



دمج التكنولوجيا في تعلم اللغة العربية: الاستراتيجيات التكيفية في عصر التحول

INTEGRATION OF TECHNOLOGY IN ARABIC LANGUAGE TEACHING: ADAPTIVE STRATEGIES IN AN ERA OF TRANSFORMATION

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Abstract

The integration of technology in Arabic language learning offers significant potential to enhance engagement, effectiveness, and personalization, particularly through digital platforms and data-driven adaptive strategies. Nevertheless, challenges persist, including limited teacher digital literacy, unequal access to technology, and insufficient pedagogical guidelines. This study aims to identify effective models of technology integration and adaptive strategies for Arabic language learning in the digital era. Using a literature review and qualitative analysis of recent relevant studies, the findings highlight blended learning, flipped classroom, and AI-assisted language learning as promising models. Adaptive strategies include tailoring materials to student learning profiles and applying learning analytics for pedagogical decision-making. Recommendations include enhancing teacher competencies, developing curriculum-based technology integration frameworks, and conducting empirical studies to validate these models in diverse educational settings. This research contributes to improving technology-based Arabic learning and informing policy for more equitable and effective implementation.

Keywords Arabic language learning; technology integration; adaptive strategies

مستخلص البحث

أظهر دمج التكنولوجيا في تعلم اللغة العربية إمكانات إيجابية في زيادة المشاركة والفعالية وتخصيص عملية التعلم، لا سيما من خلال استخدام المنصات الرقمية والاستراتيجيات التكيفية القائمة على البيانات. ومع ذلك، لا يزال تطبيقه يواجه تحديات، مثل محدودية معرفة المعلمين الرقمية، وعدم المساواة في الوصول إلى التكنولوجيا، ونقص التوجيه التربوي المنظم. تهدف هذه الدراسة إلى تحديد نماذج دمج التكنولوجيا والاستراتيجيات التكيفية ذات الصلة لتعلم اللغة العربية في العصر الرقمي. الطريقة المستخدمة هي مراجعة الأدبيات مع تحليل نوعي للبيانات ونتائج البحوث الحديثة ذات الصلة. تشير النتائج إلى أن نماذج التكامل الفعالة تشمل التعلم المدمج، والفصول الدراسية المقلوبة، ودمج الذكاء الاصطناعي لتعلم اللغة، بينما تشمل الاستراتيجيات التكيفية التمييز بين المواد بناءً على ملفات تعريف تعلم الطلاب واستخدام تحليلات التعلم لاتخاذ القرارات التربوية. توصي هذه الدراسة بتعزيز قدرات المعلمين، ووضع إرشادات لدمج التكنولوجيا القائمة على المناهج الدراسية، وإجراء المزيد من البحوث لاختبار فعالية هذه النماذج في سياقات تعليمية مختلفة.

INTRODUCTION

The integration of technology in Arabic language teaching has become a crucial aspect in the era of digital transformation. The use of various digital media, learning applications, and artificial intelligence technology allows Arabic language learning to be more interactive, adaptive, and relevant to the needs of the times (Fatimah et al., 2025; Satrio, 2025). This transformation not only covers traditional skills such as reading and speaking, but also digital communication skills, which are increasingly important in today's global context (Muzakki et al., 2025).

The development of digital technology and the industrial revolution 4.0 have brought significant changes to the world of education, particularly in the way Arabic is taught. The Society 5.0 era, which prioritizes the integration of digital information technology with human life, requires an adaptive learning approach that utilizes digital technology to make the learning process more effective and efficient (Arifah et al., 2025). Institutions such as the United Arab Emirates have also undertaken national initiatives to develop Arabic-language AI models and advanced learning tools, making technology integration a strategic force for the preservation and modernization of Arabic in the context of higher education and massive learning (TOI World Desk, 2025).

Tactically, various studies show that the use of technology—such as AI applications, e-learning, gamification, and interactive media—increases motivation, engagement, more communicative interaction, and student learning outcomes in Arabic language learning. For example, in the Indonesian context, digital innovations such as the flipped classroom and mobile learning have been shown to enrich the teaching experience, although they also highlight challenges in infrastructure and teacher readiness (Aini et al., 2025; Fitrianto, 2024; Muzakki et al., 2025; Romadhoni et al., 2025; Susiawati et al., 2025). At a more concrete level, recent studies reveal how AI-based adaptive technologies (e.g., Duolingo, Rosetta Stone) that apply machine learning and natural language processing can automatically tailor material to student abilities, provide instant feedback, and encourage more personalized and sustained learning engagement (Fitri, 2025).

