

Integrating Technology to Enhance Immersive and Inclusive Experiences of Exhibitions: Insights from Expo 2025 in Osaka

Noor Alsafi, Sabah Ebrahim & Layla Ebrahim

University of Bahrain, Bahrain

inoor.alsafi@gmail.com; 202208229@Stu.uob.edu.bh

Layla.emh@gmail.com; 202208921@Stu.uob.edu.bh

Sabahmorning83@gamil.com; 202208526@Stu.uob.edu.bh

Received	Accepted	Published
10.10.2025	28.05.2026	30.06.2026

<https://doi.org/10.61275/ATEj-2026-3-2-2>

Abstract

As technologies such as virtual reality, augmented reality and projection mapping become increasingly common in exhibition environments, concerns have arisen regarding the accessibility and inclusivity of these technologies for users with varying abilities and levels of technological familiarity. It is most relevant in the situations where exhibitions increasingly employ modern technologies. In this context, this study investigates how digital technologies can be integrated into exhibition design to enhance immersive and interactive visitor experiences while maintaining accessibility and inclusivity.

This research employs a mixed-method approach combining an online survey of 57 participants, an interview with a frequent exhibition visitor, and observational analysis of visitor behavior at the Switzerland Pavilion during Expo 2025 in Osaka.

The findings indicate that visitors prefer hybrid experiences that combine physical and digital interactions, and that successful engagements depend on clear interaction design, continuity of experience, sensory balance, and flexible participation opportunities. The study also reveals that technological attractions do not necessarily lead to sustained engagement, and usability alone is insufficient to ensure meaningful participation.

Through triangulation of the collected data, five key spatial insights were identified to inform future exhibition design strategies. The research concludes that technology should be integrated as a supportive spatial and interpretive tool that enhances visitor understanding, movement, and participation rather than functioning as the primary focus of the exhibition experience.

Keywords: Exhibition Design, Interactive Technology, Immersive Experience, Visitor Engagement, Accessibility, Inclusivity, Digital Exhibitions.

Introduction

In recent years, digital technology has become increasingly integrated into contemporary exhibition design, transforming exhibitions from static display environments into immersive and interactive spatial experiences. Visitors are no longer positioned only as passive

observers, but as active participants who engage with exhibition content through interactions, movement, and sensory experience.

Within interior architecture, this transformation has significantly influenced how exhibition spaces are designed and experienced. While digital technologies have expanded opportunities for participation and experiential storytelling, their increasing complexity introduces challenges related to accessibility, usability, and user comfort. Visitors with limited technological familiarity or sensory sensitivities may experience difficulty navigating highly immersive environments, creating a growing need for exhibition designs that balance engagement with inclusivity.

Although existing studies extensively explore digital engagement and immersive interaction within exhibition spaces, comparatively less attention is given to how these environments accommodate diverse visitor needs and varying levels of technological familiarity. Existing literature frequently prioritizes technological innovation and experiential impact, while limited research investigates accessibility, sensory comfort, and adaptive interaction strategies within exhibition environments.

Therefore, this study investigates how digital technologies can enhance exhibition experiences while remaining accessible and inclusive for diverse users. In this context, the aim of this study is to investigate how digital technologies can be integrated into exhibition design to support immersive and interactive experiences while maintaining accessibility and inclusivity within exhibition environments.

The specific objectives are:

- (1) To identify the ways in which visitors interact with technology-integrated exhibition environments.
- (2) To identify user preferences toward immersive and interactive technologies.
- (3) To identify accessibility and usability challenges within exhibition spaces.
- (4) To develop spatial insights for more inclusive exhibition design.

Theoretical Framework

This research draws on theoretical perspectives that examine the relationship between technology, visitor experience, and inclusive exhibition design. These include Interactive Experience Theory, Immersion Theory, and Inclusive Design Theory, which help explain how digital technologies influence visitor engagement, participation, and accessibility within exhibition environments.

