

Gamified Augmented Reality Digital Storytelling for Malaysian Traditional *Kuih* Heritage Through Museum Experience Scale (MES)

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ABSTRACT

This pilot study examines the validity of an AR gamified digital storytelling installation that is based on Malaysian traditional kuih to engage visitors with Malaysian traditional cultural heritage. Titled *Kembara Jejak Warisan Kuih Muih*, the interactive installation integrates gamification mechanics, digital storytelling, and AR visualisation to revitalise intangible cultural heritage through immersive, participatory experience design. This installation was exhibited at *Interface: Where Visual Meets Poetry* in GMBB Kuala Lumpur and was measured using the Museum Experience Scale, a valid multidimensional framework for assessing visitors' engagement and experiential responses. Fifteen visitors who repeatedly encountered the installation were purposively selected as the data sample. The results indicate that levels of engagement, emotional bonding, immersion, cultural learning and usability are high. The participants reported significant meaning-making through interaction and expressed great interest in revisiting such interactive heritage experiences. Findings indicate that gamified AR digital storytelling can be employed as an innovative way to communicate and perpetuate intangible cultural heritage within exhibition contexts. This pilot study explores issues of interactive heritage preservation, digital exhibition design, and experiential storytelling in Southeast Asian visual culture, marking the first move in these discussions. It also demonstrates the suitability of the Museum Experience Scale (MES) for evaluating hybrid interactive art and heritage installations. It provides a foundation for future large-scale studies on gamified AR heritage engagement.

1. INTRODUCTION

The digitalisation of the aspects of contemporary exhibition and museum activity has suddenly brought about a cultural change, involving a process newer than others: the establishment of sources for these activities in cultural institutions is the transition from object-centred to the audience-centric, interactive environment that favours participation, immersion

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and meaningfully engagement (Falk et al., 2011; Tkavle, Séraphin & Flemming, 2021). Digital storytelling, gamification, and immersive technologies such as Augmented Reality (AR) have introduced new ways to reflect cultural narratives, engage contemporary users, and offer alternative ways to experience culture (Adewojo, 2025; Okanović et al., 2022). These advances position interactive digital media as the driver of cultural renewal and extended collective memory. Tangible and intangible cultural heritage (including traditional foodways) is often the most challenging to maintain, owing to its reliance on collective memory, expertise, and community involvement (Chang et al., 2015; Rizvić et al., 2019). In Malaysia, kuih stands for crucial cultural memory and inherited intergenerational knowledge, highlighting the breadth of regional variety in this country as much as its culinary prowess. However, with rapid urbanisation, globalisation, and shifting consumption culture, traditional food heritage is increasingly being eroded in most places, as young urbanites develop only a meagre acquaintance with and respect for it. Conventional means of exhibiting and documenting do not sustain engagement, interest, or connection (Spron & Leon-Penilla, 2006), especially among technologically driven individuals with a taste for connectivity and interactive experiences (Psomadaki et al., 2019; Kasemsarn & Nickpour, 2025).

Digital storytelling is promoted as a tool to enhance cultural experiences by transforming heritage stories into engaging, immersive experiences that foster emotional attachment and deeper interpretation (Tzima et al., 2020; Vrettakis et al., 2019). In particular, the inclusion of game elements adds appeal to participatory learning by introducing a sense of playfulness, activities, and advancement into the story design, encouraging active engagement and enhanced memory retention (Wu et al., 2022; Ng et al., 2025). Consequently, the game can be understood as a contemporary means of mediating experience and action as cultural memory (Douglas & Brauer, 2020). Equally, AR technologies can engage with and visualise the world by overlaying digital content in the physical space, contextualising cultural stories and enabling audience immersion (McLean & Wilson, 2019; Gong et al., 2022). In a way, gamified Augmented Reality that combines interactive digital storytelling can be considered an attractive medium for delivering ICH interactively through exhibition experiences.

