

Research Article:

A Systematic Literature Review on the Use of Augmented Reality in Teaching Arabic Language in Malaysia

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ABSTRACT

The integration of technology into education has profoundly transformed conventional teaching methods, driving educators to adopt diverse digital tools that enrich the learning experience. This transformation has modernised pedagogical approaches and opened new avenues for student engagement and improved academic performance. Among the most innovative developments in this digital era is Augmented Reality (AR), a technology that superimposes virtual elements onto the real world to create interactive and immersive learning environments. Although AR has been effectively implemented in disciplines such as science and mathematics, its pedagogical framework for Arabic language education remains underdeveloped, limiting its systematic adoption in instructional settings. Guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, this study systematically reviewed literature published between 2021 and 2025 to ensure methodological rigor and transparency. Articles were retrieved from Scopus, EBSCO Discovery Service (EDS), and Google Scholar. The inclusion criteria encompassed peer-reviewed empirical studies conducted in Malaysia that examined the use of AR in Arabic language teaching, while non-empirical works such as reviews, book chapters, and conference papers were excluded. Data were extracted and analysed through qualitative content analysis to identify prevailing research trends, pedagogical strategies, and AR tools employed across educational contexts. The review found that AR applications in Malaysian Arabic language education are predominantly focused on vocabulary enhancement, with limited attention to other skills such as reading comprehension, speaking, listening, and grammar. This review highlights that AR offers visually rich and contextually meaningful learning experiences that make abstract linguistic concepts more accessible, but its application remains uneven across skills and platforms. The review of five selected studies revealed that the implementation of AR in Arabic language teaching in Malaysia has been predominantly directed toward vocabulary acquisition. This indicates the potential for extending AR applications to enhance other language skills, including reading, speaking, listening, and writing.

Keywords: Augmented Reality, Arabic language, systematic review, educational technology, language learning

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INTRODUCTION

Augmented Reality (AR) has increasingly attracted attention within educational research due to its capacity to integrate digital objects into physical learning environments, thereby creating multimodal and interactive learning experiences. Across educational disciplines, AR has demonstrated potential in improving learner engagement, supporting conceptual understanding, and facilitating situated learning through the combination of visual, verbal, and spatial information (Azuma, 1997; Akçayır & Akçayır, 2017). As digital learning environments continue to expand under the broader agenda of Education 4.0, recent studies continue to associate AR with emerging instructional models under the Fourth Industrial Revolution (Joshi et al., 2024).

Despite this growing international interest, the pedagogical integration of AR remains uneven across language education domains. Existing research has predominantly concentrated on English language learning, science education, and STEM-related disciplines, while recent international studies also demonstrate growing AR experimentation across broader language learning environments; however, Arabic language education remains comparatively underrepresented, particularly within context-specific instructional settings (Li et al., 2025). This imbalance suggests that although AR has been widely explored as a tool for visualisation and interactive learning, its pedagogical role in supporting Arabic language instruction remains under-theorised and insufficiently synthesised within current educational technology scholarship.

Within Malaysia, AR has begun to appear in selected educational innovations, although its pedagogical integration remains uneven across subject areas (Shaharudin et al., 2021). This gap becomes especially relevant because Arabic language teaching continues to face persistent instructional challenges, including conventional teaching approaches, limited instructional innovation, and difficulties in sustaining learner engagement. Although Arabic has long been institutionalised within Malaysian religious secondary schools and higher education institutions, several constraints remain evident, including curriculum limitations, ineffective instructional strategies, and insufficient integration of digital pedagogies (Aldebsi & Eldesoky, 2023; Mansor et al., 2021; Alshaibani, 2021). These conditions make Malaysia a relevant context for examining how AR has been introduced, conceptualised, and pedagogically positioned within Arabic language teaching.

Although AR has demonstrated increasing pedagogical relevance across educational disciplines, systematic evidence concerning its instructional positioning within Arabic language education remains limited, particularly when examined through context-specific national developments. Existing review studies have largely concentrated on English language learning, science education, and STEM-related technological interventions (Yilmaz, 2018), while Arabic language teaching remains comparatively underrepresented within systematic educational technology synthesis. More importantly, current AR scholarship rarely examines how local pedagogical adoption reflects broader methodological, technological, and instructional patterns within emerging language-learning contexts.

This creates an important scholarly gap, as understanding AR implementation in specific educational settings may reveal how technological innovation is pedagogically adapted under contextual constraints. Therefore, this study systematically reviews empirical studies on the use of AR in teaching Arabic language in Malaysia in order to identify prevailing research patterns, pedagogical trends, and directions for future development.

THE AUGMENTED REALITY TECHNOLOGY IN TEACHING ARABIC LANGUAGE

The Cognitive Theory of Multimedia Learning (CTML), developed by Richard E. Mayer, provides a relevant theoretical foundation for explaining the educational potential of augmented reality (AR) in language learning environments. CTML proposes that learners process information through two separate cognitive channels: a verbal channel for words and auditory input, and a visual channel for images and graphical representations. Because each channel has limited processing capacity, meaningful learning occurs when instructional materials are designed to support the active selection, organisation, and integration of multimodal information without overloading cognitive resources. In digital learning environments, this principle becomes particularly important because the effectiveness of instructional technology depends not only on content delivery but also on how verbal and visual elements are coordinated to facilitate understanding (Parong & Mayer, 2018).