Interactive Design Theory

Interactive design theory focuses on creating meaningful exchanges between users and their environment through active participation rather than passive observation. In exhibition design, interaction allows visitors to engage directly with content through physical actions such as touch, movement, gesture, or digital input. As exhibition spaces increasingly incorporate digital technologies, visitors are no longer positioned solely as observers but as participants who can influence and respond to exhibition content. This shift changes the role of exhibitions from information delivery environments to experience-driven spaces that encourage engagement and participation (Zhong & Kluensuwan, 2024). Therefore, interaction is understood as a dynamic relationship between the visitor, the exhibition environment, and the information being communicated.

Immersion Theory

Immersion theory explains how environments can capture and sustain users' attention by creating a strong sense of presence and involvement. Immersive experiences are often achieved through the integration of multiple sensory elements such as visuals, sound, spatial effects, and interactive technologies. Within exhibition environments, technologies such as virtual reality, augmented reality, projection mapping, and multimedia installations are commonly used to create immersive experiences that strengthen emotional engagement and understanding (He &

Kosenko, 2025). However, immersion is not solely dependent on technological complexity. Effective immersive environments require a balance between sensory stimulation and clarity, as excessive technological input can increase cognitive load and reduce visitors' ability to interpret information effectively (He & Kosenko, 2025).

User-Centered and Inclusive Design Theory

User-centered design theory emphasizes designing environments around users' needs, abilities, and expectations rather than around technology itself. The primary objective is to ensure that interactions are intuitive, understandable, and meaningful for diverse audiences. Within exhibition design, this approach becomes increasingly important as technological systems introduce varying levels of complexity. Inclusive design extends this principle by ensuring that exhibition environments remain accessible to visitors with different levels of technological familiarity, physical ability, and sensory sensitivity. Consequently, accessibility and inclusivity are considered essential components of successful interactive exhibition design, ensuring that engagement opportunities are available to the widest possible range of users (Qi & Wang, 2025; He & Kosenko, 2025).

These theoretical ideas provide a potent framework to conceptualize, gather data and interpret the findings of this research.

Review of Literature

Scholars increasingly recognize digital technologies as a significant force shaping contemporary exhibition environments. Existing research has examined how these technologies influence exhibition design, the challenges associated with their implementation, and their impact on visitor interaction and engagement.

Design Strategies for Hybrid Exhibition Spaces

Current literature suggests that the integration of digital technologies requires a shift away from traditional static displays toward hybrid exhibition environments where physical space and digital information are combined. Zhong and Kluensuwan (2024) describe this transformation as intelligent interactive design, in which exhibition spaces function as responsive environments that allow visitors to actively influence exhibition conditions rather than passively observe content. Similarly, Qi and Wang (2025) propose the FRACH framework as a systematic approach for integrating immersive technologies such as VR, AR, and 3D reconstruction. According to their model, technologies should support narrative communication and visitor engagement rather than functioning as isolated digital attractions. He and Kosenko (2025) further argue that digital technologies fundamentally reshape the relationship between spatial design, artistic content, and visitor experience.

While all three studies advocate for the integration of digital technologies within exhibition spaces, they differ in their emphasis. Zhong and Kluensuwan (2024) focus on interaction and responsiveness, Qi and Wang (2025) focus on structured technological frameworks, and He and Kosenko (2025) focus on the experiential relationship between technology and visitors. Despite these differences, all studies assume that technology can positively enhance visitor experience when integrated into the spatial environment. However, they provide limited discussion regarding how different users navigate these technologically enhanced environments, particularly those with diverse backgrounds, abilities, and levels of experience.

Challenges and Limitations of Digital Integration

Despite their potential benefits, digital technologies also introduce several challenges. One major concern is technological dominance, where the visual appeal of technology overshadows the educational or cultural content of the exhibition (He and Kosenko, 2025). Additional challenges include accessibility barriers, technological obsolescence, financial constraints, and cognitive overload. He and Kosenko (2025) warn that excessive reliance on immersive technologies can overwhelm visitors and reduce interpretive clarity. Qi and Wang

(2025) similarly emphasize the importance of user-centered design strategies that balance technological innovation with visitor comfort and understanding.