Nevertheless, in Southeast Asia, there is still limited empirical research on how gamification, augmented reality (AR), and digital storytelling are used together for cultural heritage conservation. For the most part, the existing literature focuses on technological innovation and user engagement; thus, we see little attention paid to how these projects support meaningful heritage interpretation or to why contemporary people continue to appreciate them (Adewojo, 2025; Rinallo, 2020). Therefore, the wider cultural influence of the technologies remains unknown. In addition, there are few definitive evaluation frameworks for systematically assessing visitors' experience in interactive, technology-enhanced heritage environments. A more comprehensive assessment of how digital techniques encourage audience engagement, foster affective connections, and support cultural learning outcomes has been limited by this. With millions of people studied, the Museum Experience Scale (MES) provides a well-established, multidimensional measure of visitor engagement, emotional response, sense-making, and knowledge retention in museums and other cultural settings (Othman et al., 2011; Othman et al., 2021). When the audience is viewing interactive digital heritage installations, it becomes a systematic way to assess their experience (Mahphoth & Khalifah, 2017). This study employs the Museum Experience Scale (MES) to provide a systematic assessment of visitors' experience with Authentic Traditional Kuih, grounded in Malaysian culture and modern high-tech gamification with augmented reality at a digital storytelling installation. The objective of this study is to evaluate the efficiency of interactive museum exhibitions that employ gamified digital storytelling and Malaysian traditional *kuih* product stories with a view to capturing the public response. This study aims to examine the use of gamified and AR-enhanced digital storytelling to media visitors' participation in Malaysian traditional kuih and attractions.

2. LITERATURE REVIEW

2.1 Digital Storytelling and Cultural Heritage

Digital storytelling has become an important method for cultural bearing and sharing, integrating traditional storytelling with modern digital technology. It enriches audience engagement, emotional and cognitive attachment, and impact in museum, touristic, and educational settings by converting culture-related information into interactive and immersive experiences (Podara et al., 2021; Adewojo, 2025; Tzima et al., 2020). Through interactive and multimedia technologies, digital storytelling brings heritage narratives to life for modern visitors. Academics highlight the importance of digital storytelling in preserving tangible and intangible heritage, such as oral traditions, rituals, and culinary arts, through intergenerational transmission of knowledge and cultural identity (Chang et al., 2025; Rizvić et al., 2019). Its participatory setting offers the public an opportunity to go beyond passive consumption and actively interpret cultural narratives, thereby enabling greater emotional and cognitive engagement (Vrettakis et al., 2019; Shim et al., 2024). The convergence of technologies such as AR, VR, and interactive media has further expanded the possibilities for digital storytelling in heritage sites. These technologies are perceived to deepen immersion and interpretative understanding by enabling audiences to visualise layered narratives and experience cultural content through multisensory interaction (Adewojo, 2025; Okanović et al., 2022). As a result, there has been growing attention to the potential of digital storytelling to revitalise intangible heritage by repackaging it in ways that are accessible, engaging, and meaningful in digitally mediated contexts (Psomadaki et al., 2019; Kasemsarn & Nickpour, 2025). Despite its potential, challenges relating to authenticity, accessibility, and ethical representation remain critical considerations in digital heritage storytelling (Rinallo, 2020). Nevertheless, there is a recent, consistent theme in the literature that digital storytelling offers a perfect model for extending participation and, therefore, the momentum of cultural heritage in both interactive and experiential forms of communication. From this perspective, this paper examines the models used by the new AR method and gamified storytelling to present Malaysian traditional kuih heritage to museum audiences in today's exhibition context.