Within Arabic language teaching, AR aligns closely with CTML because it enables linguistic content to be presented through simultaneous visual, textual, and interactive experiences. Abstract language elements such as vocabulary, sentence structures, pronunciation cues, and contextual meaning can be linked directly to three-dimensional representations, allowing learners to associate language input with concrete learning situations. For instance, AR can overlay three-dimensional visuals, pronunciation, and example sentences onto linguistic elements (e.g., كتاب / kitāb, “book”), while also animating grammatical structures such as مفعول → فاعل → فعل. This enables learners to internalise both lexical meaning and grammatical relationships more intuitively through interactive visualisation. Through this integration, AR supports active cognitive engagement, as learners interact with digital content rather than receiving information passively. This process enhances meaning construction, retention, and contextual understanding, which are central to multimedia learning environments. Therefore, CTML not only explains the multimedia affordances of AR but also provides an analytical lens for understanding why current AR applications in Arabic language education remain concentrated in visually manageable learning components, particularly vocabulary.

Across the reviewed literature, AR consistently demonstrates its effectiveness in enhancing learner engagement, retention, and comprehension through multimodal interaction. These findings appear largely consistent across different educational contexts, suggesting that AR's strength lies in its ability to integrate visual, verbal, and interactive elements within meaningful learning environments. In particular, studies have also reported high levels of

learner readiness and satisfaction in AR-supported Arabic language learning, especially in vocabulary-focused applications, indicating that AR is well received as a pedagogical tool among learners (Chin & Wang, 2021; Radianti et al., 2020; Serin, 2017; Sahrim et al., 2023).

However, while these positive outcomes are consistently reported, they are predominantly derived from controlled or small-scale implementations, often within specific instructional contexts or limited participant groups. As a result, the generalisability of these findings remains constrained, particularly in relation to long-term learning effectiveness and broader classroom integration. Furthermore, the existing literature rarely engages in comparative analysis across different learner levels, instructional designs, or learning environments, making it difficult to determine how AR performs under varying pedagogical conditions. In addition, most studies tend to emphasise perceptual outcomes such as engagement, motivation, and satisfaction, while providing limited empirical evidence on deeper learning dimensions, including knowledge retention, transferability, and cognitive processing. This suggests that although AR demonstrates strong potential as an interactive learning tool, its pedagogical effectiveness has not yet been comprehensively examined through robust and diversified research designs.

Beyond these general limitations, a more specific pedagogical pattern can be observed in the application of AR within Arabic language education. Current implementations remain predominantly focused on vocabulary learning, where visual-object association can be most easily operationalised. While this aligns with the affordances of AR and the principles of multimedia learning, it also reflects a limited scope in addressing broader language competencies such as grammar, discourse, and communicative interaction. When viewed in relation to developments in other educational domains, this narrow focus becomes more evident. AR has been shown to support more complex, interactive, and context-driven learning experiences, including situated and immersive learning environments (Azuma, 1997; Akçayır & Akçayır, 2017; Alvarez-Marín & Velázquez-Iturbide, 2022). This contrast highlights a gap between the broader capabilities of AR and its current application within Arabic language pedagogy, suggesting the need for more diversified and pedagogically integrated AR implementations.

Taken together, these observations indicate that although AR demonstrates strong potential as a pedagogical tool in Arabic language education, its current implementation remains limited in both scope and depth. This underscores the need for future research to move beyond initial adoption and explore more comprehensive, theory-driven approaches that support a wider range of language skills and learning contexts.

Despite these promising developments, the integration of AR in Arabic language education is not without challenges. Several studies highlight practical constraints, including limited access to AR-capable devices, inconsistent internet connectivity, and the need for substantial instructional redesign to accommodate AR-based learning (Hutahaeen et al., 2022; Faramarzi & Dayag, 2023; Erwinsah et al., 2019). In addition, the development of effective AR learning materials requires pedagogical and technical expertise, which may

not be readily available among educators (Bawadi et al., 2023; Bagus Nur Rahma Putra et al., 2021). These constraints suggest that the implementation of AR remains uneven and context-dependent, particularly in resource-limited educational settings.

These observations highlight the need for a systematic examination of how AR is implemented and pedagogically positioned within Arabic language education, particularly in context-specific settings such as Malaysia. Accordingly, the present study conducts a systematic review of empirical research to identify prevailing trends, methodological patterns, and pedagogical directions in AR-based Arabic language teaching. To guide this analysis, five research questions were formulated:

1. What is the distribution over time of studies examining AR use in Arabic language teaching?
2. What are the types of learners (samples) commonly selected in these studies?
3. What research designs and data collection methods are employed to explore AR in the teaching of Arabic language?
4. What types of AR platforms and technologies are utilised in Arabic language teaching?
5. What types of Arabic teaching fields are explored through AR tools and pedagogical approaches in the selected studies?

To systematically address these research questions and provide a clear overview of current practices, the following section outlines the methodology employed in this study, detailing the criteria, procedures, and analytical framework used for the systematic review.

METHODOLOGY

This section describes the method used to collect articles related to the application of AR in Arabic language teaching in Malaysia. The review adopted the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework. The literature search was conducted on 16 to 20 July 2025 across three databases: Scopus, EBSCO Discovery Service (EDS), and Google Scholar.

