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DEVELOPMENT OF THE ASOMAR MODEL USING INTERPRETIVE STRUCTURAL MODELING (ISM)

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Abstract

This study aims to develop a Quranic reflection Model (Model AsomAR) through Arabic vocabulary learning, integrating Augmented Reality (AR) technology to support adult Deaf and Hard-of-Hearing (DHH) learners. The research employs Interpretive Structural Modeling (ISM), involving seven experts specializing in Quranic education for DHH learners, Arabic language education, and educational technology. The study systematically identifies and structures key elements or components necessary for effective Quranic understanding and Arabic vocabulary acquisition among DHH learners. The expert panel's input facilitates the hierarchical development of the model, ensuring pedagogical and technological relevance. The findings contribute to inclusive education, providing a structured approach to Arabic learning and Quranic reflection for the DHH community. The study highlights the potential of AR-assisted learning in enhancing engagement and comprehension, offering valuable insights for educators, curriculum developers, and policymakers.

Keywords: *Quranic, Reflection, Arabic, Vocabulary, Learning*.

INTRODUCTION

Tadabbur Al-Quran or Quranic reflection, is a central tenet of Islamic education, encouraging believers to deeply contemplate the meanings and lessons within the sacred text. The lack of a dedicated curriculum tailored to deaf students in Quranic education poses a significant academic barrier, as current programs remain unchanged and are not adapted to meet their unique learning needs (Seman et al., 2019). This spiritual and linguistic journey poses significant challenges for Deaf and Hard-of-Hearing (DHH) individuals, particularly due to limited access to suitable pedagogical resources and technologies.

Arabic, as the language of the Quran, is complex and highly dependent on auditory cues, further complicating its acquisition for DHH learners. Emerging technologies such as Augmented Reality have shown promise in overcoming these barriers by enhancing visual engagement and offering multisensory learning experiences. Previous studies demonstrate that AR can aid Arabic vocabulary learning and Quranic understanding among DHH adults, promoting both language acquisition and deeper spiritual connection (Ahmad Yusoff, N. F. et al., 2024).

Similar applications have proven successful in literacy and sign language development for deaf children, emphasizing the importance of visual tools and interactive methods (Almutairi & Al-Megren, 2017). Despite prior AR applications in literacy, no structured Quranic reflection model exists for adult DHH learners. Building on this foundation, this study advances the AsomAR model to integrate Arabic vocabulary learning and AR technology for Quranic reflection by employing Interpretive Structural Modeling (ISM).

This approach enables systematic organization of expert knowledge into a structured model, ensuring that both pedagogical and technological components are hierarchically and logically aligned for the DHH educational context.

LITERATURE REVIEW

Augmented Reality (AR) technology has versatile applications across multiple sectors, including the automotive industry, healthcare, education, and office settings. As noted by Azuma (1997) and Tamura (2014), AR enhances the user's perception of the real environment by overlaying virtual elements that convey information beyond the reach of human senses. Although this information is not physically present, it supports users in completing real-world tasks. The unique capabilities of virtual objects position AR as a highly promising tool, particularly in fostering creativity within applications such as instructional aids and educational resources.

Billinghurst (2002) and Wu (2013) suggested that AR possesses various features capable of offering a learning experience that differs significantly from traditional approaches. AR has the capacity to stimulate multiple senses, such as touch and hearing (Azuma, 1997; Serio, 2012). With the integration of AR into tools like books or flashcards, learners not only engage with the content but also benefit from additional support or scaffolding. This is made possible through AR applications on smartphones, allowing for flexible, on-demand learning anytime and anywhere (Ramli, 2020).

Recent studies highlight that AR can significantly elevate educational quality for deaf or hard-of-hearing students by offering immersive, interactive, and accessible learning experiences tailored to their needs. For instance, a prototype AR-based animation tool designed to teach Hijaiyah letters to deaf children in Malaysia revealed strong increases in learner engagement and comprehension, teachers praised its use of vibrant visuals, animated characters, and sing-along features, though further testing in real classrooms was recommended (Mohd Noor et al., 2025).