Several previous studies have focused on the integration of technology in Arabic language learning using various approaches. For example, research emphasizing the use of a holistic approach through a combination of linguistics,

teaching methodology, and technology to strengthen student competence (Runtoni, 2025). In addition, other studies show the effectiveness of using interactive multimedia and technology-based applications that have been proven to increase student motivation and communication skills (Khairanis, 2024). Reformulation of Arabic learning strategies in the era of digital disruption has also begun to be offered, including through flipped classrooms and inquiry-based learning to adapt learning to the contemporary context (Mazyuna, 2025). Furthermore, recent research has begun to explore artificial intelligence, such as AI-powered Visual Question Answering (VQA) applications, which provide a more adaptive and personalized Arabic learning experience (Delassi et al., 2025).

However, most of these studies still focus on the effectiveness of using certain media or platforms, without conducting an in-depth examination of integrated adaptive strategies oriented towards personalized learning. In other words, the gap that emerges is the need for research that not only tests the effectiveness of media but also formulates a comprehensive adaptive strategy model that can be systematically implemented in Arabic language classes, especially in the context of digital education transformation.

This study aims to develop and evaluate technology-based adaptive strategies in Arabic language teaching that are responsive to the individual needs of students. The novelty of this research lies in its focus on designing an integrative adaptive strategy model, rather than simply using a single medium or application. Specifically, this study aims to (1) Analyze various models of technology integration in Arabic language teaching that have been offered by previous studies, particularly related to the application of digital media, interactive platforms, and artificial intelligence (AI). (2) Formulate adaptive strategies based on theoretical studies and the latest findings relevant to Arabic language learning needs in the era of digital transformation, emphasizing the aspect of personalized learning as the novelty of this research.

METHOD

This study uses a library research approach (Sari & Asmendri, 2020) with a qualitative-descriptive type. The research data was obtained from primary and secondary literature, including books, reputable journal articles, proceedings, and official documents relevant to the theme of technology integration in Arabic language teaching. Data collection techniques were carried out through three main stages: (1) Identification of sources from academic databases (Google Scholar,

Scopus, ResearchGate, and national and international journal portals); (2) Classification of literature based on the focus of the study, such as the use of digital media, interactive platforms, adaptive learning, and the integration of artificial intelligence (AI); and (3) Data reduction by selecting relevant recent literature (2020–2025).

Data analysis used content analysis (Schreier, 2012), with the following steps: critical reading, examining arguments, comparing findings, and synthesizing emerging concepts. Source triangulation techniques (Adarusni & Alfansyur, 2020) were applied by comparing results from various literature to maintain data validity. The results of the analysis were used to formulate a conceptual adaptive strategy that can be applied in Arabic language learning in the era of digital transformation.

The literature review process in this study began with identification, which involved determining keywords such as “technology integration,” “Arabic language teaching,” “AI in Arabic learning,” and “adaptive strategy in language teaching” to search for relevant literature from various academic databases. The next stage is classification, which involves grouping literature based on main themes, including the use of digital media, the application of artificial intelligence, adaptive learning strategies, and pedagogical approaches in Arabic teaching. This is followed by content analysis, which examines the strengths, limitations, and findings of previous studies to identify patterns and gaps in research. Next, the concept synthesis stage was carried out by combining the analysis results to develop a coherent and comprehensive adaptive strategy framework. The final stage was recommendations, namely formulating a conceptual adaptive strategy that could be used as a reference for the development of Arabic language teaching in the era of digital transformation.

RESULT AND DISCUSSION

Technology Integration Models in Arabic Language Teaching

The development of digital technology has brought significant changes to the world of education, including Arabic language learning. This transformation has not only impacted on the availability of learning resources, but also influenced methods, strategies, and patterns of interaction between educators and students. Various innovations such as digital media, online learning platforms, and artificial intelligence (AI) have been utilized to improve the quality of learning, expand access, and tailor materials to individual needs. In the context of Arabic language

learning, the use of technology is important given the challenges faced by learners, such as the complexity of the language structure, limitations of the language environment, and the need for intensive and continuous practice.

On the other hand, previous studies show that the application of technology in Arabic language learning still faces several obstacles, ranging from teachers' limited digital skills, poor infrastructure readiness, to the lack of technology integration that truly suits the needs of competency-based language learning. Therefore, an in-depth literature review is needed to identify the technology integration models that have been developed, evaluate their effectiveness, and formulate adaptive strategies that can respond to the challenges of the digital transformation era. This approach is expected to produce a concept of Arabic language learning that is more personalized, interactive, and relevant to the latest technological developments.

