showing that generated teaching materials require systematic quality control.
10.	Halisah et al. (2025)	R&D using a modified Borg & Gall model and ADDIE; high-school experimental and control groups; experimental class n = 32.	Lectora Inspire multimedia produced an N-Gain of 0.6272 and a significant group difference ($p < 0.05$), supporting listening comprehension and motivation.

Across the ten core studies, the evidence supports instructional potential but not an unconditional claim of effectiveness. Development studies report gains in feasibility, engagement, vocabulary, pronunciation, speaking, and listening, whereas evaluation studies reveal substantial risks of linguistic and dialectal error in AI-generated or automatically transcribed Arabic (Akasheh et al., 2024; Allaithy & Zaki, 2025). The synthesis therefore indicates that learning outcomes depend on the task, cognitive design, teacher mediation, infrastructure, and verification procedures rather than on the presence of technology alone.

4.1. The Effectiveness of AI in Personalized Learning

The integration of artificial intelligence in learning Arabic has opened a new chapter in the effectiveness of precise educational personalization. Traditional approaches often treat the classroom as a single, homogeneous entity, ignoring differences in information processing speed and the cognitive backgrounds of each student. In this context, AI comes with adaptive algorithms that act as smart diagnostic machines. These systems continuously monitor students' language interactions, identify patterns of linguistic errors, and dynamically map individual competencies. For example, when a student struggles with applying the rules of *i'rab* (changes in word-end vowels) or gender agreement (*tadzkiir wa ta'niits*) between subject and predicate, the AI system doesn't just detect these mistakes mechanically. The machine learning algorithm will immediately adjust the difficulty level of the next exercises, provide a portion of more basic supporting material, and give a structured explanation tailored to the user's cognitive profile (Murdani et al., 2025).

Furthermore, the effectiveness of this AI-based personalization is supported by the deep integration of Learning Analytics for educators. The analytics dashboard provided by AI platforms can turn raw interaction data into highly valuable pedagogical insights. Teachers no longer have to guess which materials need to be reviewed in the next session; the AI system will present detailed data visualizations showing which syntactic (*nahwu*) or morphological (*sharaf*) concepts most often trigger collective errors in the class. As a result, the pedagogical interventions carried out by teachers become much more focused and efficient. This synergy shows that personalization doesn't depersonalize the teacher-student relationship; rather, it optimizes the teacher's instructional role, turning them from mere content deliverers into learning strategy designers and humanistic cognitive mentors.

Besides that, AI's ability to personalize text or discourse types (genre-based personalization) provides a strong extrinsic motivation. Students interested in the diplomacy and international relations sector can be personalized to receive Arabic texts on political themes, complete with a glossary of specialized diplomatic vocabulary. On the other hand, students focused on religious studies will be presented with classical texts along with deeper grammatical analysis. This interest-based automatic content curation approach ensures that learning Arabic doesn't feel abstract or disconnected from students' future career relevance. Through personally relevant content stimulation, active student engagement will increase exponentially, transforming Arabic learning from a boring academic obligation into a rewarding, student-centered intellectual adventure in the era of Society 5.0. (Nasaruddin, 2024).

4.2. The Role of Cognitive Multimedia in Vocabulary Mastery

The Cognitive Theory of Multimedia Learning (CTML) developed by Richard E. Mayer provides a very crucial scientific foundation for designing Arabic vocabulary learning media (*mufradat*) that is friendly to the limits of human working memory. In cognitive psychology, it is agreed that human working memory has strict capacity limits when processing new information simultaneously. Conventional vocabulary learning, which often relies solely on written word lists for rote memorization, often triggers cognitive fatigue and results in only temporary retention.

4.3. Challenges and Obstacles in Technology Implementation

Even though the integration of Artificial Intelligence (AI) and Multimedia Cognitive-based technology offers very promising transformative prospects, its practical implementation in the Indonesian education landscape still faces a maze of multidimensional challenges. These obstacles not only stem from material technical limitations but also have strong roots in pedagogical, psychosocial, cognitive, and ethical aspects. One of the most fundamental and crucial challenges that immediately stands out is the digital divide, which is uneven both geographically and socio-economically. Immersive

and adaptive digital Arabic language learning requires the availability of a stable broadband internet connection as well as adequate hardware ownership.