Although these studies acknowledge the limitations of digital integration, most discussions remain largely conceptual. The literature identifies sensory overload and accessibility barriers as potential concerns, yet provides limited empirical evidence regarding how visitors experience these challenges within exhibition environments. Collectively, these findings indicate that technological innovation alone cannot guarantee meaningful exhibition experiences and must be balanced with usability, interpretive clarity, and visitor needs.

Fostering Meaningful Visitor Interaction and Engagement

A recurring theme within the literature is the transformation of visitors from passive observers into active participants. Zhong and Kluensuwan (2024) describe this process as cognitive interaction, where visitors engage intellectually and emotionally through interaction with responsive environments. Qi and Wang (2025) expand this perspective by emphasizing collaborative interaction, arguing that immersive technologies should encourage social engagement rather than isolating users within individual experiences. He and Kosenko (2025) similarly suggest that digital exhibitions succeed when technologies strengthen the relationship between visitors, exhibition content, and the exhibition environment.

Although these studies agree that participation is central to successful exhibition experiences, they focus primarily on the benefits of interaction and provide limited discussion regarding why some users choose not to participate. Furthermore, engagement is often treated as an outcome of interaction rather than being examined as a more complex process influenced by clarity, accessibility, confidence, and perceived value. This highlights the need to investigate visitor experiences directly in order to understand the factors that encourage or discourage participation within interactive exhibition environments.

Summary - Research Gap

The literature demonstrates that digital technologies have significant potential to enhance visitor engagement, immersion, and interaction within exhibition environments. However, existing studies focus primarily on technological innovation and conceptual frameworks while providing limited insight into how users experience these environments in practice. In particular, there is insufficient understanding of how immersive and interactive exhibition spaces can balance engagement with accessibility and inclusivity for users with varying levels of technological familiarity, confidence, and ability. Therefore, this study investigates how technology can be integrated into exhibition design in a way that enhances immersive and interactive experiences while maintaining accessibility and inclusivity for diverse users.

Research Methodology

This study adopted a mixed-method research approach to investigate how digital technologies can enhance immersive and interactive exhibition experiences while maintaining accessibility and inclusivity. Combining quantitative and qualitative methods enabled the collection of both measurable data and in-depth insights into visitor preferences, experiences, and behaviors. Data were collected through three primary methods: a questionnaire survey, a semi-structured interview, and observational analysis.

Questionnaire Survey

A questionnaire survey was conducted to explore visitors' perceptions, preferences, and experiences regarding technology-integrated exhibition environments. The survey was distributed online and received responses from 57 participants. Questions focused on visitors' experiences with immersive technologies, interaction preferences, accessibility considerations, and perceptions of technology within exhibition spaces. Responses were later analyzed using descriptive statistics, percentages, and frequency distributions to identify common patterns and trends among participants.

Interview

An interview was conducted with a frequent exhibition visitor to obtain more detailed insights into experiences that could not be captured through the survey responses alone. The interview explored topics related to engagement, usability, accessibility, immersive technologies, and factors influencing participation within exhibition environments. The semi-structured format allowed the participant to discuss personal experiences freely while ensuring that key research topics were consistently addressed. The interview was recorded, transcribed, and reviewed to identify recurring themes and observations relevant to the research objectives.

Observations

An observational study was conducted using the Switzerland Pavilion at Expo 2025 Osaka as a case study. The pavilion was selected because of its extensive use of immersive and interactive technologies within a contemporary exhibition environment. Observation was guided by the AEIOU framework (Fig.10-10, which examines Activities, Environment, Interactions, Objects, and Users. Notes were recorded regarding visitor movement, interaction patterns, engagement levels, technological features, and spatial organization. The observation provided direct evidence of how visitors interacted with technology-integrated exhibition environments in practice.