Several models of technology integration in Arabic language learning have been identified through literature reviews. These include the following:

a) Digital media and interactive approaches

Digital media and interactive approaches refer to the use of technology — such as online applications, multimedia, animation, interactive videos, and web- or mobile-based platforms—that enable the learning process to be participatory, communicative, and responsive. Interactive approaches emphasize the active involvement of learners through activities such as group discussions, language games, dialogue simulations, animations, digital crossword puzzles, and interactive quizzes. This concept supports the development of comprehensive language skills, including vocabulary, grammar, listening comprehension, and speaking skills (N. Syarifah, 2021).

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including vocabulary, grammar, listening comprehension, and speaking skills (Syarifah, 2024).

Several recent studies show the significant application of interactive digital media in Arabic language learning. Khairanis (2024) developed a learning model by combining online and multimedia applications with interactive methods such as group discussions, language games, and dialogue simulations. This model has been proven to increase student motivation and communication skills. Furthermore, Syarifah's (2024) research found that there are about 20 types of interactive multimedia used in Arabic language learning, including Adobe Flash, Android applications, Canva, animated videos, and platforms such as Mondly, Wordwall, and Quizizz, which are effective in increasing interest, motivation, speaking skills, vocabulary mastery, listening skills, and text comprehension. Fillah (2024) developed media in the form of animated videos and crossword puzzles that received a "very good" rating in terms of content, presentation, and suitability for use as Arabic learning media. Meanwhile, Safitri et al. (2025), through a literature review, showed that digital-based interactive media is effective in increasing the interest, engagement, and understanding of *Madrasah Ibtidaiyah* students in Arabic language learning, by describing the characteristics of the media, its implementation strategies, and its impact on learning outcomes.

The use of interactive digital media has been proven to significantly increase student motivation and engagement through a variety of interesting activities (Safitri et al., 2025; S. Syarifah, 2024). In addition, this media is effective in improving language proficiency, especially in terms of vocabulary, listening skills, and text literacy, as demonstrated through the use of interactive multimedia and animated videos (Fillah, 2024; S. Syarifah, 2024). Another advantage is its high flexibility, where students can access materials anytime and anywhere through various devices. Furthermore, some digital platforms also provide personalization features so that learning can be tailored to individual needs.

Despite its many benefits, the implementation of interactive digital media is not without obstacles. One of them is dependence on infrastructure, as it requires adequate equipment and a stable internet connection, which may not be available evenly in all regions. In addition, the digital literacy of teachers and students still varies, which affects their ability to design and utilize media optimally. The potential for disruption and loss of focus is also a challenge, given that students can

be distracted by non-academic content during online learning. In addition, a well-thought-out instructional design is needed so that the use of digital media is not only visually appealing but also effective in supporting pedagogical objectives (Fillah, 2024).

Digital media with an interactive approach offers great opportunities to improve the quality of Arabic language learning, especially in developing communication skills and learning motivation. However, its successful implementation depends on infrastructure readiness, teachers' digital competence, and well-planned learning design. In the context of digital transformation, this model is relevant to be integrated with adaptive and personalized learning strategies to meet the needs of today's generation of learners.

b) E-Learning Integration Portal

An e-learning integration portal is a digital platform that combines Arabic language and Islamic education curricula into a single integrated system, allowing students to access materials, assignments, evaluations, and structured learning interactions. These portals can vary, ranging from open-source Learning Management Systems (LMS) such as Moodle, institutional portals developed specifically by schools or universities, to commercial platforms that facilitate the integration of multimedia content, discussion forums, and AI features for personalized learning. A study in Indonesia by Akzam et al. (2024) explored the potential of this solution through a qualitative descriptive approach using literature review methods, analysis of existing portal content, and interviews with experts. The results of the study show that e-learning integration portals can increase student motivation, improve the efficiency of material delivery, and provide access to quality learning resources relevant to the teaching of Arabic and Islamic Education.

In terms of advantages, e-learning integration portals have proven to be effective in increasing student motivation and engagement, providing flexibility to learn anytime and anywhere, and accelerating the distribution of learning materials. Interactive features such as online quizzes, instructional videos, and multimedia-based simulations enrich the learning experience. In addition, the combination of traditional Islamic educational values with digital technology innovations creates synergy that deepens understanding of the material while building students' digital

literacy. Despite its potential, the implementation of e-learning integration portals in Indonesia still faces several challenges. One of them is resistance to changes in the learning culture, where some teachers or institutions are not yet ready to adapt to digital systems. Infrastructure constraints such as limited devices and uneven internet access are also significant obstacles. However, the development of artificial intelligence (AI) offers opportunities to deliver personalized learning, allowing each student to receive learning materials and activities tailored to their profile, abilities, and needs (Akzam et al., 2024).