The second challenge comes from the readiness of educators' digital competencies. The TPACK framework (Technological Pedagogical Content Knowledge) emphasizes that mastery of teaching content and methods should organically align with understanding of technology. Unfortunately, most Arabic language teachers in Indonesia haven't received structured, comprehensive, and continuous training on integrating AI and multimedia cognitive design. There's a tendency for cognitive resistance among senior teachers who feel comfortable with conventional lecture-based methods (*thariqah al-alqiyah*). On the other hand, among teachers trying to adopt technology, misconceptions often occur where digital tools are used just decoratively, for example, simply transferring text from printed books into presentation slides without understanding how to package the material to be friendly to students' working memory, according to CTML principles. As a result, technology fails to act as a cognitive accelerator and just becomes a new administrative burden for teachers (Skulmowski, 2023).

Finally, there are ethical challenges and social-cultural degradation. Language learning isn't just about transferring graphic symbols and syntactic rules; it's a process of enculturation and internalizing living human values. Arabic is rich with spiritual content, literature, language aesthetics (*dzaug ad-adabi*), and social ethics (*adab*) that can only be truly experienced and learned through humanistic social interaction between teachers and students in a real language environment (*bi'ah lughawiyyah*). The presence of virtual assistants, if not balanced with wise pedagogical moderation, risks eroding this human touch. Students might become very skilled at interacting mechanically with the machines behind devices, but lose social empathy, emotional intelligence, and genuine interpersonal communication skills in the real world. Therefore, bridging the technical gap while maintaining the humanistic value of education becomes the biggest challenge in navigating the future of Arabic language learning in the digital era (Supriyanto & Toifah, 2024)

4.4. The Synergy of Pedagogy and Technology in the Digital Era

The fundamental transformation in the landscape of teaching Arabic should not be understood as an effort to replace the essence of human educators with the reliability of machine algorithms. On the contrary, the key to the success of this digital revolution lies in creating a harmonious synergy between technological computational efficiency and the warm, humanistic touch of teachers. In modern education, artificial intelligence (AI) and multimedia cognition should be positioned proportionally as tools (supporting means), not as goals (primary objectives). The use of smart technology opens golden opportunities for a revolutionary restructuring of the teacher's role. Educators are freed from mechanical, administrative, and repetitive instructional burdens such as correcting spelling exercises (*imla'*), conducting basic grammar drills, or drafting raw vocabulary lists. The extra time and mental energy gained from this automation allows teachers to fully focus on the essential roles that lines of AI code could never replicate: strengthening emotional bonds, guiding character development, instilling ethical values, and stimulating students' critical-analytical thinking skills.

In the context of adaptive Arabic language teaching methodology, this synergy creates a more structured scaffolding model. Here, AI can play the role of providing micro-scaffolding, personally assisting students in overcoming everyday linguistic technical difficulties, like searching for word synonyms (*mufradat*), checking syntactic grammatical accuracy (*nahwu*), or practicing phonetic pronunciation (*istima'/kalam*). On the other hand, human teachers hold full authority over macro-scaffolding, guiding students to perform high-level thought synthesis, deconstructing Arabic literary texts (*balaghah*) rich in implicit meaning, and critically curating the digital outputs produced by artificial intelligence. Active learning models like Task-Based Language Teaching (TBLT) and Problem-

Based Learning (PBL) can be optimally implemented through this hybrid approach. For example, students can be assigned to conduct initial research and draft essays on social-community themes in Arabic using generative AI assistance, and then in physical class, the teacher facilitates scientific debate sessions, critical reflection, and contextual pragmatic analysis of the essays. This way, students not only become linguistically skilled, but also cognitively trained to analyze information bias and understand the socio-cultural nuances embedded in the language (Tsany et al., 2022).