All references were exported and managed using Mendeley, and duplicate records were removed automatically and verified manually. The selection process involved two experts who screened the studies based on predefined inclusion and exclusion criteria. The screening was conducted in three main stages: identification, screening, and eligibility.

After the screening process, eligible articles underwent data extraction and thematic analysis to identify current trends, instructional approaches, and technological implementations of AR in Arabic language learning within the Malaysian context. The findings of the review, structured according to the research questions outlined earlier, are presented in the subsequent section.

Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA)

The review was guided by the PRISMA 2020 Statement (Page et al., 2021), a systematic review framework that supports transparent and replicable evidence synthesis. Although PRISMA was originally developed for health and medical research, this study adapts its core principles to a non-medical educational context, specifically Arabic language teaching and instructional technology. The adapted framework was employed to:

1. Formulate clear and structured research questions.
2. Define explicit inclusion and exclusion criteria.
3. Conduct a systematic, transparent search across major academic databases within a defined time period.

Following PRISMA 2020 guidelines, the review emphasises a rigorous selection process, reproducible screening stages, and structured reporting to ensure the reliable identification and analysis of studies on the integration of AR in Arabic language education in Malaysia. This adaptation aligns with the PRISMA 2020 purpose of enhancing transparency while accommodating disciplinary differences outside clinical research domains.

Databases

This review utilised three academic databases: Scopus, EBSCO Discovery Service (EDS), and Google Scholar, selected to ensure comprehensive coverage of peer-reviewed research in educational technology, Arabic language studies, and computer-assisted language learning. Scopus was chosen for its strong indexing of high-quality journals in technology-enhanced language education. EDS was included to capture cross-disciplinary educational research through institutional academic collections. Google Scholar was used to maximise retrieval sensitivity and identify additional peer-reviewed journal articles that may not be indexed in Scopus or EDS.

In line with the review protocol, only peer-reviewed empirical journal articles were included, while grey literature sources (e.g., theses, books, book chapters, and conference proceedings) were intentionally excluded to maintain consistency in methodological reporting and publication standards.

Eligibility and Exclusion Criteria

Several inclusion and exclusion criteria were established for study selection. First, only peer-reviewed empirical journal articles were included to ensure methodological reliability, while review papers, book chapters, book series, and conference proceedings were excluded in accordance with the predefined protocol. Second, the publication period was set to 2021–2025 to capture recent empirical evidence following the increased adoption of digital learning modalities and AR integration in education post-2020, particularly after the

global shift toward technology-enabled instruction. Third, only studies conducted within Malaysia were considered to maintain contextual relevance to national educational settings. Although Arabic language learning and teaching are pedagogically interconnected, this review applied a teaching-focused sampling lens to align with the specific research objective on instructional implementation (as reflected in Table 1). Additionally, only articles published in English, Malay, or Arabic were screened to ensure accurate interpretation and analysis by the reviewers. The full inclusion and exclusion framework is presented in Table 1.

Table 1. The inclusion and exclusion criteria

Criterion	Eligibility	Exclusion
Literature type	Peer-reviewed empirical journal articles	Systematic review articles, book series, books, book chapters, conference proceedings, theses
Timeline	between 2021 and 2025	< 2021
Countries	Malaysia	Non-Malaysian countries
Scope	Teaching of Arabic Language	Studies focusing only on Arabic language learning or unrelated to teaching
Technology focus	Augmented Reality	Non-AR technologies
Language of publication	English, Malay, Arabic	Other languages

Systematic Review Process

The systematic review procedure consisted of three main stages: identification, screening, and eligibility. The keyword identification process drew from prior literature and thesaurus-supported terms related to AR, Arabic language teaching, and the Malaysian educational context. Search strings tailored to each database are presented in Table 2.

The systematic search was performed on 16–20 July 2025. Database filters were applied where available, including document type (journal articles) and publication year (2021–2025). No additional automation tools were used for query generation; all strings were manually verified and executed by the reviewers to ensure accuracy.

A total of 585 records were retrieved: Google Scholar ($n = 581$), Scopus ($n = 3$), and EDS ($n = 1$). The disproportionately high number of Google Scholar results compared to Scopus and EDS is attributed to Google Scholar's broader indexing scope, which includes a wide range of journals, institutional repositories, and early-release publications, whereas Scopus employs stricter indexing standards and more limited coverage of Arabic-language-education keywords within technology-enhanced learning domains.

Table 2. The search string used for the systematic review process

Databases	Keywords used	Filters applied
Scopus	TITLE-ABS-KEY ((“Augmented Reality” OR “AR”) AND (“Arabic Language” OR “Arabic Learning” OR “Arabic Instruction” OR “Arabic Education” OR “Arabic Speaking” OR “Arabic Reading” OR “Arabic Writing” OR “Arabic Listening”) AND (“Teaching” OR “Education” OR “Instruction” OR “Learning”) AND (“Malaysia” OR “Malaysian”)) AND PUBYEAR > 2021 AND PUBYEAR < 2026	2021–2025, Journal articles
EDS	(“Augmented Reality” OR “AR”) AND (“Teaching Arabic”) AND (“Malaysia” OR “Malaysian”)	2021–2025, Peer-reviewed journals
Google Scholar	(“Augmented Reality” OR “AR”) AND (“Teaching Arabic”) AND (“Malaysia” OR “Malaysian”)	2021–2025 (manual screening applied)