Similarly, an AR-enhanced real-time captioning system co-designed with deaf students and teachers in Sri Lanka achieved an adoption rate of nearly 92%, demonstrating its effectiveness in supporting comprehension within a school environment (Samaradivakara et al., 2024). Recent innovation also addresses emotional context: an AR captioning interface overlaying affective cues such as speaker tone or facial expressions has been shown to reduce cognitive load and boost understanding when compared to standard captions in STEM lessons (Ubur, 2025).

Moreover, a 2024 ACM ASSETS study with 11 DHH participants playing an AR game found that excessive visual or audio cues could hinder attention, underscoring the importance of designing AR systems that offer customizable, text or haptic feedback suited to deaf learners (Luna et al., 2024).

Wan Ab Aziz et al. (2021) developed an Augmented Reality (AR) application called ARabic-Kafa for Arabic vocabulary learning, designed to support both teachers and students. The app uses a Marker-Based Tracking method to display 3D objects and includes audio pronunciation to enhance learning. Tests showed that the 3D objects are clearly visible at a minimum distance of 10 cm and an angle between 30° and 90°. However, this application was designed specifically for typical students and teachers only.

Besides, there is a *Mobile Augmented Reality (MAR-Arab)* application developed by Che Hashim et al. (2017) for early Arabic language learning using the ADDIE model, which includes analysis, design, development, implementation, and evaluation phases. The app features two main modules—*Learning* and *Practice*—integrating multimedia elements such as animations, audio, video, and 3D objects to engage learners. User testing indicated that the application enhanced students' interest, improved comprehension, and accelerated learning, demonstrating its effectiveness in Arabic language education.

METHODOLOGY

Design and Development Research (DDR) was introduced by Richey and Klein (2007). According to Seels and Richey (1994), this method involves a systematic approach in designing, developing, and evaluating whether a program or product is effective, as well as maintaining consistent internal criteria. Meanwhile, Wang and Hannafin (2005) explain that the Design and Development Research (DDR) method encompasses the processes of needs analysis, design, development, and implementation.

Based on this explanation, the study on designing a model for Quranic reflection (AsomAR Model) through Arabic vocabulary learning, assisted by AR Technology, specifically for the adult 'Deaf and Hard-of-Hearing (DHH) community, is conducted in three phases:

Phase I

Needs analysis using the approach by Hutchinson and Waters (1987, p.19). Data collection covered learner familiarity with Juz' 'Amma vocabulary (humans, animals, plants, natural phenomena) and their interest in AR-assisted learning (Ahmad Yusoff, N. F., 2024).

Phase II

It Comprises two sub-phases:

i. Phase II (A): Design phase utilizing the Fuzzy Delphi Method (FDM). A study proceeded to capture expert opinions on the essential components and elements of the Tadabbur Al- Quran model (Ahmad Yusoff, N. F., 2025).
ii. Phase II (B): Model development phase using Interpretive Structural Modeling (ISM) software.

Phase III

Model usability evaluation phase employing the Modified Nominal Group Technique (MNGT).

This study focused on Phase II (B): Model development phase using Interpretive Structural Modeling (ISM) software. Interpretive Structural Modeling (ISM) is a structured methodology that enables educators and experts to collectively identify, map, and hierarchically organize the relationships among factors within a complex teaching or learning system (Warfield, J. N., 1976). Utilizing ISM software facilitates the systematic transformation of qualitative expert opinions into quantitative, navigable models, which can greatly enhance instructional design by highlighting key drivers and dependencies.

The ISM method is suitable for complex systems where components are interdependent, making it ideal for educational model development involving pedagogy, language, and technology. This technique is also a tool capable of elementing a structured and comprehensive model, in line with the view that this technique is a highly powerful decision-making tool for solving and untangling complex problems and is particularly suitable for model development (Jadhav et al., 2015; Sohani & Sohani, 2012).

