

## EDUCATIONAL ENGAGEMENT THROUGH AR AND VR: A REVIEW WITH APPLICATION TO SHARIAH-COMPLIANT SUSTAINABLE GARDEN CONCEPTS

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### ABSTRACT

The rapid advancement of immersive technologies such as Augmented Reality (AR) and Virtual Reality (VR) offers new opportunities for enhancing educational engagement. Globally, AR and VR have been applied in diverse fields, including architecture, sustainability education, and cultural heritage preservation. However, in Malaysia, the integration of these technologies into higher education remains limited, particularly in community-based learning environments that emphasise sustainability and Shariah-compliant values. Current studies tend to focus on technical adoption or user experience, with insufficient attention given to aligning immersive learning with the principles of Maqasid Shariah and the integration of 'Aqli (rational) and Naqli (revealed) knowledge. This review paper explores global and local literature on AR and VR in education, identifying gaps and opportunities for application within the context of Shariah-compliant Sustainable garden concepts. The methodological approach includes a scoping review of recent publications from Scopus, Web of Science, and Google Scholar, synthesising key themes on immersive learning, community engagement, and Islamic education. Findings highlight AR and VR's transformative role in advancing interactive and experiential learning, especially within STEM, cultural, and Islamic education. However, a research gap persists in their application to sustainable and environmental design. The review contributes by identifying emerging trends and research opportunities, establishing a foundation for future interdisciplinary and Shariah-aligned innovation in sustainability-focused design education.

**Keywords:** Immersive learning, Augmented Reality (AR), Virtual Reality (VR), Educational Engagement, Maqasid Shariah.

## INTRODUCTION

In recent years, immersive technologies such as Augmented Reality (AR) and Virtual Reality (VR) have emerged as transformative tools in the field of education. Their capacity to create interactive, engaging, and context-rich learning environments has made them increasingly relevant in both formal and informal educational settings. Globally, AR and VR are being integrated into STEM education (Sanfilippo et al., 2022; Tene et al., 2024), cultural learning (Gao et al., 2021; Shadiev et al., 2025), and community-based engagement (Ranasinghe et al., 2025; Calil et al., 2021); offering new ways to visualise complex science concepts (Mansour et al., 2024), simulate real-life scenarios (Yusa et al., 2023; Mansour et al., 2024), and enhance student motivation (Yusa et al., 2023; Aldeeb et al., 2024, Permana et al., 2024). Despite these advancements, the use of immersive technologies in Islamic Energy Garden contexts particularly those integrating shariah-based and sustainability-focused learning remains relatively underexplored.

In Malaysia, Universiti Sains Islam Malaysia (USIM) provides a distinctive framework for exploring this integration. The philosophy of Universiti Sains Islam Malaysia (USIM) is grounded in the integration of Naqli (revealed knowledge) and ‘Aqli (rational knowledge), complemented by noble character and ethical conduct as the core foundation for nurturing an excellent generation and an enlightened society. Guided by its core values, USIM aspires to produce Al-Qawiyyul Amin graduates individuals of strength and trustworthiness who embody integrity, unity, professionalism, efficiency, and a global outlook (USIM, 2025). In line with its vision, USIM ensures that all academic programs and courses are designed to integrate iNaQ (Integration of Naqli and ‘Aqli) values. This holistic approach aims to produce scholars, leaders, and professionals who are competent, grounded in the Islamic scholarly tradition, and guided by noble religious and cultural values for the well-being of humanity (USIM, 2025). Supporting this perspective, Bahri and Suparto (2025) emphasise that integrating religious knowledge with general science is essential for maintaining the relevance of Islamic education and equipping it to face the challenges of globalisation.

Within this context, Education 5.0 aims to align higher education with the demands of the Fourth and Fifth Industrial Revolutions by fostering creativity, critical thinking, and digital fluency (Chakraborty, 2024). Mupaikwa (2025) also found that AI promotes student-centered learning and fosters learner independence and innovation. The current use of generative AI in smart education remains limited, particularly in enhancing creativity, critical thinking, and adaptability. This highlights the need for deeper exploration of its potential to revolutionise teaching and learning practices (Chakraborty, 2024; Mupaikwa, 2025). Although Education 5.0 promotes the integration of AI, VR/AR, and adaptive platforms, many institutions especially in developing regions still lack the resources or expertise to embed these technologies that emphasised on the integration of the Maqasid Shariah principles in the Teaching and Learning in Higher Education.