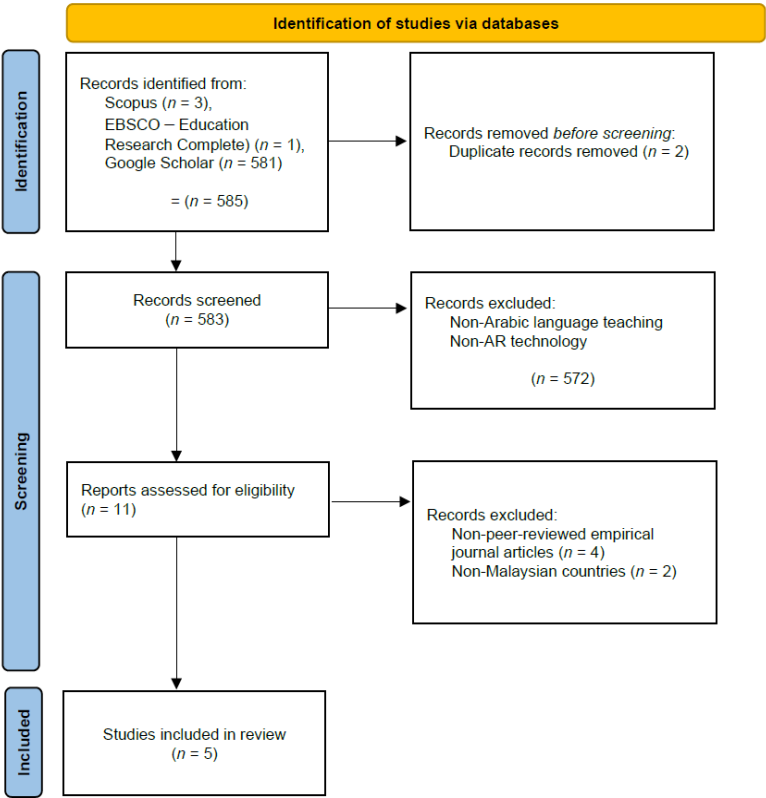


Figure 1. The flow diagram of the study (Source: Page et al., 2021)

Following identification, two duplicate records were removed, leaving 583 studies for screening. During the screening stage, 572 studies were excluded as they did not focus specifically on AR implementation for Arabic language teaching. This resulted in 11 articles for eligibility assessment. In the eligibility stage, 6 articles were excluded for the following reasons: (a) Not peer-reviewed journal articles ($n = 3$), (b) Did not meet Malaysian context requirement ($n = 2$).

Following full-text assessment, five articles met all inclusion criteria and were selected for analysis (see Figure 1).

Data Abstraction and Analysis

The final set of articles underwent a structured data extraction and analysis process. Data were extracted using a researcher-developed extraction table, which recorded key information including author(s), year, AR tool or platform, research design, instructional approach, Arabic teaching focus (e.g., reading, speaking, grammar), sample characteristics, and reported outcomes.

Data extraction and analysis were conducted by two reviewers independently to minimise bias. Following independent extraction, results were cross-checked and reconciled through discussion, and any discrepancies were resolved by consensus to ensure consistency and reliability.

The analytical approach employed was qualitative content analysis with a descriptive synthesis method, as the review aimed to categorise and interpret patterns rather than measure effect sizes. The analysis involved:

1. Initial abstract screening.
2. Full-text examination.
3. Open coding to identify AR tools and pedagogical strategies.
4. Categorisation into thematic groups based on instructional focus and AR implementation features.

To enhance analytical trustworthiness, two expert reviewers conducted the data extraction and analysis. The results were then cross-checked and discussed, and any discrepancies were resolved through consensus. The final findings were subsequently organised into narrative summaries supported by classification tables in the findings section.

ANALYSIS AND FINDINGS

Based on the systematic review, a total of five studies were identified from the 585 articles published between 2021 and 2025, all of which examined the application of AR in Arabic

language teaching within the Malaysian context. Rather than merely presenting individual study outcomes, the analysis reveals several overarching patterns that characterise the current landscape of AR integration in Arabic language education.

Overall, the findings indicate that AR implementation remains pedagogically narrow, predominantly centred on vocabulary acquisition, while broader language skills such as grammar, discourse, and literary interpretation remain largely underexplored. In addition, the reviewed studies reflect a methodological tendency towards small-scale, exploratory, and predominantly quantitative designs, with limited longitudinal or comparative investigations. From a technological perspective, AR applications are largely mobile-mediated and frequently implemented as extensions of printed learning materials, with minimal diversification in platform design or technical reporting.

These patterns suggest that the integration of AR in Arabic language education in Malaysia is still at an early and exploratory stage, characterised by fragmented implementation and limited theoretical grounding. Therefore, the findings presented in this section are organised according to the research questions (RQ1–RQ5) to provide a more structured analysis of publication trends, learner types, research designs, technological platforms, and instructional focus areas.

Table 3 presents a structured overview of the selected studies, highlighting their research focus, objectives, and AR implementation approaches. This table serves as the basis for identifying cross-study patterns in pedagogical orientation, methodological design, and technological application. A closer examination of the selected studies reveals several consistent patterns in how AR has been implemented across different instructional contexts. Across all five studies, findings consistently report positive outcomes associated with AR integration, particularly in enhancing learner engagement and supporting language acquisition. However, this consistency should be interpreted cautiously, as most studies rely on small-scale or perception-based data, limiting the strength of empirical generalisation.