In this study, seven experts were selected using purposive sampling. These experts represent three key domains: Quranic education for DHH learners, Arabic language education, educational technology and AR integration. Each expert had at least five years of experience in their field.

Data was collected through structured workshops and discussions using Concept Star software, which facilitates the ISM process by providing an interactive environment for conceptual mapping and model development. The researcher adopted the ISM approach based on the study steps of Maaruf et al. (2023) with minor modifications, as shown in Table 1.

TABLE 1: Steps in the Interpretive Structural Modeling (ISM) Approach

Step	Description
Step 1: Identifying Elements and Model Elements	The researcher identified relevant elements and elements for designing a Quranic reflection (Tadabbur Al-Quran) model through Arabic vocabulary learning supported by AR technology, specifically tailored for the adult Deaf and Hard-of-Hearing (DHH) community, based on expert consensus.
Step 2: Selecting Contextual Relationships and Relationship Phrases	The researcher established contextual relationships regarding how each element and element would be generated and connected with one another. Contextual phrase: *In developing a Quranic reflection model through Arabic vocabulary learning supported by AR technology for the adult DHH community. Relationship phrase: Should be prioritized before...*
Step 3: Determining Relationships Between Elements and Elements	Experts compared each pair of elements and elements and voted based on their experience and expertise to determine whether there was a direct relationship between each pair.
Step 4: Generating the Model	The researcher produced a diagram known as the model prototype using ISM software (Concept Star).
Step 5: Presenting and Evaluating Model Content	Experts reviewed the model's content and provided suggestions for improvement and revisions if necessary.
Step 6: Generating the Final Model Content	The researcher regenerated the model content based on the suggested improvements.

FINDINGS

Based on the findings from Phase 2(a) of Model Design, the researcher identified the elements accepted by experts during the Fuzzy Delphi evaluation for designing this model. A total of 14 elements were entered into the ISM (Concept Star) software. The list of elements was arranged in order of priority based on expert consensus.

In this stage, researchers focused on the development of the model. This study developed a model based on expert consensus regarding the relationships between selected elements, using the best pairing technique and Interpretive Structural Modelling (ISM) software support. The resulting model was presented to expert panels for review and validation. The impact of the expert voting conducted has resulted in a model generated by ISM, as shown in the diagrams below in Figure 1.

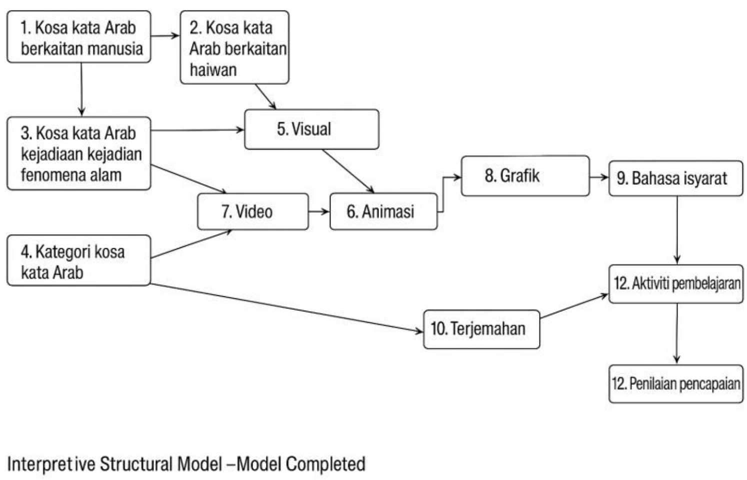

FIGURE 1: AsomAR Model generated by Interpretive Structural Modelling (ISM)

The development of the AsomAR model, structured using Interpretive Structural Modeling (ISM), presents a hierarchical and integrated system designed to enhance the process of Quranic reflection through Arabic vocabulary learning with the aid of AR technology. This model specifically addresses the needs of Deaf and Hard-of Hearing (DHH) adult learners.