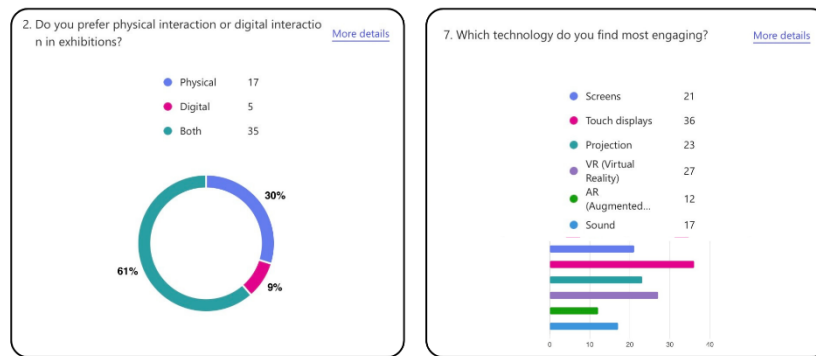


Fig.1: Preference For Interaction **Fig.2: Most Engaging Technology Type**
Source: Research Data

Data Collection

Data were collected through an online survey, a semi-structured interview, and direct observation. The combination of these methods enabled methodological triangulation, allowing findings from different sources to be compared and cross-validated. This approach strengthened the reliability of the research and provided a comprehensive understanding of the relationship between technology, visitor experience, accessibility, and inclusivity within exhibition environments.

Findings and Analysis

The findings presented in this section are derived from the survey, interview, and observational analysis. The results are analyzed in relation to the literature reviewed in this study to identify patterns concerning immersive, interactive, and inclusive exhibition experiences.

Survey

The survey findings provide insight into visitors' preferences and perceptions regarding technology-integrated exhibition environments. Analysis of the responses revealed recurring patterns related to hybrid interaction, engagement, participation, usability, and accessibility

Preference for Hybrid Interaction

The survey findings indicate a strong preference for hybrid exhibition experiences that combine both physical and digital forms of interactions. A total of 61% of the respondents preferred exhibition environments that integrate physical and digital experiences, demonstrating a clear preference for hybrid interactions over fully digital experiences (Fig.1). Touch-based technologies received the highest engagement (36 responses), followed by virtual reality (27 responses) and projection-based systems (23 responses) (Fig.2). These findings suggest that visitors value immersive technologies when they complement the physical exhibition experience rather than replace it. This finding supports Zhong and Kluensuwan (2024), that digital technologies should be integrated into the spatial experience rather than treated as separate elements. Similarly, Qi and Wang (2025) emphasize that meaningful interactions emerge when physical actions are directly connected to digital responses.

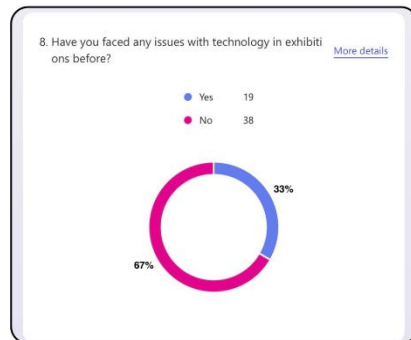


Fig.3: User Behavior

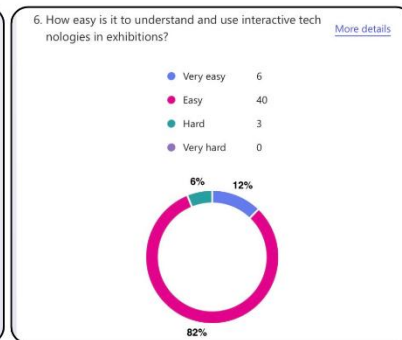


Fig.4: Ignoring Technology

Source: Research Data

Engagement and Participation

The survey results reveal that 56% of the respondents were interested and 21% were excited when interacting with exhibition technologies, while 23% reported feeling neutral or bored. This indicates that technological interactions alone does not guarantee engagement. Rather, engagement appears to depend on the quality and structure of the experience itself. Visitors are more likely to remain engaged when interactions encourage participation, exploration, and active involvement. This finding supports Qi and Wang (2025), who argue that immersive experiences require carefully structured interactions that sustain visitor interest throughout the exhibition journey.