First, the majority of studies primarily focused on vocabulary acquisition as the central pedagogical objective, often through the development of AR-based applications or learning models that integrate visual and audio elements to support lexical understanding (Wan Daud et al., 2021; Sahrim et al., 2023; Ahmad Yusoff et al., 2024; 2025). This consistent emphasis suggests that AR is predominantly conceptualised as a tool for facilitating visual–lexical association, which aligns with the affordances of AR and the principles of multimedia learning, but limits its application in supporting higher-order language competencies.

Second, several studies extend beyond learner outcomes to examine user readiness and perception, particularly among teachers and students. While students consistently demonstrate highly positive attitudes towards AR-supported learning environments, teachers' readiness appears comparatively moderate, with limitations observed in technological familiarity and confidence, especially among more experienced educators

(Asbulah et al., 2022). This contrast highlights a potential gap between learner acceptance and instructional readiness in classroom implementation.

Third, the reviewed studies also demonstrate an emerging interest in specialised learner groups, particularly hearing-impaired learners, where AR is utilised to provide accessible and visually enriched learning experiences (Ahmad Yusoff et al., 2024; 2025). These findings indicate that AR holds strong potential for inclusive education; however, such applications remain limited in scope and have not yet been extended to broader learner populations.

Overall, while the findings consistently support the educational potential of AR, the absence of methodological diversity, the concentration on vocabulary learning, and the limited exploration across learner groups collectively indicate a significant gap in the current literature. This suggests the need for more comprehensive, theory-driven, and pedagogically integrated research to fully realise the potential of AR in Arabic language education.

Table 3. Summary of the selected studies.

Study	Title	Objectives
Wan Daud et al. (2021)	ARabic-Kafa: Design and development of educational material for Arabic vocabulary with augmented reality technology	To develop and produce educational materials utilising Augmented Reality technology through the ARabic-Kafa platform to enhance Arabic vocabulary learning and provide effective support for both teachers and students.
Asbulah et al. (2022)	Teachers' Attitudes Towards the Use of Augmented Reality Technology in Teaching Arabic in Primary School Malaysia	The readiness of teachers from the aspect of knowledge and their attitude towards the use of augmented reality technology in the teaching of Arabic in Malaysia.
Sahrim et al. (2023)	Augmented Reality Technology in Learning Arabic Vocabulary from Perception of University Students	This study aims to examine the level of perception among students at University Sains Islam Malaysia (USIM) regarding the use of augmented reality as a new technology in Arabic language learning today.
Ahmad Yusoff et al. (2024)	Augmented Reality Technology for Arabic Vocabulary Learning as A Model of Quran Reflection for Hearing Impaired Adults	This study aims to analyse the need for a new model design of Quranic reflection through learning Arabic vocabulary for adult learners with hearing impairments using innovative Augmented Reality Technology.
Ahmad Yusoff et al. (2025)	Fuzzy Delphi Method: Designing a Tadabbur Al-Quran Model in Arabic Vocabulary Learning for Hearing-Impaired Muslim Adults and assisted with Augmented Reality Technology	This study aims to develop a Tadabbur al-Quran Model integrating Augmented Reality (AR) technology to enhance Arabic vocabulary learning for hearing-impaired Muslim adults.

RQ1: What is the Distribution Over Time of Studies Examining AR Use in Arabic Language Teaching?

The analysis reveals a persistently low level of scholarly engagement in AR-based Arabic language research over time, indicating that the field remains underdeveloped rather than progressively evolving (see Table 4).

Only one study was identified for each year between 2021 and 2025, suggesting that research production has remained stagnant with no observable growth trajectory. This pattern reflects limited research continuity, where individual studies appear as isolated contributions rather than part of a sustained research agenda.

Table 4. Number of articles published by year

Year	No. of articles	Studies
2021	1	Wan Daud et al. (2021)
2022	1	Asbulah et al. (2022)
2023	1	Sahrim et al. (2023)
2024	1	Ahmad Yusoff et al. (2024)
2025	1	Ahmad Yusoff et al. (2025)

Although AR has demonstrated increasing pedagogical relevance across educational disciplines, its application within Arabic language education has not developed into a dominant research focus. In contrast, broader educational technology research during the same period has been heavily driven by the rapid expansion of AI, which has attracted significantly greater scholarly attention and investment (Cabanillas-García, 2025).

This imbalance suggests that AR research in Arabic language education remains marginalised within the wider digital learning landscape, highlighting the need for more sustained, theory-driven, and empirically grounded investigations to strengthen its scholarly presence.

RQ2: What are the Types of Learners (Samples) commonly Selected in These Studies?

The analysis of participant distribution reveals an uneven research focus across learner groups, with a clear concentration on specific populations rather than a balanced representation of the Arabic language learning spectrum (see Table 5).

Table 5. Types of learners (samples)

Level	No. of articles	Studies
Primary	2	Wan Daud et al. (2021); Asbulah et al. (2022)
Secondary	-	-
University	1	Sahrim et al. (2023)
Others	2	Ahmad Yusoff et al. (2024; 2025)

Among the five reviewed studies, two focused on primary school students, reflecting a strong tendency to position AR as a supportive tool for early-stage language acquisition, particularly in facilitating vocabulary learning through visual and interactive elements.