At the national level, Malaysia’s National Artificial Intelligence Roadmap 2021–2025 identifies education as a key sector for AI adoption, while the forthcoming Education Blueprint 2026–2036 emphasises equitable, accessible, and future-ready learning supported by AI (MOSTI, 2023; Malay Mail, 2025). Despite these policy aspirations, current approaches to teaching sustainability and Islamic environmental ethics in universities and community programs often remain theoretical, text-based, and less interactive. Teaching about Islam through gardens offers humanistic and artistic approaches that reveal cultural, geographic, and spiritual diversity within Muslim traditions (Sabzali & Jefferani et al., 2025).

Students often struggle to connect the abstract principles of Maqasid Shariah such as the preservation of faith, life, intellect, property, and lineage with real-world practices when learning is limited to theoretical lectures and textbooks. Integrating technologies like AR and VR into teaching offers a solution by allowing learners to experience sustainability concepts through immersive garden simulations, explore Shariah-compliant design layouts, and visualise the integration of renewable energy and ecological features interactively (Idris et al., 2025b). Furthermore, educational engagement programs utilising AR and VR focused on Shariah-based environmental aspects can enhance technological literacy and deepen public understanding of Shariah-compliant sustainability concepts which will be the focused of this study.

The research gap lies in the lack of comprehensive reviews that connect immersive technologies with Islamic-based sustainability education. While numerous systematic reviews examine AR and VR in STEM or higher education, very few discuss their potential for community-based learning rooted in Islamic values and sustainable development goals (SDGs). Addressing this gap is vital to support educators, policymakers, and designers in developing tools that align with Malaysia's vision for sustainable campuses and Islamic pedagogy. This paper therefore reviews current trends in AR and VR for educational engagement, with a special focus on their application to Shariah-Compliant Sustainable Garden concepts. The review highlights methods, opportunities, and challenges in leveraging immersive technologies to strengthen environmental awareness, Islamic values, and community participation in sustainability practices.

## LITERATURE REVIEW

### Immersive Technologies in Education

Education has evolved from teacher-centered learning (Education 1.0) to AI-driven, personalised, and immersive learning (Education 5.0), integrating digital tools, virtual reality, and generative AI for lifelong education (Chakraborty, 2024), see Figure 1. Immersive technologies such as AR and VR are transforming education globally by offering new modes of visualisation, interactivity, and experiential learning. AR in education has proven particularly valuable for enhancing visualisation and contextual learning, allowing abstract concepts to be presented in tangible and interactive ways (Mansour et al., 2024; Yusa et al., 2023). Applications are especially evident in STEM education, where AR supports complex scientific visualisation and boost student motivations (Yusa et al., 2023; Aldeeb et al., 2024, Permana et al., 2024), as well as in heritage and environmental studies, where it overlays digital narratives onto physical spaces for deeper engagement (Zain et al., 2024).

In contrast, VR provides fully immersive and simulated environments, enabling learners to explore experiences beyond the classroom. VR applications are widely used in higher education and professional training, where students benefit from experiential simulations (Sanfilippo et al., 2022; Tene et al., 2024), and in cultural learning contexts (Gao et al., 2021; Shadiey et al., 2025), where virtual environments replicate heritage sites (Zain et al., 2024; Bahaddad, Almarhabi, and Alghamdi, 2024; Hussein and Al Ali, 2025), community, and religion practices (Asril et al. (2023; Aryati et al., 2024). Together, VR and AR expand traditional teaching by creating more interactive, student-centered learning pathways (Mansour et al., 2024).

Beyond individual learning contexts, VR and AR technologies are increasingly employed for community engagement, offering innovative ways to involve society in co-creation, cultural preservation, and sustainability awareness. Case studies highlight their role in participatory design, smart cities planning (Liu et al., 2024), cultural heritage (Zain et al., 2024; Hussein and Al Ali (2025), and environmental education (Balcha et al., 2025; Ladykova et al., 2024). In urban planning, VR has been used to simulate neighbourhood developments, enabling local communities to visualise proposed infrastructures and contribute feedback before construction (Ranasinghe et al., 2025). This participatory approach not only improves design outcomes but also strengthens civic ownership of urban spaces (Ranasinghe et al., 2025). Similarly, AR applications have been employed in heritage education, where digital overlays bring cultural landmarks and intangible traditions to life, allowing younger generations to appreciate cultural assets in more interactive ways (Zain et al., 2024).