Barriers to Interaction

Although 81% of respondents indicated a willingness to try interactive technologies (Fig.3-10), participation was often limited by practical barriers. The most common reasons for avoiding interaction were excessive time requirements (41%), unclear instructions (27%), and lack of interest (27%) (Fig.4).

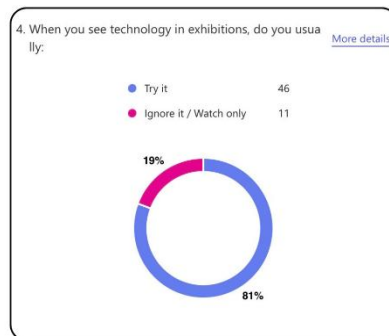


Fig.5: Technical Issues

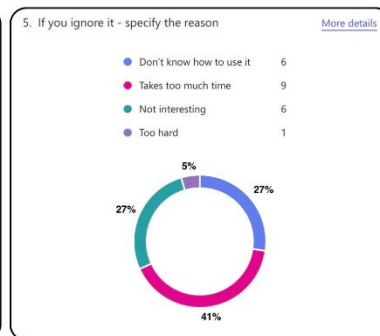


Fig.6: Ease of Use

Source: Research data

These findings reveal a gap between attraction and participation. Visitors may initially approach an installation but choose not to engage when interaction appears complicated, time-consuming, or difficult to understand. This finding supports Zhong and Kluensuwan (2024) and Qi and Wang (2025), who emphasize that clarity, efficiency, and intuitive interaction are critical factors influencing visitor participation within technology-integrated exhibition environments.

Usability and Meaningful Engagement

The survey showed that 82% of respondents considered exhibition technologies easy to use (Fig.6). However, despite this high usability rating, 19% still chose not to engage with interactive technologies (Fig.3). This suggests that usability alone is insufficient to encourage participation. While ease of use may remove barriers to interaction, meaningful engagement appears to depend on whether visitors perceive value, relevance, or enjoyment in the experience itself. This finding aligns with He and Kosenko (2025), who argue that visitor engagement depends on meaningful interaction rather than technological functionality alone. Therefore, exhibition technologies should be designed to create memorable and purposeful experiences rather than simply providing accessible interfaces.

Accessibility and Reliability

Accessibility emerged as another significant finding. A total of 58% of respondents believed that some users may struggle with interactive technologies (Fig.7) , particularly individuals with limited technological familiarity. In addition, 33% of respondents reported experiencing technical issues while interacting with exhibition technologies (Fig.5-10). These findings highlight concerns regarding both accessibility and reliability within immersive exhibition environments. This supports He and Kosenko (2025), who identify technological barriers as a major challenge in technology-integrated exhibitions. Consequently, exhibition designers should provide alternative methods of interaction and interpretation to ensure that engagement opportunities remain accessible to a diverse range of users.

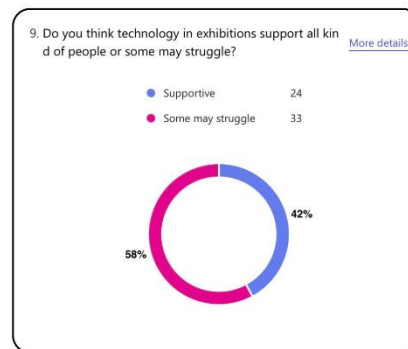


Fig.7: Inclusivity
Source: Research Data

Interview

Interview responses were analyzed using an Empathy Map (Fig.8) by categorizing the participant's responses into what she says, thinks, feels, and does in order to identify recurring motivations, concerns, behaviors, and perceptions related to technology-integrated exhibition experiences. Through coding and thematic analysis, four key themes emerged: engagement, clarity, sensory balance, and inclusivity.