In addition, two studies targeted specialised learner groups, specifically hearing-impaired learners, indicating an emerging research direction that utilises AR to support inclusive and accessibility-oriented learning environments. In contrast, only one study involved university-level students, while no studies were found at the secondary level. This absence highlights a significant gap, as the secondary level represents a key transitional phase in Arabic language education, where learners engage with more complex linguistic and cognitive demands.

This distribution reflects a pedagogical tendency to position AR primarily as a visual-support tool for learners who benefit from multimodal input, while limiting its application in more cognitively demanding learning contexts (Wan Daud et al., 2021; Asbulah et al., 2022; Sahrim et al., 2023; Ahmad Yusoff et al., 2024; 2025). Consequently, current research provides a restricted view of AR’s pedagogical potential, underscoring the need for more balanced and representative sampling approaches.

RQ3: What Research Designs and Data Collection Methods Are Employed to Explore AR in the Teaching of Arabic Language?

The analysis of research designs reveals a clear methodological concentration within a limited range of approaches, indicating that AR research in Arabic language teaching in Malaysia remains predominantly exploratory in nature (see Table 6).

Table 6. Type of research designs

Research designs	No. of articles	Studies
Analysis, design and development, and testing phase	1	Wan Daud et al. (2021)
Quantitative method	3	Asbulah et al. (2022); Sahrim et al. (2023); Ahmad Yusoff et al. (2024)
The Design and Development Research (DDR)	1	Ahmad Yusoff et al. (2025)

Among the five reviewed studies, three employed quantitative methods, primarily relying on questionnaires to examine learner perceptions, attitudes, and engagement. This dominant reliance on perception-based data suggests that current research is largely oriented toward measuring immediate responses rather than investigating deeper learning processes or long-term instructional impact.

In addition, one study adopted a multi-phase design involving analysis, design, development, and testing, while another employed Design and Development Research (DDR), focusing on iterative refinement and expert validation. Although these approaches reflect emerging efforts toward structured instructional design, they remain limited in number and scope.

A similar pattern is observed in data collection methods (see Table 7), where questionnaires dominate, followed by content analysis and the Fuzzy Delphi Method. The limited use of diverse data sources indicates a lack of methodological triangulation across studies.

Table 7. Data collection methods

Data collection methods	No. of articles	Studies
Questionnaire	2	Asbulah et al. (2022); Sahrim et al. (2023)
Content analysis	2	Wan Daud et al. (2021); Ahmad Yusoff et al. (2024)
Fuzzy Delphi method	1	Ahmad Yusoff et al. (2025)

This methodological pattern suggests that AR research in Arabic language education remains at an early stage of development, with insufficient use of longitudinal, comparative, and mixed-method approaches necessary for generating robust pedagogical evidence (Wan Daud et al., 2021; Asbulah et al., 2022; Sahrim et al., 2023; Ahmad Yusoff et al., 2024; 2025).

RQ4: What Types of AR Platforms and Technologies are Utilised in Arabic Language Teaching?

The analysis of AR platforms and technologies reveals a clear technological pattern characterised by a strong reliance on mobile-mediated delivery and limited diversification in implementation approaches (see Table 8).

Table 8. Types of AR platforms and technologies

Type	No. of articles	Studies
Mobile app only	1	Asbulah et al. (2022)
Mobile app and book	2	Ahmad Yusoff et al. (2024; 2025)
Mobile app and computer	1	Wan Daud et al. (2021)
Not specified	1	Sahrim et al. (2023)

Most studies utilised mobile-supported AR applications, often integrated with printed learning materials such as books, indicating a prevailing tendency to extend traditional instructional resources rather than develop fully digital learning ecosystems. Only one study employed a hybrid mobile-computer approach, while another did not specify the platform used, reflecting inconsistencies in technical reporting.

This pattern suggests that AR implementation remains functionally limited, with a focus on accessibility and ease of integration rather than on technological innovation or immersive learning design (Wan Daud et al., 2021; Sahrim et al., 2023; Ahmad Yusoff et al., 2024; 2025).

More critically, the lack of detailed technical descriptions, including interaction design and system features, restricts cross-study comparability and limits the ability to evaluate the effectiveness of different AR delivery models. This limitation not only reflects technological constraints but also indicates that AR has yet to be conceptualised as a fully immersive instructional ecosystem within Arabic language education. As a result, current implementations remain pedagogically conservative, focusing on enhancement rather than transformation of learning environments.

RQ5: What Fields of Arabic Teaching Fields Are Explored Through AR Tools and Pedagogical Approaches in the Selected Studies?

The analysis of instructional focus reveals a clear pedagogical concentration in the application of AR within Arabic language education, with a dominant emphasis on vocabulary-based learning (see Table 9).

Table 9. Types of Arabic teaching fields are explored through AR

Fields of Arabic teaching	No. of articles	Studies
Vocabulary-focused learning	4	Wan Daud et al. (2021); Sahrim et al. (2023); Ahmad Yusoff et al. (2024; 2025)
General Arabic education context	1	Asbulah et al. (2022)

Among the five reviewed studies, four specifically implemented AR to support vocabulary acquisition, utilising features such as visual overlays, 3D object representation, and contextual word association to enhance lexical understanding. This pattern indicates that AR is primarily conceptualised as a tool for facilitating visual-lexical mapping, where abstract linguistic elements are translated into concrete and interactive representations (Wan Daud et al., 2021; Sahrim et al., 2023; Ahmad Yusoff et al., 2024; 2025).