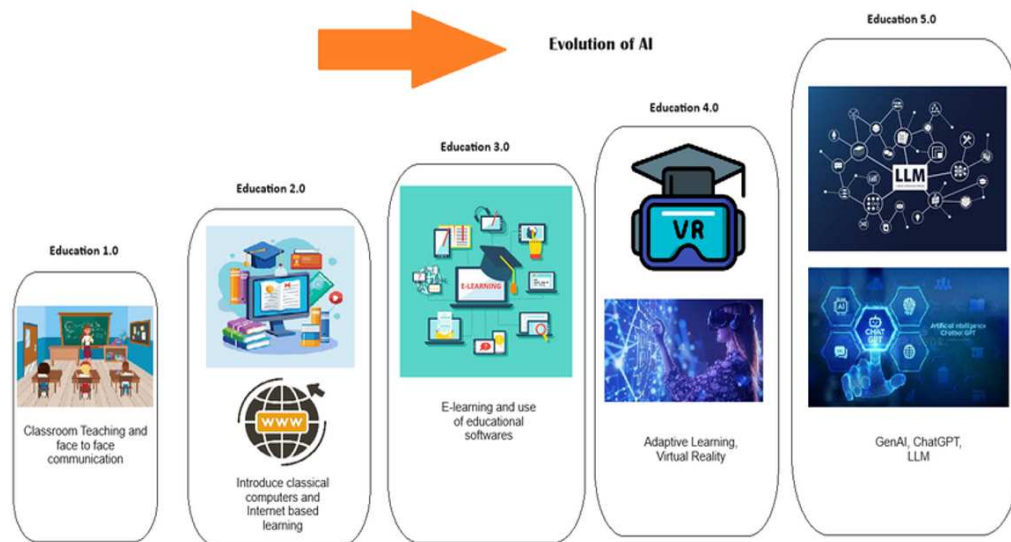


Figure 1: The development of Education 1.0 to 5.0 through the influence of AI.  
(Source: Chakraborty, 2024).

Sustainability-focused applications of VR and AR are gaining traction as tools to raise environmental consciousness and foster behavioural change. For instance, the program used Augmented Reality Mobile Game-Based Learning (ARM-GBL) combined with physical play to teach environmental concepts to preschool children. Through interactive AR activities such as waste sorting games and collaborative tasks, children developed better understanding of environmental issues, showed stronger teamwork and empathy, and achieved higher learning retention and task accuracy compared to traditional digital learning methods (Balcha et al., 2025). In community-based projects, VR has been applied to simulate the impacts of climate change, such as sea-level rise or deforestation, helping communities understand long-term environmental risks and inspiring collective action toward sustainable practices (Calil et al., 2021). In this current study, VR and AR was applied to design Shariah-compliant sustainable gardens, enabling users to explore energy-efficient layouts, water-saving systems, and renewable energy features within an Islamic framework. These applications promote ecological awareness while embodying the Maqasid Shariah principles of stewardship (amanah) and environmental preservation.

## **METHODOLOGY**

This scoping review employed a systematic approach to identify, evaluate, and synthesise studies on the use of immersive technologies specifically VR and AR in educational engagement, with an emphasis on their potential application in Shariah-compliant sustainable garden concepts. To ensure comprehensiveness and rigor, three primary academic databases were utilised: Scopus, Web of Science (WoS), and Google Scholar, selected for their extensive coverage of peer-reviewed and high-impact publications. The search strategy employed a combination of keywords and Boolean operators, including “augmented reality,” “virtual reality,” “immersive learning,” “Islamic education,” “STEM Education”, “sustainable garden,” and “community-based learning”. To refine the search, filters were applied to limit publications between 2020 and 2025, ensuring the inclusion of the most recent and relevant research reflecting current technological advancements.