Besides that, educators have a moral responsibility to explicitly integrate digital literacy and ethical AI use into their teaching syllabus. Students should be taught how to effectively do prompt engineering, verify the accuracy of linguistic information, and value academic honesty amidst the ease of automatically generated text. Integrating these ethical aspects ensures that technological advancements go hand in hand with shaping students' character integrity and intellectual depth. Through a harmonious balance between precise machine capabilities and empathetic teacher guidance, learning Arabic transforms into a learning experience that is not only cognitively efficient but also meaningful socially and psychologically, preparing young people to become civilized, broad-minded global communicators ready to contribute to modern civilization (Haq, 2023).

4.5. Future Implications of Arabic Language Education

A deep dive into the integration of Artificial Intelligence (AI) and Multimedia Cognition projects an epistemological disruption as well as a massive methodological transformation for the future of Arabic language education globally, especially in Indonesia. In the next decade, the direction of educational technology development will no longer just focus on static learning applications or basic chat assistants. The development of digital technologies is progressing toward an era characterized by spatial computing and affective artificial intelligence (AI). The implications of this technological development will touch every dimension of Arabic language education, from the ontology of the classroom, restructuring of the national curriculum, modeling of linguistic assessment systems, to the shift in professional orientation of its graduates on the global stage.

First, in the future, the concept of language environment (*bi'ah lughawiyyah*) will undergo a total redefinition through the use of Extended Reality (XR) technology, which combines Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) powered by dynamic AI engines. Physical classrooms will seamlessly integrate with immersive 3D virtual spaces, where students can simulate real social interactions in authentic Middle Eastern environments without geographical limitations. Students can "walk around" the traditional Khan el-Khalili market in Cairo, engage in fictional business negotiations in Dubai's commercial district, or attend scientific symposiums at Al-Azhar University virtually. The AI engines embedded in these immersive environments will manage virtual agents (intelligent agents) that act as native speakers. This virtual agent not only has incredibly natural vocal articulation but is also equipped with artificial emotional intelligence that can detect a student's anxiety levels, voice intonation, pronunciation fluency, and body language in real-time. Having this immersive ecosystem can effectively break down students' psychological barriers in communication, trigger natural language acquisition, and permanently strengthen their visual-auditory memory retention (Jamil & Agung, 2022).

Second, the most revolutionary implications will happen in the total reform of the assessment and evaluation system for Arabic language competence. Conventional paper-based exams and standardized multiple-choice tests will be replaced by continuous, dynamic, and authentic assessments based on big data analytics. AI will passively track students' language development over time through their daily activities on digital platforms. Evaluation is no longer done in a single stressful exam session, but is instead distributed across every language interaction the student has. Machine learning algorithms will analyze progress in grammar mastery (*nahwu*), vocabulary variety (*mufradat*),

pronunciation fluency (*kalam*), and deep understanding of literary texts (*balaghah*) with precision. Teachers will get a complete, objective, and diagnostic picture of students' cognitive profiles without burdening them with the stress of formal exams. Future report cards or competency certificates will no longer be a single index score, but an interactive and dynamic digital linguistic competency portfolio.

Third, the future of teaching Arabic will require a restructuring of macro-level curriculum policies towards a transdisciplinary approach. Arabic should no longer be taught in isolation merely as classical grammar or just for religious rituals. Future curricula should be able to integrate Arabic language proficiency with information technology, data analysis, global communication, and the digital economy. Universities and Islamic boarding schools should start designing innovative study concentrations, such as Arabic Computational Linguistics, digital content localization, AI-based translation, and cross-cultural Arabic-Indonesian multimedia journalism. This step is really crucial to equip graduates with 21st-century skills, so they don't just end up being passive consumers of developing technology, but also become active players as content creators, language curators, and data analysts in the global digital ecosystem that uses Arabic as a tool for international geopolitics and economics (Masriah & Kusnawati, 2024).