2.2 Gamification as a Conservation Method

Gamification has been identified as a useful tool for raising conservation awareness, boosting engagement, and contributing to the protection of cultural and natural heritage. Utilising the principles of game design, including rewards, challenges, and narrative progression, in non-game contexts (Deterding et al., 2011), gamification makes conservation activities more interactive and participatory by rewarding active participant engagement rather than mere observation (Kc & Sapkota, 2025; Douglas & Brauer, 2020). Based on these findings, gamified interventions may increase motivation, participation, and awareness in the fields of environment and cultural heritage, making gamification a novel idea for fostering conservation activities. In the cultural heritage sector, gamification is used to animate physical and intangible heritage through computer and smartphone games and immersive systems. Engagement in discovery-based experiences and storytelling immersion can enable the public to access legacy information and foster intergenerational learning and cultural understanding (Ng et al., 2025; Karvanková et al., 2024). Using storytelling and interactive mechanisms, gamification contributes to experiential learning and enhances the emotional bond with heritage stories by placing users in virtual environments (Wu et al., 2022). Gamification as an approach to conservation is directly related to the successful implementation of key engaging design elements, including autonomy, feedback loops, community engagement, and narrative immersion. While narrative-based gaming presents consistency and enhances the interpretive experience in emotional engagement with conservation messages, gamification elements like points, badges, and collaboratively solving challenges have also been found to increase user motivation and retention through points that are more informative and stimulate a sense of competition between individuals or families (Wee & Choong, 2019; Du et al., 2020).

Additionally, it has been shown that immersive, gamified learning settings go beyond conventional teaching methods in fostering intrinsic motivation and focused retention (Tan et al., 2018). However, the value of gamification relies on context-rich design and appropriate underlying user motivations and conservation goals. Problems such as the simplification of complex issues, the short-term nature of interactive effects, and inequalities in access underscore the importance of careful and ethical application (Adewojo, 2025). Despite these caveats, the evidence base repeatedly points

to gamification as a promising model for achieving conservation objectives through immersive, interactive engagement. In this research, gamification is explored as a conservation tool to reappropriate Malaysian traditional kuih heritage by creating an interactive cultural experience that engages the audience, thereby aiding the retention of cultural memory in a modern exhibition context.

2.3 Augmented Reality for Engagement Visualisation

Augmented Reality (AR) has been identified as an innovative technology that enables better visualisation for end-users. It enables digital information to be placed in the real world and accessed in a context-aware way. In a real-world interaction with digital content found in AR, users' immersion, cognitive, emotional, and interactive is an important element that correlates to users' understanding, motivation and involvement in domains such as public communication, education or cultural heritage (McLean & Wilson, 2019; Gong et al., 2022; Pandya, 2025). The main features of AR, its vibrancy, interaction, integration, and novelty, are substantially responsible for its efficacy in engagement visualisation. While interactive elements such as gesture-driven exploration and multisensory feedback encourage active user participation, high-quality visual overlays and animations enhance immersion and comprehension. Integrated "in-situ" visualisation, in which digital data is mapped directly onto reality, assists in learning and information comprehension (Raj et al., 2025; Suhail et al., 2024). Research indicates that augmented reality enhances involvement in several ways. Enhanced comprehension and retention of complex knowledge improve cognitive engagement, increased motivation and enjoyment boost emotional engagement, and greater involvement and time spent interacting with the content increase behavioural engagement (Gong et al., 2022; Ranasinghe et al., 2025). These multifaceted engagement-related aspects position AR as an instrument for visualising narratives and cultural material in interactive environments. In museum and cultural heritage settings, AR allows visitors to see intangible stories and the hidden depth of meaning behind objects through dynamic digital overlays, deepening interpretive engagement. Through situating storytelling within hybrid physical digital environments, AR reimagines heritage engagement as an immersive and participatory practice with relevance to contemporary audiences (Gong et al., 2022; Scholz & Smith, 2016). Looking through the benefits of working with AR, however, it has problems with its digital visualisations: they are not authentically reproduced, look artificial, and create a technological barrier. Designing AR posed challenges due to the need to balance visual realism, usability, and contextual relevance (Aitamurto et al., 2020). In conjunction with this research, augmented reality (AR) is a broad engagement and visualisation tool to enrich experiential interaction, interpretative understanding, and emotional attachment. The integration of interactive storytelling, gamification, and AR has significant potential to revitalise cultural heritage through immersive, participatory exhibition experiences.