Screening of retrieved studies followed clearly defined inclusion and exclusion criteria. Articles were included if they: (i) explicitly discussed the application of AR or VR in educational contexts, (ii) addressed community or cultural engagement, or (iii) explored Islamic or values-based educational frameworks. Studies were excluded if they focused solely on technical development (e.g., hardware), were unrelated to education, or were not available in full text. The initial search yielded 86 articles. Following abstract screening and full-text review, 15 articles were selected for detailed analysis, forming the basis for the synthesis and discussion presented in this review.

## **FINDING & DISCUSSION**

### **Immersive Technologies in Science, Technology, Engineering, and Mathematics (STEM)**

The integration of immersive technologies such as AR and VR into education has gained significant momentum in recent years, particularly in higher education and STEM-related fields. A number of studies demonstrate the impact of these tools across varied educational contexts. In the field of STEM education, Latif et al., (2024) found that AR and VR significantly improved students’ engagement, comprehension, and retention, showing 30% higher learning outcomes and 85% engagement compared to traditional methods across STEM and humanities subjects. Similarly, Wong et al., (2024) The study showed that using the Virtual and Augmented Reality Technology-Enhanced Learning (VARTeL) environment in higher education led to a 24.8% improvement in post-test scores, demonstrating significant gains in students’ understanding of abstract STEM concepts, engagement, and learning efficiency. Students reported that immersive VR games such as virtual cells, F1 racing car, and vector geometry made learning more intuitive, interactive, and effective compared to traditional methods (Wong et al., 2024).

Meanwhile, Andalib and Monsur (2024) found that VR enhanced student learning in landscape architecture by improving spatial understanding, design visualisation, and engagement. When combined with 3D modeling and sketching, VR promoted creativity, critical thinking, and effective design communication. Additionally, Krüger and Ramm (2024) developed an AR-enriched botanical garden workshop supporting STEM learning through hands-on exploration and digital visualisation. Students used AR, photogrammetry, and design thinking to create 3D plant models, enhancing understanding of sustainability, innovation, and environmental systems.

Shen and Yu (2024) demonstrated that immersive VR experiences effectively replicate Jiangnan garden environments, enabling quantitative analysis of users' visual and emotional responses. VR enhanced participants' cognitive engagement, revealing how spatial qualities influence emotions and deepening understanding of traditional garden impressions through immersive, sensory-rich exploration.

Finally, heritage-based education has benefitted from immersive applications. Zain et al. (2024) explored the use of Mixed Reality (MxR) to create immersive cultural edutainment experiences at the Jugra heritage site, aiming to enhance visitor engagement and understanding of local history. The study developed a storyboard framework to guide the design of authentic and educational MxR content, emphasising cultural accuracy and user interactivity (Zain et al., 2024). Findings revealed that MxR significantly improved users' engagement, curiosity, and comprehension of cultural narratives through sensory-rich and interactive experiences.

Additionally, Rahman et al. (2024) found that the "Echoes of Tradition" 3D virtual tour of Kampung Adat Pulo Garut effectively enhanced users' immersive spatial experiences and cultural understanding. Using Unreal Engine and LiDAR-based modeling, the VR environment provided accurate, interactive visualisations that improved learning engagement and supported digital cultural preservation in Indonesia (Rahman et al., 2024). Moreover, Jangra, Singh, & Mantri (2024) found that using virtual reality (VR) simulations in cultural heritage education significantly improved user engagement, emotional connection, and knowledge retention. Participants using the VR-Simulator reported higher positive emotions and engagement levels than traditional methods. The study highlights VR's strong potential to enhance STEM-related educational experiences by integrating interactive, immersive technologies that foster emotional learning and digital literacy (Jangra, Singh, & Mantri, 2024).

Research in Islamic education has also begun to integrate immersive technologies. Asril et al. (2023) developed a Virtual Reality (VR)-based learning module for teaching Hajj rituals in Integrated Islamic Elementary Schools. Students reported higher motivation and deeper understanding through immersive, authentic experiences. Sudiro and Munjin (2024) studied VR applications for teaching management of Islamic Religious Education at Junior High School significantly enhanced student engagement (by over 35%), active participation, and higher-order thinking skills. The VR-based teaching model, structured around preparation, action, and evaluation stages, created an interactive and immersive learning environment, making complex religious concepts easier to understand (Sudiro and Munjin, 2024).