Fourth, the future of AI-based Arabic learning in Indonesian higher education requires evidence-based adoption rather than uncritical normalization. The core studies show that AI can support material preparation, dialogue, feedback, and flexible practice, but they also document variable linguistic quality and serious difficulty with dialectal speech recognition (Akasheh et al., 2024; Allaity & Zaki, 2025). Adoption rates or personal experience should therefore not be treated as evidence of pedagogical effectiveness. Universities should instead establish teacher training, source-verification procedures, transparent AI-use disclosure, data-protection guidance, and clear responsibility for reviewing machine-generated Arabic before it is used in instruction or assessment.

Finally, these future implications ultimately bring the nature of language teaching back to the axis of civilized humanity. Amid rapid digital automation, Arabic language education will focus on developing cultural intelligence, critical literacy, and an appreciation of the universal humanistic values contained in Arab literature and civilization. AI and cognitive multimedia will bear the burden of exhausting technical instruction, while human educators will fully dedicate themselves to guiding students to become communicators who are not only structurally fluent but also sensitive, wise in speech, and morally upright. By maintaining this ethical synergy, the future of Arabic language teaching in the Society 5.0 era will produce a generation of independent learners who are resilient, digitally literate, globally minded, and strong in upholding the values of spiritual humanism.

5. Conclusion

This study gives a comprehensive overview of the significant changes in the Arabic learning ecosystem triggered by the integration of Artificial Intelligence (AI) and the application of Multimedia Cognitive Theory principles. Based on the analysis conducted, it can be concluded that technology is no longer just a supplement but has become a key catalyst, shifting the learning paradigm from a passive-conventional approach to a more adaptive, personalized, and interactive learning environment. The use of AI, especially generative language models, has proven effective in providing personalized learning support. This technology's ability to tailor materials, give real-time feedback, and offer conversation simulations that feel like interacting with native speakers is a huge breakthrough for students' language skills. This synergy lets students learn at their own pace, so cognitive hurdles in understanding complex Arabic language structures can be significantly reduced.

On the other hand, integrating Multimedia Cognitive Theory provides a theoretical foundation for designing media that can optimize learners' cognitive capacity. By balancing visual, auditory, and textual elements, learning materials become easier to absorb and remember in long-term memory. The use of interactive technologies like Augmented Reality and multimedia-based quizzes has been proven to drastically increase student engagement, turning a learning process that was once seen as heavy and boring into an activity that is motivating, fun, and relevant to the learning styles of the digital generation. However, the effectiveness of this technology really depends on a well-planned implementation strategy. Challenges related to internet access gaps, disparities in hardware facilities across regions, and the urgent need to improve teachers' pedagogical skills are factors that need to be addressed. No matter how advanced the technology is, it won't have a transformative impact if it's not accompanied by teachers who can transform into visionary technology facilitators. In addition, digital literacy and proper use of AI are absolutely necessary so that students can use digital tools critically, maintain academic honesty, and have the ability to curate material on their own.

Overall, the future of Arabic language education in the digital era holds huge potential for shaping a generation that is not only technically skilled but also able to express the scholarly values of Arabic in the modern global discourse. The success of this transformation requires ongoing collaboration between flexible curriculum policies, learning media innovations based on solid cognitive theory, and educators' commitment to keep learning. By balancing technological sophistication with fundamental educational values, learning Arabic will continue to be relevant, appreciated, and become a dynamic tool for civilization for the next generation Z.

This review has several limitations. The core corpus was limited to ten studies and included heterogeneous designs, local development trials, qualitative studies, and literature reviews; consequently, the synthesis cannot be interpreted as a pooled causal estimate or generalized to all Arabic-learning contexts. The reconstruction of the search record from the manuscript's reference base may also have omitted relevant Arabic-language or subscription-only publications. Future studies should use larger controlled samples, longitudinal measures of language proficiency and learner autonomy, and transparent reporting of AI model versions, prompts, error rates, and teacher-verification procedures.

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