2.4 Museum Experience Scale (MES)

In the past few decades, much scholarly attention on museums and exhibitions has been devoted to user experience, especially in terms of interactive and techno-scientific displays. Among the available measurement methods in this respect, the MES is among the most advanced and flexible theories, allowing the evaluation of a multidimensional experience spanning physical, hybrid, and digital realms (Othman et al., 2011; Othman et al., 2021). The Kira (2006) was developed with standard psychometric procedures and assesses four essential experiential dimensions: engagement, knowledge, learning, meaningful experience, and emotional connection. These dimensions jointly capture the cognitive, affective, and interpretative behaviours of visitors to exhibitions and cultural content, while allowing for a comprehensive assessment of museum experiences beyond satisfaction (Othman et al., 2011). The reliability and construct validity of the scale have been well established, and it has been used across various settings, including technology-enhanced exhibitions, multimedia guides, and game-based heritage learning environments (Mahphoth & Khalifah, 2017; Othman et al., 2021).

Compared with other visitor experience tools, MES offers a balanced system of emotional, cognitive, and interpretative dimensions and is especially well-suited to assess interactive and immersive exhibits. Although other scales,

such as the Visitor Experience Scale and the Digital Museum Visitor Experience Scale, consider tourism- or technology-specific variables, MES remains the most widely used because it is flexible and includes a broad range of core experience-related constructs (Lee & Smith, 2015; Zhu et al., 2024). The flexibility of MES in digital and interactive contexts has also made it particularly applicable to museum exhibition studies in the current world. A comprehensive framework offers a systematic yet meaningful way to assess how visitors engage with both cultural material and storytelling technology, yielding insights for exhibition design and audience-centred innovation. (Othman et al., 2021).

Its trustworthiness is accessible across multiple exhibition formats and technological interventions, allowing researchers to assess the emotional and materially immersive aspects of interactable media in museum contexts (Falk, 2016). The existing literature illustrates its potential as a living-with-significance scenario in museum work, placing greater value on concepts such as engagement, immersion, and meaningful interpretation. The application is evident in immersive installations, museums, and digital heritage settings created with user experience (UX) in mind, as the core interest of those applications is experiential quality and active participation in events. The MES provides the primary framework for assessing visitor engagement with a gamified, AR-augmented digital storytelling installation, thereby providing a reliable methodological foundation for assessing experiential interaction within an installation from a contemporary cultural heritage exhibition.

2.5 Conceptual Framework

The gamification as a conservation strategy and Augmented Reality (AR) as an engagement and visualisation tool in digital storytelling environments are two concepts selected for this study. The model supports the interpretation-focused theories by combining digital heritage scholarship, interactive exhibition design, and experiential learning to deepen visitors' experience of intangible cultural heritage works through digitally mediated interaction. Gamification promotes active cultural learning and aids in the retention of cultural memory through narrative development, exploration, and reward-based participation.

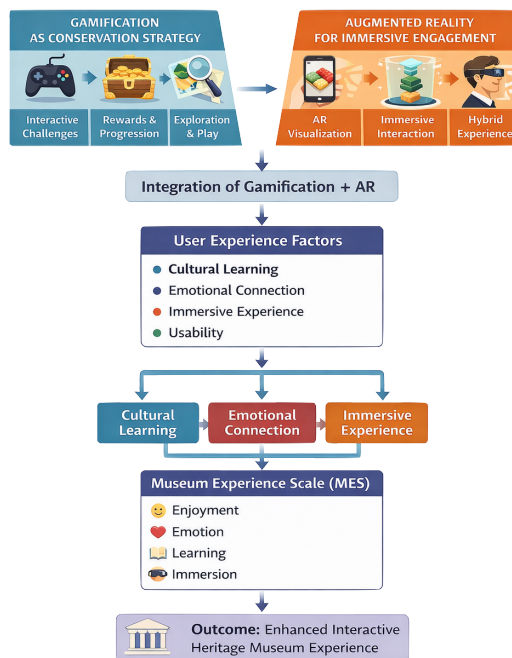


Fig. 1. Conceptual Framework of Gamified Augmented Reality Digital Storytelling for Malaysian Traditional Kuih Heritage
Source: Hafizah Rosli, 2026

This is consistent with research showing that play-based interaction is a successful strategy for maintaining interest and developing an emotional bond with cultural narratives. AR is positioned as an engagement and visualisation mechanism that enhances immersion and interpretative storytelling by overlaying digital content onto physical exhibition environments. AR enables visitors to dynamically visualise intangible cultural narratives, strengthening cognitive, emotional, and sensory engagement with heritage content. Its integration within digital storytelling environments facilitates hybrid physical-digital interaction that supports meaningful experiential learning.