SAYS • Prefers interactive exhibitions over passive displays • "It creates a more personalized and exciting experience" • Interaction should be easy, quick, and accessible • Crowding affects willingness to interact • Technology is generally easy but sometimes needs guidance • Some people may struggle if not familiar with technology • Too much technology can be overwhelming • Prefers a balance between physical and digital	THINKS • Evaluates whether interaction is worth the time • Expects systems to be intuitive without effort • Believes exhibitions should be inclusive for all users • Sees value in personal contribution (co-creation) • Thinks balance is important to avoid overload
FEELS • Excited when interacting with immersive environments • Proud when her work becomes part of the exhibition • Engaged when experience feels personal • Frustrated by crowding or complexity • Comfortable when interaction is smooth and guided	DOES • Actively participates in interactive installations • Creates and contributes content (e.g., drawings displayed) • Avoids crowded or confusing interactions • Relies on visual cues or staff when needed • Moves efficiently through spaces without spending too long in one spot

Fig.8: Empathy Map
Source: Research Data

Theme 1: Engagement Through Participation

The participant expressed a clear preference for interactive exhibition experiences that allow visitors to actively contribute rather than simply observe. A particularly memorable experience involved creating content that became part of the exhibition itself, generating a stronger sense of personal involvement and emotional connection. This suggests that participation enhances engagement by allowing visitors to influence the exhibition experience. This finding supports Zhong and Kluensuwan (2024), who describe interactive environments as systems that encourage active visitor involvement.

Theme 2: Clarity and Time Efficiency

The participant repeatedly emphasized that interactions should be easy to understand and quick to complete. She noted that visitors are unlikely to spend excessive time at a single installation and are more likely to engage when interactions require minimal effort. This aligns with Zhong and Kluensuwan (2024), who identify simplicity and efficiency as important factors influencing participation. The findings indicate that complexity can discourage engagement even when visitors are interested in the experience.

Theme 3: Sensory Balance and Overload

Although the participant enjoyed immersive environments, she expressed concern about exhibitions that rely excessively on technology. She believed that technology should be balanced with physical displays to prevent visitors from becoming overwhelmed. This supports He and Kosenko (2025), who identify sensory overload as a key challenge within immersive exhibition environments. The findings suggest that immersive technologies are most effective when they complement rather than dominate the experience.

Theme 4: Inclusivity and User Differences

The participant acknowledged that some visitors may struggle with exhibition technologies due to limited familiarity. This finding highlights the importance of inclusive design strategies that accommodate users with varying abilities, backgrounds, and levels of technological experience. Qi and Wang (2025) argue that interactive environments should be designed to support visitors with diverse levels of ability and technological literacy. The interview therefore highlights the need for flexible interaction systems that support different types of users.

Observations

AEIOU Framework

Element	Guiding Question	Observation Example
A-Activity	what are users doing?	1. Users walk through sequential spaces 2. Stop briefly at interactive points 3. Observe before interacting
E-Environment	What are the physical conditions?	1. Controlled lighting 2. Enclosed immersive spaces 3. Digital projections + screens
I-Interactions	How do users interact with people and space?	1. Touch-based interaction 2. Observation before participation 3. Hesitation at unclear interfaces
O-Objects	What tools or elements are used?	1. Screens, projections 2. Interactive surfaces 3. Digital displays
U-Users	Who are the users?	1. Mixed engagement levels 2. Some active, some passive 3. Different familiarity with technology

Fig.9: AEIOU Observation Table

Activities

Visitors engaged in a variety of interactive activities, including voice input, face scanning, touchscreen interaction, QR-code scanning, and participation in AI-generated experiences. These activities required active involvement rather than passive observation, encouraging visitors to engage directly with exhibition content.

Environment

The exhibition environment combined immersive technologies with controlled lighting and multimedia displays to create a highly engaging atmosphere. Bilingual instructions were provided throughout the exhibition; however, limited tactile elements and the absence of dedicated quiet spaces may have reduced accessibility for some users.

Interactions

Visitors interacted with both technological systems and other visitors. Observation showed that many visitors paused at interactive installations, observed the outcomes of their actions, and frequently shared experiences through discussion, photography, and video recording.