Overall, the e-learning integration portal is a strategic innovation in Arabic language and Islamic education teaching that combines efficiency, accessibility, and relevance of learning content. Its successful implementation depends heavily on infrastructure readiness, institutional policy support, and teacher training to optimize its use. In the future, the development of this portal can focus on utilizing AI technology to strengthen personalization and adaptability, making it more responsive to the challenges and learning needs of the digital transformation era.

c) Smart Technology and LMS (Learning Management System)

In the context of higher education in Indonesia, the integration of smart technology—including Learning Management Systems (LMS) and social media platforms—has had a positive impact on enriching the Arabic language learning experience. Smart technology and Learning Management Systems (LMS) refer to the use of digital platforms that support structured and interactive online learning. LMS such as Moodle, Google Classroom, or similar systems enable centralized management of teaching materials, assignments, quizzes, discussion forums, and interactions between lecturers and students. A literature study by Literasiologi revealed that the synergistic use of LMS and social media can increase student motivation and understanding of Arabic material at the *Madrasah Tsanawiyah* level, although challenges such as infrastructure limitations still need to be anticipated (Suparno et al., 2025). In addition, quantitative research at one university (for example, Garut University) during the pandemic concluded that the effectiveness of LMS use is greatly influenced by user conditions and the learning context, and models such as UTAUT II can be used to evaluate the level of adoption of such systems (Andini et al., 2023).

Smart technologies such as LMS and social media have opened opportunities for more interactive, independent, and contextual Arabic language learning. LMS

enables structured material development and assessment, while social media adds an authentic and communicative dimension to the learning process. However, challenges such as uneven infrastructure, digital literacy gaps, and potential distractions remain important issues that must be managed with well-thought-out implementation strategies and institutional policy support.

d) AI-based Visual Question Answering (VQA)

Visual Question Answering (VQA) is a multimodal artificial intelligence technology that combines computer vision and natural language processing to answer text-based questions about specific visual content (Klingler, 2024). In the context of language education, particularly Arabic, Delassi et al. (Delassi et al., 2025) developed an AI-based educational tool that uses VQA as the core of the learning activity. This system can generate interactive visual quizzes that stimulate vocabulary, grammar, and visual comprehension using a constructivist approach. Interestingly, this system utilizes a Vision-Language Pretraining model to generate contextual image descriptions, followed by a Large Language Model that creates adaptively customized Arabic quizzes.

The advantage of the VQA approach in Arabic language teaching is its ability to provide an immersive and personalized learning experience. This method not only increases student engagement visually, but also strengthens the adaptive aspect—because the system can adjust the difficulty level and quiz content based on student responses. In addition, this approach is in line with the principle of adaptive learning, which is the automatic adjustment of learning content based on the abilities and progress of learners.

Despite its great potential, the use of VQA still faces several challenges. *First*, the development of VQA datasets specifically for Arabic is still relatively limited—with most public datasets available for English, Chinese, or Korean (Kamel et al., 2023). *Second*, technical challenges such as models that are still limited in their understanding of complex visual contexts or language ambiguities still need to be overcome (Bernardi & Pezzelle, 2021). *Third*, the effectiveness of this system on an educational scale (e.g., in elementary or secondary schools) has not been widely tested, so further research is needed to examine the long-term impact and user acceptance in real learning contexts.

AI-based VQA technology is a promising innovation for Arabic language teaching. With its ability to create adaptive visual-based quizzes, VQA can be an effective tool for increasing interactivity, personalization, and overall language comprehension. Moving forward, the development of Arabic-language datasets, model optimization, pedagogical evaluation at the school level, and integration into adaptive learning platforms are important directions for realizing the full potential of this technology.

Adaptive Strategy for Technology Integration in Arabic Language Learning

Based on the analysis of the technology integration model described above—ranging from interactive digital media, e-learning integration portals, smart technology and LMS, to the use of AI such as Visual Question Answering (VQA)—there is an urgent need to formulate an adaptive strategy that can address challenges and optimize the potential of technology in Arabic language learning. This adaptive strategy rests on three main pillars: personalization of learning, synchronization of content and technology, and strengthening human resource capacity.

First, Personalized Learning through Learning Analytics and AI. Personalization is the key to efficient and contextual learning. Technologies such as AI-ALST (AI-based Arabic Language and Speech Tutor) and QVoice provide real-time pronunciation feedback and customized exercises (Shao et al., 2022). In addition, learning analytics (LA) enables teachers and systems to understand individual student progress—providing feedback, predictions, and recommendations for relevant material (Khor & K, 2023). These findings are in line with research results on the adoption of AI in Arabic language education, which highlights the importance of factors such as performance expectancy and facilitating conditions to maintain the engagement and effectiveness of adaptive systems (Al-Jamali & Abdalla, 2025).