The conceptual framework argues that incorporating gamification and AR into a digital storytelling environment enhances visitor engagement, emotional attachment, cultural understanding, and the visiting experience. These empirical dimensions are measured with the Museum Experience Scale (MES) and are used to design a structured, multidimensional instrument to measure public interactive experiences in culture. The framework also helps inform the development of the interactive installation and to measure visitor experiences in this pilot study.

3. METHODOLOGY

Exploring the experience effect of an interactive digital art exhibit integrating gamification, digital storytelling, and Augmented Reality (AR) to share Malaysian traditional *kuih* heritage, this study uses a pilot exploratory research method. The objectives of the pilot are to establish whether interactive digital approaches to intangible cultural heritage engagement are effective and whether the MES is appropriate as an evaluation tool in a hybrid interactive art and exhibition environment. The research is positioned within practice-based and audience experience research in art and design, where exploratory pilot studies are commonly conducted to evaluate prototype installations and emerging digital exhibition formats. As an alternative to striving for quantitative validity in a specific exhibition setting, the research initiative aims to offer interpretive and analytical insights into cultural learning, audience participation, and immersion. The pilot results are intended to guide upcoming extensive research and extended implementation of interactive heritage installations. However, the study is constrained by its pilot scale, including a small sample size and a brief exhibition timeline. It also reflects audience responses particular to the environment and is not meant for broad generalisation.

The study was conducted during the public exhibition *Interface: Where Visual Meets Poetry*, held at GMBB, Kuala Lumpur. The interactive installation *Kembara Jejak Warisan Kuih Muih* was on exhibition, exploring the revitalisation of Malaysian traditional *kuih* through gamification, digital storytelling, and AR-enhanced interaction. Utilising visual elements, collectibles and AR-triggered content, the exhibit functioned as a hybrid phygital interactive experience. The gamification elements, like exploration, discovery, and interaction, help inspire audiences to engage more actively with cultural narratives. Augmented reality elements, such as visualisations and interaction methods, allow the viewer to experience digital overlays and animated narratives in relation to physical exhibition elements. Conducting the study within a live exhibition environment ensured ecological validity by capturing authentic visitor responses within a real-world cultural setting.

3.1 Research Instrument

The primary instrument used by the study to collect data was an improved version of the Museum Experience Scale (MES). For assessment, visitor experience been questioned on multiple elements, such as engagement, emotional response, meaningful experience, and immersion. Museum and exhibition studies frequently employ the widely accepted MES framework. It is appropriate for assessing digital and interactive display spaces due to the variety of its features.

The questionnaire comprised structured Likert-scale items measured on a five-point scale (1 = strongly disagree to 5 = strongly agree).

The instrument assessed six key dimensions:

1. Engagement and enjoyment
2. Emotional and meaningful experience
3. Cultural learning and knowledge discovery
4. Immersion and sense of presence
5. Usability and interface interaction
6. Overall satisfaction and behavioural intention

Minor adaptations were made to fit MES items into the context of interactive digital storytelling and an AR-based installation while maintaining their theoretical constructs intact. These modifications ensured content validity in the specific environment of gamified, AR-enriched exhibition interaction.

3.2 Sampling Strategy

A purposive sampling method was used to select participants who lived through the installation. This method guaranteed that the respondents had the necessary experiential background to judge the interactive artwork. Volunteers were recruited from visitors who had completed the installation experience by the time of the exhibition. A total of 15 participants took part in the study. Respondents represented diverse demographic and professional backgrounds, including students, creative practitioners, educators, and members of the general public. The diversity of participants enabled the study to capture multiple perspectives on audience engagement and experiential response. As a pilot study, the sample size is considered appropriate for exploratory evaluation of interactive installations and for testing the applicability of MES within this context. In exhibition and interaction design research, small purposive samples are commonly utilised when participants must have direct experience with a specific artefact or installation. The objective of this phase is to generate preliminary insights rather than achieve statistical generalisation.