It ensures that pedagogical and technological components are aligned to promote effective and inclusive learning. The structured relationships between the elements demonstrate how the model bridges linguistic content with accessible delivery mechanisms, supported by interactive learning activities that reinforce understanding. Here is an explanation related to the relationship between the elements in the ISM model in Table 2.

TABLE 2: The relationship between the elements of the ISM model

Relationship	Implication
1→ 2/3	Learning begins with vocabulary related to humans, followed by animal or natural phenomena.
1, 2, 3 → 5 (Visual)	Basic vocabulary (humans, animals, natural phenomena) is used to produce visual materials such as pictures or illustrations. These visuals serve as a supporting medium to understand vocabulary meanings.
3 → 7 (Video)	Vocabulary related to natural phenomena is best delivered through video due to its dynamic and contextual nature. Videos portray real-life situations (e.g., floods, earthquakes), helping students understand meanings visually and narratively.
5 → 6 (Animation)	Visuals developed from vocabulary are used in the form of animation to make learning more engaging and interactive. For example, animations of animal or human movements.
7 → 6 (Animation)	Content from videos can be modified or adapted into animation for simpler and more easily understood learning purposes.
6 → 8 (Graphic)	Elements from animation such as shapes or symbols can be extracted into graphics for static materials like posters or infographics.

5, 6 → 8 (Graphic)	Both visuals and animations contribute to the development of graphics that simplify understanding in a concise and compact manner.
8 → 9 (Sign language)	Graphics serve as visual guides in the creation of appropriate sign language, supporting the needs of students with different abilities.
9 → 11 (Learning activities)	Sign language is used in learning activities to support inclusive learning for hearing-impaired students.
4 → 10 (Translation)	Vocabulary categories help build a structured translation system organized by themes such as humans, animals, and natural phenomena.
10 → 11 (Learning activities)	Translations are used in learning activities in language games such as vocabulary arrangement and matching.
11 → 12 (Achievement assessment)	Learning activities form the basis for assessment whether through quizzes and test.

Fundamentally, the model is composed of three interdependent components: Arabic vocabulary content, multimedia-based delivery, and interactive learning and assessment. The vocabulary serves as the foundational layer, organized thematically into domains such as humans, animals, and natural phenomena. These foundational categories are then transformed into visual materials such as pictures and illustrations to enhance comprehension.

Vocabulary on natural phenomena is best presented through videos that depict real-life contexts, while visuals and videos are further developed into animations to create engaging and interactive learning experiences. The animations are later simplified into static graphics such as posters or infographics, which aid in concise understanding. These graphics also guide the development of sign language resources, ensuring accessibility for Deaf and Hard-of-Hearing learners.

Sign language is then incorporated into inclusive learning activities, allowing all students to participate actively. Additionally, vocabulary themes are used to construct a structured translation system that supports language games and matching exercises, reinforcing comprehension. Finally, these learning activities become the foundation for achievement assessment, where quizzes and tests evaluate learners' understanding and application.

Overall, the sequence demonstrates a coherent pedagogical flow from vocabulary acquisition to multimodal representation, interactive engagement, and inclusive assessment.

DISCUSSION

The AsomAR model directly responds to the educational needs of DHH learners. This model also extends existing scholarship on Arabic vocabulary acquisition and AR-based pedagogy by proposing a structured, multimodal, and inclusive system that interlinks linguistic content, multimedia delivery, and interactive assessment. Compared to prior studies, this model introduces a more holistic integration that bridges Quranic pedagogy, inclusivity, and educational technology.

Previous AR studies in Arabic language education such as Che Hashim et al. (2017) and Wan Ab Aziz et al. (2021) studies demonstrated that AR applications can effectively enhance learners' interest and motivation through the integration of 3D objects, animations, and audio. However, these works primarily targeted mainstream learners and focused on vocabulary recognition rather than conceptual comprehension or reflective engagement.