These works illustrate the potential of AR/VR to engage learners not only cognitively but also spiritually and socially, making them suitable for embedding within Shariah-compliant sustainable garden concepts. However, despite these advances, limited studies explicitly address the integration of AR/VR in Islamic-based sustainable campus design in Malaysia, highlighting a research gap that this paper aims to explore. Tene et al. (2024) conducted a systematic review (2002–2023) on the integration of immersive technologies (VR, AR, XR, MR) in STEM education, analysing 22 empirical studies. The review found that AR was the most frequently applied tool, followed by VR. Both technologies significantly enhanced student engagement, comprehension, and motivation, with students demonstrating improved understanding of abstract STEM concepts and stronger collaboration in interactive environments (Tene et al., 2024).

The review highlights that immersive technologies foster active, experiential, and inquiry-based learning, aligning closely with STEM's problem-solving and innovation-driven goals (Tene et al., 2024). Zhang et al. (2024) conducted an umbrella review examining the integration of extended reality (XR) technologies VR and AR in STEM education. This study found that XR enhances student motivation, engagement, and skill development through immersive and interactive learning experiences (Zhang et al., 2024). Overall, XR demonstrates strong potential to transform STEM education by making learning more engaging and effective (Zhang et al., 2024). These findings suggest that AR/VR not only enriches content delivery but also cultivates deeper learning outcomes, thereby making it a promising tool for transformative education in Malaysia and beyond.

### **Immersive Technologies in Islamic Education**

The integration of immersive technologies such as VR and AR in Islamic education reflects a growing trend toward harmonising technological innovation with spiritual and ethical principles (Asril et al., 2023). From an Islamic perspective, these technologies are increasingly recognised not only as pedagogical tools but also as mediums to deepen faith, enhance Islamic understanding (Asril et al., 2023; Aryati et al. (2024), and sustain cultural heritage (Hussein and Al Ali (2025). Recent studies demonstrate that immersive technologies effectively bridge the gap between abstract religious concepts and experiential learning. For example, Asril et al. (2023) developed a VR-based Hajj education module that successfully simulated pilgrimage experiences, enhancing students' comprehension, engagement, and sense of spiritual presence. Similarly, Aryati et al. (2024) found that virtual pilgrimage simulations fostered emotional connection and reflective understanding of Islamic rituals, showing how VR can enhance spiritual embodiment and empathy among learners.

The immersive technologies play a vital role in architectural visualization and sustainable environmental design. VR and AR enable users to explore heritage spaces, eco-design concepts, and energy systems interactively, enhancing comprehension of Shariah-compliant sustainability principles. Hussein and Al Ali (2025) demonstrated that AR applications could effectively simulate the original appearance of heritage sites, thereby enriching the visitor experience and fostering a deeper appreciation of cultural heritage. The findings revealed that participants reported a heightened sense of authenticity and expressed satisfaction with the AR experience, indicating its potential as a valuable tool in heritage tourism. This is further supported by Bahaddad, Almarhabi, and Alghamdi (2024), who integrated AR and deep learning to enhance the spiritual and cultural experience of tourists in Makkah, providing real-time contextual information and enriching religious engagement. Such innovations demonstrate how immersive tools can support da'wah (religious outreach) and cultural sustainability in Islamic contexts.

Scholars also highlight the alignment of technology use with Shariah principles. Hassan, Asri, and Noordin (2024) argued that VR technology is permissible within Islam when it serves lawful, educational, and societal benefits. Their Shariah compliance analysis emphasised that digital innovation must uphold ethical governance and avoid misuse that contradicts Islamic moral values. Hamzah et al. (2024) applied the Technology Acceptance Model (TAM) to assess user perceptions of VR-based Hadith learning, revealing strong acceptance linked to usefulness, ease of use, and motivational appeal. Similarly, Djusmin and Zahir (2024) demonstrated that AR-based digital modules for Islamic education enhanced conceptual clarity and learner motivation.