3.3 Data Collection Procedure

Data were gathered on-site throughout the public exhibition *Interface: Where Visual Meets Poetry* held at GMBB Kuala Lumpur. Visitors who completed the interactive installation *Kembara Jejak Warisan Kuih Muih* were invited to participate voluntarily in the study, and a questionnaire was administered immediately after participants completed the installation to capture real-time experiential responses. Instant post-experience data collection is widely recommended in museum and exhibition research to minimise the bias and improve response reliability, particularly in measuring emotional and immersive experiences (Falk & Dierking, 2013; Othman et al., 2011). Participants required approximately five to seven minutes to complete the questionnaire. The instrument consisted of Likert-scale items adapted from the Museum Experience Scale (MES) to measure engagement, emotional response, cultural learning, immersion, usability, and overall satisfaction. Structured Likert-scale instruments are frequently used in visitor experience research due to their reliability and ability to capture multifaceted sensory reactions in interactive museum environments (Mahphoth & Khalifah, 2017; Othman et al., 2021). In addition to quantitative items such as ratings, optional open-ended questions were used to capture qualitative feedback on visitors' perceptions, emotional reactions, and improvement suggestions.

In planned exploratory and pilot studies, combining quantitative and qualitative feedback is recommended to supplement experiential response interpretations with context (Creswell & Creswell, 2018) and to enhance the validity of findings. The emphasis in data collection is on generating initial insights into visitor experience rather than statistical generalisation. The collection of pilot-scale data is commonly employed in interactive exhibition and design research to trial instruments, assess prototype installations and ascertain experiential patterns ahead of more extensive implementation (Gray & Malins, 2016).

3.4 Data Analysis

Data were analysed using descriptive statistical methods to identify patterns of visitor engagement and experiential response across the MES assessment. Mean scores and response distributions were calculated to determine overall trends in engagement, immersion, emotional connection, and usability. Qualitative responses were analysed using thematic review to complement quantitative findings and provide contextual insight into visitor perceptions. The analysis focuses on identifying experiential patterns and evaluating the effectiveness of the installation rather than establishing inferential statistical significance. The results provide preliminary empirical evidence to support future expanded studies with larger and more diverse samples.

3.5 Ethical Considerations

All study participants provided voluntary and anonymous consent, were notified of the purpose of the research, and assured that all responses would only be used for scholarly research publications. All data were collected without any personally identifiable information and analysed in aggregated form in accordance with the standard ethical research protocol for art design research.

4. ANALYSIS AND FINDINGS

The findings reveal consistently positive responses across all measured dimensions, indicating strong audience reception towards the gamified and AR-enhanced digital storytelling installation. As a pilot investigation ($n = 15$), the analysis is exploratory, focusing on identifying experiential trends and assessing the potential of interactive digital storytelling as a strategy for engaging audiences with Malaysian traditional *kuih* heritage within a contemporary exhibition context (Podara et al., 2021). Overall, visitor responses demonstrate a high level of engagement and enjoyment when interacting with the installation. Participants reported that integrating gamified elements, such as exploration, discovery, and interactive visual components, enhanced their interest and sustained their attention throughout the experience. The mean scores for enjoyment ($M = 4.73$) and engagement ($M = 4.60$) indicate a strong positive reception among participants in *Figure 2*. The high mean scores suggest that the combination of interactive gameplay and digital storytelling successfully transformed the heritage content into an engaging experiential environment. This aligns with research indicating that gamification enhances motivation, participation, and sustained engagement in cultural and conservation contexts (Wu et al., 2022; Douglas & Brauer, 2020). By embedding playful mechanics within narrative interaction, the installation shifted visitors from passive observers to active participants, reinforcing the participatory nature of contemporary heritage communication (Tzima et al., 2020).