The AsomAR model advances this by embedding Quranic reflection (tadabbur) as a core pedagogical dimension, transforming AR from a visualization tool into a means of spiritual and linguistic exploration. This innovation aligns with Al-Qaradawi's (1999) and

Al-Ghazali's (2000) perspectives that tadabbur involves both linguistic understanding and moral contemplation, thereby situating AR within a Quranic epistemological framework.

In terms of vocabulary sequencing, the model's thematic structure by starting from human-related words, followed by animal and natural phenomena vocabulary, supports Nation's (2012) principle that learning should begin with high-frequency, socially relevant words for easier comprehension. This finding also aligns with Barcroft (2004), who emphasized the importance of personal relevance and visual association in vocabulary retention. Yet, AsomAR extends beyond these linguistic principles by contextualizing them within Quranic domains. Thus, linking lexical meaning to spiritual reflection becomes an approach scarcely addressed in prior language acquisition research.

Regarding multimedia-based delivery, the AsomAR model substantiates Mayer's (2009) multimedia learning principle and Moreno & Mayer's (2007) view that dual-channel (visual and verbal) processing enhances comprehension. While prior AR language models (e.g., Bacca et al., 2014) demonstrated that animation and interactivity improve engagement, AsomAR emphasizes hierarchical integration visuals evolve into animations, animations simplify into graphics, and graphics scaffold sign language.

This structured multimodal flow represents a methodological refinement over earlier AR designs, where multimedia elements were often applied independently rather than systematically layered. In the realm of inclusive education, the AsomAR model addresses a significant gap. Earlier works on AR pedagogy have rarely considered the needs of Deaf and Hard-of-Hearing (DHH) learners.

By incorporating graphics-to-sign language transformation and sign-supported activities, this study aligns with Marschark and Hauser (2011), who highlighted the role of visual mediation in improving DHH learners' comprehension. The model also resonates with the Universal Design for Learning (UDL) framework (CAST, 2018), which emphasizes accessibility through multiple representations and modes of engagement.

Thus, AsomAR advances the discourse on inclusivity by operationalizing these principles within Quranic and linguistic learning contexts—areas historically limited to auditory instruction. Furthermore, the integration of interactive learning and assessment reflects contemporary trends in communicative and task-based language teaching (Ellis, 2003; Brown, 2004).

Unlike traditional evaluation systems that emphasize memorization, AsomAR encourages performance-based assessment through games, quizzes, and AR interaction. This aligns with constructivist learning theory (Vygotsky, 1978), where learners build knowledge actively through contextualized experience rather than passive reception. Critically, while previous research emphasized either technological innovation (Che Hashim et al., 2017) or linguistic sequencing (Nation, 2012), AsomAR synthesizes these domains into a coherent pedagogical flow.

Its ISM-based structure (Warfield, 1976; Sushil, 2012) provides a clear visualization of how each component—vocabulary, media, sign language, and assessment—interacts hierarchically and causally. This systemic integration distinguishes AsomAR as not merely an instructional tool but a pedagogical model grounded in Quranic, cognitive, and inclusive principles.

In conclusion, the AsomAR model builds upon prior AR, linguistic, and educational studies but moves beyond them by embedding Quranic spirituality and inclusivity into an empirically structured learning framework. It thus contributes a novel paradigm that connects language, revelation, and technology, offering a model of tadabbur al-Quran that is both technologically enhanced and universally accessible.

CONCLUSION

The AsomAR model exemplifies an inclusive, multimodal, and spiritually grounded instructional design that integrates Quranic pedagogy, inclusive education, and AR learning principles. It demonstrates that Quranic reflection can be meaningfully enhanced when linguistic, cognitive, and sensory elements are harmonized through technology. This integration not only strengthens comprehension and retention but also democratizes access to Quranic learning for individuals with hearing differences.

AR-assisted learning significantly increases student engagement and improves comprehension, offering valuable insights for educators, curriculum planners, and policymakers.

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