Second, Content Synchronization with Relevant and Contextual Technology. Arabic language learning content must be aligned with curriculum objectives and relevant to the cultural and social context of learners. For example, the United Arab Emirates, through the Falcon Arabic (2025) project, is developing a large language model based on a high-quality Arabic corpus, which supports the creation of adaptive materials such as thematic dialogues, summaries of classical texts, and context-based comprehension questions (Admin, 2025; Sarah El Safty, 2025; TOI

World Desk, 2025). This model can be integrated with LMS and VQA systems to create authentic multimodal learning, where students not only read or hear Arabic but also practice it in relevant visual and situational contexts.

In addition, Arabic-based VQA can generate interactive quizzes that connect images with narratives, supporting visual-linguistic comprehension skills and facilitating scenario-based learning. Recent research shows that synchronization between content and the right technology increases vocabulary retention and student engagement by up to 35% compared to non-adaptive media (Delassi et al., 2025). This strategy allows for the combination of traditional media (classrooms, classic texts) with adaptive digital features (AI, multimedia, AR) to create contextual, interactive learning while maintaining the authenticity of the Arabic language.

Third, Strengthening Human Resources and Infrastructure. Strengthening teacher competencies and technological infrastructure is fundamental to ensuring that adaptive strategies can be implemented consistently. Studies in Indonesia show that the adoption of AI in Arabic language learning is still hampered by low pedagogical digital literacy among teachers and limited facilities (Satrio, 2025). Therefore, blended learning-based training programs that combine adaptive learning design theory, technical practice in using AI/LA, and on-the-job coaching are recommended to accelerate human resource readiness. Research by Habib (2025) confirms that teacher readiness is a key factor in the successful integration of smart technology in language learning.

On the other hand, the success of adaptive technology implementation is highly dependent on the quality of infrastructure such as internet speed, device availability, and institutional policies. Experience from the implementation of R&D-based LMS in several universities shows that stable network access, an adequate device-to-student ratio, and clear data privacy policies can increase the effectiveness of digital learning by up to 40% (Huda et al., 2023; Nafilah et al., 2024). With the right policy support and investment, schools and universities can adopt a sustainable AI-in-the-loop approach, where teachers and AI complement each other in managing, adapting, and evaluating Arabic language learning.

An adaptive strategy for integrating technology into Arabic language learning that focuses on personalized learning, synchronizing content with relevant

and contextual technology, and strengthening human resources and infrastructure, is a complementary framework for responding to the challenges of the digital transformation era. Personalization through Learning Analytics (LA) and artificial intelligence has been proven to significantly increase student engagement and achievement, while content and technology synchronization ensures that learning materials remain contextual, authentic, and in line with the latest developments. On the other hand, successful implementation depends on teacher readiness and adequate infrastructure quality, making continuous training and policy support key factors. By integrating these three pillars simultaneously and continuously, educational institutions can create an adaptive, inclusive, and sustainable Arabic language learning ecosystem, thereby preparing students not only as language users but also as active participants in global culture and knowledge.

CONCLUSION

The model of technology integration in Arabic language learning includes interactive digital media, e-learning integration portals, smart technology and LMS, as well as AI-based innovations such as Visual Question Answering (VQA). Each model offers unique contributions, ranging from increased motivation and engagement in learning, expanded access, to the provision of more personalized and adaptive materials. However, the success of its implementation is influenced by infrastructure readiness, teacher digital competence, and the suitability of learning designs to student needs. The proposed adaptive strategy focuses on three main pillars—personalization of learning through Learning Analytics and AI, synchronization of content with relevant and contextual technology, and strengthening of human resources and infrastructure. These three pillars complement each other to address the challenges of digital transformation, with personalization increasing student engagement, synchronization maintaining the authenticity and relevance of materials, and strengthening human resources and infrastructure ensuring long-term sustainability and effectiveness.

Although this study provides a comprehensive overview of technology integration models and adaptive strategies in Arabic language learning, there are several limitations that should be noted. First, most of the data and references used are sourced from international studies, so the context of application in the Arabic language education environment in Indonesia still requires stronger empirical validation. Second, this study refers more to literature studies than field research, so it does not describe in depth the actual practice of technology integration in the classroom. Therefore, future research should conduct field studies using mixed

methods to test the effectiveness of the proposed models and adaptive strategies. Future research could also explore the sociocultural factors that influence the acceptance of technology in Arabic language learning, so that the resulting recommendations are more contextual and applicable for educators and policymakers.

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