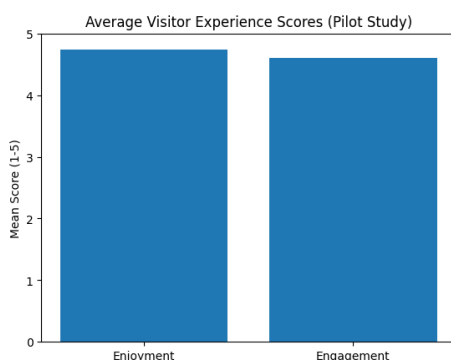


Fig. 2. Average Visitor Experience Scores (Pilot Study)

Source: Hafizah Rosli, 2026

Participants reported meaningful and emotionally engaging experiences when interacting with the installation. Many expressed appreciation, curiosity, and a renewed awareness of Malaysian traditional *kuih* heritage, recommending that the installation incorporate emotional meaning and cultural reflection. The results are consistent with other research showing that digital storytelling improves interpretive depth and emotional involvement in heritage situations (Vrettakis et al., 2019; Podara et al., 2021). The narrative-driven structure of the installation enabled visitors to comprehend traditional *kuih* not as culinary objects, but as cultural symbols embedded with memory and identity. Emotional engagement is recognised as a key element of museum experience and contributes significantly to the memorability and impact of heritage encounters (Othman et al., 2011; Falk, 2022). In this study, emotional responses observed progressively indicate that the integration of a meaningful cultural interpretation was reinforced through narrative and interaction.

The outcomes indicate that visitors develop a cautious understanding of Malaysian traditional *kuih* heritage through interactive exploration. The gamified structure motivates participants to actively discover information rather than passively receive content, supporting experiential learning. This aligns with literature suggesting that gamified environments enhance knowledge retention and intrinsic motivation by embedding learning within interactive tasks (Ng et al., 2025; Tan et al., 2018). The results also support the conceptualisation of gamification as a contemporary conservation method. By transforming cultural narratives into participatory experiences, the installation enabled visitors to construct knowledge through engagement, thereby reinforcing cultural memory and interpretative understanding (Wu et al., 2022). In the context of intangible heritage, such interactive learning is particularly valuable for sustaining awareness and appreciation among digitally oriented audiences (Chang et al., 2025).

The participants stated that they were present and immersed while engaging with the installation and integration of visual storytelling, interactive design, and AR-enhanced content, which contributed to a consistent immersive environment. AR features enabled visitors to visualise digital overlays within the physical exhibition space, enhancing interpretative depth and experiential engagement, and the results align with research showing that AR enhances cognitive, emotional, and behavioural engagement by enabling situated and contextualised interaction (McLean & Wilson, 2019; Gong et al., 2022). Immersive technologies such as AR have been shown to strengthen presence and engagement when integrated with coherent narrative structures (Okanović et al., 2022). In this study, AR functioned effectively as an engagement and visualisation tool, enabling visitors to experience intangible cultural narratives through hybrid physical digital interaction.

Participants generally reported positive usability experiences, indicating that the installation was easy to navigate and interact with. Clear instructions and intuitive interface design supported seamless engagement with the narrative content. Usability is a critical component of visitor experience in technology-enhanced exhibitions, as poorly designed interfaces can disrupt immersion and reduce satisfaction (Othman et al., 2021). The positive usability findings suggest that user-centred design principles were effectively implemented, allowing participants to focus on cultural exploration rather than technical operation. This supports previous research highlighting the importance of interface clarity and accessibility in digital heritage installations (Psomadaki et al., 2019).

According to the findings, gamification may be a useful approach to experience conservation for intangible cultural heritage. By embedding traditional *kuih* narratives into interactive, participatory gameplay, the installation encouraged active cultural engagement and strengthened appreciation for heritage values. This supports scholarship that positions gamification as a tool for enhancing conservation awareness and sustaining cultural memory through experiential interaction (Douglas & Brauer, 2020; Wu et al., 2022). Rather than presenting heritage as static information, the gamified structure framed cultural content as dynamic and participatory, aligning with contemporary approaches to audience-centred heritage communication (Podara et al., 2021). The positive visitor responses indicate that playful engagement can contribute to meaningful heritage interpretation and experiential conservation.