Objects

The primary objects of interaction included touchscreens, AI-generated displays, projection systems, face-scanning stations, voice-input interfaces, and phygital installations. These elements acted as the main points of engagement throughout the visitor journey.

Users

Different user groups demonstrated different levels of confidence and participation. Younger visitors generally engaged immediately with the technologies, while older visitors often spent more time observing before interacting. This suggests that technological familiarity influences participation behavior.

Behavioral Insight 1: Visitors Prefer Active Physical Participation

Observation showed that visitors were more likely to engage with installations that required physical action, such as touching, speaking, or moving within the space. Interactions that involved direct participation attracted more attention and sustained engagement than passive viewing alone. This suggests that visitors value experiences where they can actively influence what happens around them rather than simply consume information. This supports Zhong and Kluensuwan (2024) and Qi and Wang (2025), who argue that digital technologies are most effective when integrated with physical interaction. The findings indicate that meaningful engagement is strengthened when digital experiences are anchored in physical actions.

Behavioral Insight 2: Engagement is Shaped by Movement Through the Space

Observation revealed that visitors frequently slowed down and gathered around interactive installations. While these installations successfully attracted attention, engagement often occurred in short, isolated moments before visitors continued moving through the exhibition. Younger visitors generally transitioned between interactions more quickly, while older visitors tended to observe before participating. This suggests that visitor engagement is influenced not only by individual installations but also by how interactions are connected throughout the spatial journey. This supports Qi and Wang (2025), who emphasize the importance of continuous and structured experiences within immersive environments. The findings indicate that engagement is strengthened when interactions are integrated into the overall visitor journey rather than functioning as isolated points of attraction.

Behavioral Insight 3: Participation Depends on Accessible and Understandable Interaction

Observation showed that visitors were more likely to engage when interactions were intuitive, clearly communicated, and required minimal effort. Some visitors interacted immediately, while others hesitated, observed first, or required additional time before participating. These differences suggest that both clarity and technological confidence influence participation. When instructions or entry points were unclear, hesitation increased, particularly among users who appeared less familiar with the technology. This supports Zhong and Kluensuwan (2024) and Qi and Wang (2025), who emphasize usability and inclusive design as key factors in successful interactive environments. The findings indicate that participation increases when interactions are easy to understand and offer different levels of support for users with varying levels of confidence and experience.

Behavioral Insight 4: Sensory Conditions Influence Navigation

The immersive environment successfully directed attention toward digital content through controlled lighting and multimedia effects. However, reduced lighting also made navigation less intuitive, causing visitors to rely on screens rather than spatial cues for orientation. This supports He and Kosenko (2025), who identify excessive sensory stimulation as a factor that can reduce spatial understanding. The findings suggest that immersion and orientation must be carefully balanced within exhibition environments.

Discussion (Triangulation)

Integrated Insight	Survey	Interview	Observation
1. Interaction must be physically grounded	Majority of users (61%) prefer hybrid interaction combining physical and digital elements	The participant associates engagement with active, physical involvement rather than passive viewing	Users engage more when interaction involves direct physical action rather than observation
2. Engagement depends on continuity	23% of users report boredom despite the presence of interaction	The participant loses interest when the experience feels disconnected or not worth the time	Interactions are often isolated points rather than part of a continuous journey
3. Clarity and speed affect participation	41% avoid interaction because it takes too long, and 27% because it is unclear	The participant emphasizes that interactions must be quick and easy to understand	Hesitation is observed when users are unsure how the system works
4. Sensory intensity must be controlled	Users show varied responses to immersive environments	The participant mentions that some experiences can feel overwhelming	Highly immersive environments can lead to passive behaviour instead of active engagement
5. Inclusivity requires flexible interaction	58% believe some users may struggle with technology	The participant highlights differences in user comfort and familiarity	Different engagement patterns are observed across users, with some interacting immediately and others hesitating

Fig.10: Triangulation Table

The triangulation process integrated findings from the survey, interview, and observation to identify recurring patterns and relationships. By comparing findings across multiple methods (Fig.10-10), stronger conclusions can be drawn regarding how technology should be integrated within exhibition environments.