Table 1: Summaries of the studies on VR/AR in STEM Education, Community Engagement and Islamic educational context.

| Author(s)  | Year | Country    | Methods   | Scope of Study   | Key Findings   |
|--|------|------------|---|--|--|
| Latif et al.                                       | 2024 | Malaysia   | Experimental study comparing AR/VR with traditional teaching                | STEM and humanities education                                      | AR/VR improved engagement (85%) and learning outcomes (30%) compared to traditional methods.                                     |
| Wong et al.  | 2024 | Hong Kong  | Implementation of VARTeL environment in higher education                    | STEM concepts in higher education                                  | VR/AR improved post-test scores by 24.8%, enhancing comprehension, engagement, and efficiency.                                   |
| Andalib & Monsur                                   | 2024 | Bangladesh | Experimental design integrating VR with 3D modeling                         | Landscape architecture education                                   | VR enhanced spatial understanding, creativity, and design communication.   |
| Krüger & Ramm                                      | 2024 | Germany    | AR-enriched workshop with photogrammetry and design thinking                | Botanical garden STEM learning                                     | AR supported hands-on exploration and understanding of sustainability and environmental systems.                                 |
| Shen & Yu  | 2024 | China      | Quantitative VR experiment with emotional and visual analysis               | Jiangnan garden spatial experience                                 | VR deepened emotional and cognitive engagement through immersive, sensory-rich exploration.                                      |
| Zain et al.  | 2024 | Malaysia   | Mixed Reality (MxR) storyboard framework                                    | Heritage education at Jugra site, Malaysia                         | MxR increased engagement, curiosity, and cultural understanding through interactive learning.                                    |
| Rahman et al.                                      | 2024 | Indonesia  | 3D VR tour using LiDAR and Unreal Engine                                    | Cultural heritage and spatial experience (Kampung Adat Pulo Garut) | VR enhanced spatial immersion, cultural appreciation, and digital preservation.  |
| Jangra, Singh, & Mantri                            | 2024 | India      | VR-Simulator evaluation using Achievement Emotion Questionnaire (AEQ)       | Cultural heritage education (Le Corbusier Museum, India)           | VR improved emotional engagement, positive affect, and knowledge retention, supporting STEM-related digital literacy.            |
| Asril, Z., Syafril, S., Engkizar, E., & Arifin, Z. | 2023 | Indonesia  | R&D approach using ISI-ARE model with expert validation and student testing | Islamic Religious Education (Hajj learning in elementary schools)  | VR enhanced comprehension, engagement, and realism in learning Hajj rituals; students reported high satisfaction and motivation. |
| Sudiro & Munjin                                    | 2024 | Indonesia  | VR-based teaching model with pre-post evaluation                            | Islamic Religious Education (Junior High School)                   | VR increased engagement (35%), participation, and understanding of complex religious concepts.                                   |

|                                   |      |              |  |  |  |
|-----------------------------------|------|--------------|--|--|--|
| Aryati et al.                     | 2024 | Indonesia    | Qualitative case study using interviews, observation, documentation. | VR use in Islamic education at Madrasah Kota Bengkulu, Indonesia.          | VR improved understanding, engagement, and teachers' perception; needs infrastructure support. |
| Hussein and Al Ali                | 2025 | Saudi Arabia | Mixed-method approach combining surveys and digital simulations.     | Evaluated AR's effect on authenticity perception of heritage sites.        | AR increased visitors' sense of authenticity and heritage appreciation.                        |
| Bahaddad, Almarhabi, and Alghamdi | 2024 | UAE          | Experimental study using augmented reality and deep learning.        | Enhancing tourist experiences at Makkah landmarks through AR applications. | AR and AI improved navigation, engagement, and cultural learning for visitors.                 |
| Hamzah et al.                     | 2024 | Indonesia    | Quantitative survey using Technology Acceptance Model (TAM).         | Investigated acceptance of VR-based hadith learning among students.        | Perceived usefulness and ease strongly influence intention to use VR learning.                 |
| Djusmin and Zahir                 | 2024 | Indonesia    | Research and development (R&D) design with validation testing.       | Created AR-based digital module for Islamic Religious Education.           | AR module improved engagement, comprehension, and interactivity in religious learning.         |

These findings affirm that immersive technology can transform Islamic pedagogy by providing multisensory, student-centered learning environments that stimulate both rational and emotional dimensions of understanding.