In contrast, only one study positioned AR within a broader Arabic educational context, focusing on teacher readiness and attitudes rather than targeting a specific language component. While this reflects an emerging awareness of pedagogical implementation, it

remains limited in addressing how AR can be systematically integrated into instructional practice across multiple language domains.

The strong concentration on vocabulary-focused applications suggests that current AR implementation is largely confined to supporting discrete and lower-level language skills. While this aligns with the visual affordances of AR and its effectiveness in facilitating word recognition and meaning association, it also reveals a restricted pedagogical scope in addressing more complex aspects of language learning. Notably, there is an absence of studies exploring grammar instruction, discourse development, communicative competence, or literary analysis through AR-based approaches.

This narrow instructional focus highlights a broader limitation in the current literature, where AR is utilised primarily as a supplementary tool rather than as an integrated pedagogical medium capable of supporting holistic language development. Consequently, the existing body of research provides limited insight into how AR can be embedded within comprehensive instructional frameworks that address multiple language skills simultaneously.

Considering these observations, it becomes evident that AR research in Arabic language education remains largely component-focused, with insufficient exploration of its potential in supporting higher-order and integrated language learning processes. This underscores the need for future studies to expand beyond vocabulary-centric applications and to investigate how AR can facilitate more complex and context-rich learning experiences across diverse areas of Arabic language instruction.

DISCUSSION

The discussion builds directly on the cross-study patterns identified in the findings, particularly the pedagogical concentration, methodological tendencies, and technological characteristics observed across the reviewed studies. Rather than reflecting isolated findings, these patterns collectively reveal how AR has been conceptualised and implemented within Arabic language education in Malaysia.

Pedagogical Concentration of Augmented Reality Remains Vocabulary-oriented

The dominance of vocabulary-focused applications in AR-based Arabic language education reflects a deeper pedagogical alignment between technological affordances and cognitive processing principles rather than a purely incidental research trend. This pattern can be meaningfully explained through the Cognitive Theory of Multimedia Learning (CTML), which posits that learning is enhanced when verbal and visual information are integrated within learners limited cognitive capacity (Parong & Mayer, 2018). In this context, AR naturally supports lexical learning because vocabulary items can be directly associated with concrete visual representations, enabling efficient dual-channel processing and reducing cognitive overload.

This alignment explains why current AR implementations are disproportionately concentrated on vocabulary acquisition, as lexical items are more easily visualised compared to abstract linguistic constructs such as syntax, discourse, or rhetorical meaning. While this trend demonstrates the effectiveness of AR in supporting foundational language learning, it simultaneously reveals a pedagogical constraint, where technological design is driven by visual feasibility rather than comprehensive language learning objectives. Similar observations have been reported in broader AR research, where applications tend to prioritise visually representable content due to the immediacy of perceptual engagement (Akçayır & Akçayır, 2017).

However, this vocabulary-oriented focus also signals a limitation in the pedagogical conceptualisation of AR within Arabic language education. International research suggests that AR can extend beyond lexical support to facilitate interactive communication, contextualised language use, and collaborative meaning-making (Azuma, 1997; Radianti et al., 2020). The limited exploration of these dimensions within the reviewed studies indicates that AR has not yet been fully integrated as a holistic instructional medium. Consequently, the current state of AR implementation reflects not only technological affordances but also a lack of pedagogical expansion, where the potential of AR to support higher-order language skills remains underutilised.

Methodological Designs Remain Small-Scale and Exploratory

The methodological landscape of AR research in Arabic language education demonstrates a clear tendency toward small-scale, exploratory, and quasi-experimental designs. This pattern reflects the early developmental stage of AR integration, where research efforts prioritise feasibility, usability, and initial learner acceptance over rigorous pedagogical validation. Such an orientation is consistent with innovation-driven educational technology research, where emerging tools are first examined through pilot implementations before progressing toward large-scale empirical validation.

From a research development perspective, this trend can be interpreted as a transitional phase rather than a methodological deficiency. Early-stage studies are essential for refining technological functionality and identifying practical constraints in real educational settings. However, when viewed through the lens of broader AR scholarship, the continued reliance on small-scale designs highlights a limitation in generating robust and generalisable pedagogical evidence. Previous studies have demonstrated that AR can be investigated through more advanced methodologies, including longitudinal interventions, mixed-method designs, and comparative experimental frameworks that capture deeper learning processes and sustained outcomes (Akçayır & Akçayır, 2017; Radianti et al., 2020).

More importantly, the methodological focus in current studies tends to prioritise surface-level variables such as learner perception, readiness, and satisfaction, while giving limited attention to cognitive and instructional dimensions such as knowledge retention, transferability, and interaction quality. From a CTML perspective, this represents a

gap in examining how AR influences cognitive processing mechanisms during learning, particularly in terms of managing cognitive load and facilitating meaningful integration of multimodal information. Without such analysis, the pedagogical value of AR remains only partially understood.