AR interactivity has elevated both audience engagement and visual immersion. Participants appreciated this dynamic visualisation of their narratives, facilitated through digital overlays and animated storytelling. AR allowed visitors to contextualise new, intangible heritage elements and reinforced their interpretive understanding of immersive presence. This aligns with studies that highlight AR as a means of engaging and visualising, and the potential for it to enhance experience depth and visitor satisfaction (Gong et al., 2022; McLean & Wilson, 2019). Placing digital narratives within the physical exhibition space, AR-enabled multisensory interaction enhanced the communicative potential of digital storytelling in heritage contexts (Okanović et al., 2022).

The findings from the pilot demonstrate the potential to embed gamification, Augmented Reality (AR), and digital storytelling in an interactive art installation to foster cultural experiences. The installation demonstrates how the application of play-based interaction and immersive visualisation can renew the presentation of intangible heritage for modern audiences, especially in an urban, digitally oriented context. The findings provide preliminary empirical evidence for a new discourse on the communication of digital heritage, showing that interactive storytelling based on gamification and AR can be more effective at increasing engagement, emotional involvement, and cultural learning (Podara et al., 2021; Wu et al., 2022). MES, as an analytical lens, enhances the examination of how experiential dimensions play out in engaging exhibition settings (Othman et al., 2011).

5. CONCLUSION

This pilot study evaluated the effectiveness of gamified Augmented Reality (AR) digital storytelling in engaging audiences with Malaysian traditional kuih heritage, using the Museum Experience Scale (MES). Findings revealed high levels of enjoyment, engagement, emotional connection, and cultural learning, demonstrating that gamification and AR successfully enhanced visitor experience. This supports gamification as a contemporary conservation method that promotes participatory interaction and experiential learning (Wu et al., 2022; Douglas & Brauer, 2020), and AR as an effective tool for immersion and interpretive understanding (McLean & Wilson, 2019; Gong et al., 2022). The MES proved suitable for evaluating multidimensional visitor experience in interactive digital heritage environments (Othman et al., 2011; Othman et al., 2021). Despite these positive trends, the study's pilot design, modest sample size, and limited exhibition duration mean that the findings are exploratory and context-specific. Future research should involve larger, more diverse participant samples to enhance reliability in statistical analyses and generalizability, incorporating inferential statistical analysis, reliability testing, and comparative exhibition contexts. Nevertheless, these foundational insights highlight the potential of gamified and AR-enhanced digital storytelling as an innovative strategy for engaging audiences with intangible cultural heritage in contemporary exhibition settings. This contributes to digital heritage discourse by emphasising experiential conservation strategies for sustaining cultural memory in technology-mediated environments.

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CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

AUTHORS' CONTRIBUTIONS

Hafizah Rosli (Corresponding Author): Conceptualisation, methodology, augmented reality (AR) development and project supervision. Also, do communication with the journal and ensure the integrity of the final manuscript. Substantially contributed to the conception and design of the work; and the acquisition, exhibition-based data collection, analysis, and interpretation of data. Norfadilah Kamarudin (Co-Author 1): Contribution to development of the paper's content, drafting of the manuscript and critical revision for important intellectual content; member of the grant team. Badrul Isa (Co-Author 2): Contributed as a member of the grant team, which helped develop the paper's content, critically reviewed the manuscript and approved the final version to be published; agrees to be accountable for all aspects of the work. Siti Sarah Mohd Sarif (Co-Author 3): All technical support, data collection, and visualisation for the research.

DECLARATION OF GENERATIVE AI IN THE WRITING PROCESS

During the preparation of this work, the author(s) used ChatGPT and Grammarly in order to support the writing process. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

ETHICS STATEMENT

This study was reviewed and approved by the Institutional Ethics Committee of Universiti Teknologi MARA (Approval No: REC/07/2024 (ST/MR/122)). All procedures involving human participants/animal subjects were in fulfilment of the ethical standards of the 1964 Helsinki Declaration. Informed consent was obtained from all participants, and data anonymity was strictly maintained throughout the study.

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