However, researchers caution that while immersive technologies offer unprecedented opportunities, they must be applied within ethical, epistemological, and cultural boundaries. Muslim (2024) and Rohmiati (2025) emphasised the importance of digital literacy and teacher preparedness to ensure technologies serve educational and spiritual purposes rather than mere entertainment. These studies collectively affirm that the adoption of AR and VR in Islamic contexts requires thoughtful alignment with Maqasid al-shariah (the objectives of Islamic law), prioritising knowledge dissemination, moral cultivation, and community well-being. In essence, immersive technologies when guided by Islamic principles, hold the potential to redefine Islamic education, heritage preservation, and cultural transmission. They can create spaces where learning is both technologically advanced and spiritually grounded, ensuring that digital progress continues to reflect faith (iman), knowledge (ilm), and excellence (ihsan). Table 1 below summaries the studies on VR/AR in STEM Education, Community Engagement and Islamic educational context.

Overall, recent studies (2023–2025) as shown in Table 1, demonstrate that augmented and virtual reality technologies significantly enhance learning, engagement, and spatial understanding across education, heritage, and tourism sectors. Most research originates from Southeast Asia and the Middle East, focusing on Islamic education, cultural heritage, and ethical technology adoption. Methods include qualitative case studies, quantitative surveys, experiments, and R&D designs. Findings consistently report improved comprehension, motivation, and authenticity of experience through immersive interaction. AR and VR applications also promote cultural appreciation and digital preservation. However, successful implementation requires adequate infrastructure, educator training, and Shariah compliance to ensure meaningful, ethical, and sustainable integration of immersive technologies.

### **Challenges & Best Practices that can be applied in Islamic Contexts**

While opportunities are promising, several challenges must be addressed. Technically, AR/VR infrastructure requires high costs for equipment, software, and maintenance, posing barriers for underfunded institutions. Pedagogically, educators may lack the training to effectively integrate immersive tools into lesson design, resulting in superficial rather than transformative applications. Ethically, concerns arise regarding over-reliance on technology, potential dilution of spiritual values, and issues of inclusivity particularly ensuring that AR/VR tools are accessible to differently abled students and rural communities. Additionally, ensuring that Islamic values are authentically embedded, rather than superficially added, remains a challenge for Shariah-compliant educational innovation.

Overall, the AR feature's capacity to translate abstract sustainability and spiritual concepts into tangible visual experiences aligns with existing research emphasising that AR technology enhances user comprehension, interaction, and engagement in architectural heritage education (Hussein and Al Ali, 2025) and Islamic Education (Bahaddad, Almarhabi, and Alghamdi. 2024). The integration of both VR and AR in the Educational Engagement framework demonstrates how these two immersive technologies can complement one another in achieving a holistic educational experience. While AR offers a hands-on, context-aware interaction, allowing users to visualise and manipulate the garden model within real physical spaces, VR provides a fully immersive simulation, enabling users to experience the spatial, environmental, and spiritual qualities of the Shariah-Based Islamic Energy Garden. Together, they bridge cognitive and experiential learning in which AR enhances comprehension through interactive exploration, while VR deepens emotional and reflective engagement by simulating real-world immersion.

## CONCLUSION

This review highlighted the transformative role of immersive technologies, particularly VR and sAR in advancing education through interactivity, visualization, and experiential learning. Global studies demonstrate their effectiveness in STEM, community and cultural engagement, as well as Islamic education. Recent studies (2023–2025) show that AR and VR technologies significantly enhance engagement, comprehension, and authenticity in education, heritage, and tourism particularly within Islamic and cultural contexts. However, there is a notable gap in research addressing their integration into sustainable and environmental design disciplines. While current works emphasise pedagogical innovation and user experience, few explore how immersive technologies can foster environmental awareness, energy-efficient design learning, or sustainable architectural practices.

Future studies should explore the integration of AR and VR into sustainable and environmental design education, focusing on how immersive technologies can enhance students' understanding of ecological systems, energy efficiency, and green architecture principles. Research could examine VR-based simulations of sustainable buildings, AR visualisations of environmental performance, and interactive design studios combining both technologies. Additionally, studies should assess how these tools influence learners' attitudes toward sustainability, decision-making in design, and awareness of environmental ethics.

Moreover, future research should emphasised pilot studies and case-based explorations of immersive learning environments in Malaysian campuses, gathering empirical data on usability, effectiveness, and ethical considerations. The contribution of this review lies in identifying the emerging trends and critical research gap in applying AR and VR to sustainability-focused design education, providing a foundation for future interdisciplinary inquiry. Its research impact extends toward guiding educators, designers, and policymakers to harness immersive technologies in cultivating ecological literacy, responsible innovation, and sustainable development practices within architectural and built environment studies.

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