Therefore, advancing AR research in Arabic language education requires a shift toward more robust and theory-driven methodologies. Future studies should incorporate larger sample sizes, longitudinal designs, and mixed-method approaches that integrate both quantitative outcomes and qualitative insights. Such methodological progression is necessary to move beyond proof-of-concept research and establish AR as an evidence-based instructional innovation.

AR Platforms Remain Technically Constrained and Pedagogically Underdeveloped

The technological implementation of AR in Arabic language education remains largely characterised by marker-based systems and mobile-mediated delivery, reflecting a technically accessible yet pedagogically limited stage of development. Marker-based AR, which relies on predefined visual triggers such as images or printed materials, aligns well with the existing structure of Arabic language instruction, particularly in supporting orthographic recognition and vocabulary acquisition. This compatibility explains its widespread adoption, as it allows AR to be integrated into traditional teaching materials without requiring significant curricular restructuring.

From a pedagogical perspective, this approach supports foundational learning processes by linking symbolic language forms to visual representations, thereby reinforcing recognition and comprehension. However, such implementations primarily operate at the level of visual enhancement rather than facilitating deeper contextual or experiential learning. As a result, AR is often used to augment existing instructional materials rather than to transform learning environments.

In contrast, advancements in AR technology, particularly markerless systems enabled by spatial tracking and environmental mapping, offer opportunities for more immersive and context-aware learning experiences. These technologies allow digital content to be embedded within real-world environments dynamically, enabling learners to engage with language in situated and interactive contexts. From a CTML standpoint, such environments have the potential to enhance meaningful learning by promoting active cognitive engagement and contextual integration of knowledge.

The limited adoption of these advanced AR paradigms suggests that current implementations are constrained not only by technological accessibility but also by pedagogical design considerations. The preference for marker-based systems indicates a tendency to align technology with existing instructional practices rather than reimagining learning experiences through the full affordances of AR.

To address this limitation, a hybrid approach that integrates both marker-based and markerless AR is proposed. Such an approach would allow learners to transition from structured, symbol-based learning to more open, context-driven interactions, thereby bridging the gap between foundational knowledge and applied language use. This progression aligns with constructivist learning principles, where learners actively construct meaning through interaction with their environment.

CONCLUSION

Based on the review conducted, the integration of AR in Arabic language education in Malaysia remains minimal, with only a few studies examining its potential in this context. Although AR has been widely applied across various academic disciplines, its use in Arabic literature is still rare, despite the field's complexity and the potential benefits of interactive visualisations in supporting comprehension. Such technology could offer a pedagogically sound means of enhancing learners' understanding of intricate vocabulary, stylistic features, and cultural contexts, thereby promoting more immersive engagement that addresses comprehension gaps and fosters a deeper appreciation of the language's literary heritage. Beyond literature, other core domains of Arabic learning, including grammar acquisition, discourse competence, and writing skills, also remain underexplored, even though these are essential for achieving language competency. Addressing these gaps presents significant opportunities for future research to innovate and integrate AR solutions that modernise Arabic language education while overcoming the limitations of traditional teaching approaches. These observations align with the findings of the review, as reflected in RQ1–RQ5, which collectively highlight the minimal scholarly focus, narrow learner coverage, methodological tendencies, limited technological deployment, and restricted instructional scope of AR in Arabic language education. The finding for each RQs could be concluded as follows:

RQ1: Despite its proven effectiveness in language teaching, AR has received minimal scholarly attention in Arabic language education from 2021 to 2025, overshadowed by the exponential growth of AI-driven research in educational technology.

RQ2: AR research in Arabic language education primarily benefits learners who rely on visual and interactive support such as primary students and hearing-impaired learners while highlighting the need for future studies involving secondary-level students.

RQ3: Previous studies predominantly adopted quantitative approaches to evaluate the practicality and effectiveness of AR technology, providing measurable insights that support future research and technological development.

RQ4: AR deployment in Arabic language instruction in Malaysia is predominantly mobile-mediated, with most implementations extending printed learning materials rather than functioning as independent mobile learning ecosystems, indicating

limited platform diversification and inconsistent technical reporting in current AR research.

RQ5: AR applications in Arabic education are largely confined to vocabulary learning, reflecting a narrow instructional focus, with minimal expansion into broader language domains or holistic pedagogical integration.

While the study employed the PRISMA framework to ensure systematic rigour, several limitations are acknowledged:

1. The small sample size ($n = 5$) constrained meta-comparative generalisation.
2. High variability and incomplete disclosure of technical AR specifications limited platform-level synthesis.
3. The review depended on published studies, excluding non-indexed experimental AR prototypes that may exist in institutional or industry silos.

Additionally, the predominance of quantitative designs in the reviewed corpus restricted the depth of interpretation regarding learner interaction and pedagogical process.

Considering the findings of this review, future research on AR in Arabic language education should be expanded to encompass broader educational fields and diverse geographical contexts beyond Malaysia, allowing for more comprehensive insights into its pedagogical impact. The limited scope of existing studies highlights the need for deeper and more systematic integration of AR into various aspects of Arabic teaching, moving beyond vocabulary-focused applications toward holistic language skills and authentic learning environments. Additionally, given the current global trend toward artificial intelligence in education, future studies are encouraged to explore the combined potential of AR and AI in enhancing Arabic language instruction. Such integration could yield more adaptive, interactive, and intelligent learning systems, ultimately contributing to the modernization and advancement of Arabic language education.

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