Integrated Insight 1: Interaction Must Be Physically Grounded

Across all three methods, users consistently demonstrated a preference for interactions that combine physical action with digital feedback. Survey respondents preferred hybrid experiences, the interview participant valued active participation, and observation showed higher engagement when visitors could directly influence the environment. These findings support Zhong and Kluensuwan (2024) and Qi and Wang (2025), who argue that digital technologies are most effective when embedded within the physical exhibition experience rather than functioning independently.

Integrated Insight 2: Engagement Depends on Continuity Rather Than Isolated Interaction

Survey findings revealed that a significant proportion of users remained neutral or bored despite the presence of interactive technologies. The interview participant emphasized that experiences must feel worthwhile, while observation showed that many interactions functioned as isolated moments rather than connected experiences. Together, these findings suggest that engagement is sustained when interactions are integrated into a continuous spatial and narrative journey. This aligns with Qi and Wang (2025) who emphasize the importance of structured interaction sequences in immersive environments.

Integrated Insight 3: Clarity and Speed Directly Affect Participation

All three methods identified clarity and efficiency as major factors influencing engagement. Survey respondents frequently avoided interactions that appeared unclear or time-consuming. Similarly, the interview participant preferred interactions that were quick and easy to understand, while observation revealed hesitation before participation when instructions were unclear. These findings support Zhong and Kluensuwan (2024) who identify clarity as a critical determinant of user engagement.

Integrated Insight 4: Sensory Intensity Must Be Controlled

The survey, interview, and observation collectively highlighted the importance of balancing immersion with comfort. While immersive technologies successfully attract attention, excessive visual and sensory stimulation can overwhelm users and reduce participation. This finding supports He and Kosenko (2025), who argue that immersive technologies can become counterproductive when sensory intensity exceeds users' cognitive capacity. Therefore, immersive environments should balance stimulation with moments of clarity and orientation.

Integrated Insight 5: Inclusivity Requires Flexible Interaction

Across all methods, differences in user confidence, technological familiarity, and participation levels were consistently observed. Survey respondents acknowledged that some users may struggle with technology, the interview participant highlighted varying levels of familiarity, and observation revealed differences in engagement behavior. Together, these findings suggest that interactive exhibitions should not assume a single type of user. Instead, interactions should provide multiple levels of engagement, allowing visitors to participate according to their abilities, confidence, and preferences.

Patterns and Relationships Across Findings

Several relationships emerged across the findings. First, users consistently preferred experiences that combined physical interaction with digital feedback, highlighting the value of hybrid exhibition environments. Second, meaningful engagement was influenced by the continuity and structure of the visitor experience rather than by isolated interactions alone. Third, participation was strongly affected by clarity, speed, and ease of interaction, with visitors showing greater willingness to engage when interactions were intuitive and efficient. Fourth, immersive technologies successfully attracted attention but required careful control of sensory intensity to avoid overwhelming users. Finally, inclusivity emerged as a recurring concern across all methods, emphasizing the need for exhibition environments that accommodate diverse user abilities, preferences, and levels of technological familiarity.

Overall, the triangulation findings demonstrate that successful exhibition experiences are shaped less by technological sophistication and more by the quality of interaction they provide. Across all three methods, visitors consistently valued experiences that were physically engaging, easy to understand, inclusive, and meaningfully connected to the exhibition narrative. These findings suggest that technology should function as a tool that supports participation, interpretation, and accessibility rather than acting as the primary attraction within the exhibition environment.

Conclusions

As exhibition environments become increasingly dependent on digital technologies, the challenge is how to integrate technology in a way that supports storytelling, complements the physical experience, and remains accessible to a wide range of visitors without creating sensory overload. The findings of this research demonstrate that technological innovation alone is insufficient to create successful exhibition environments. Instead, the value of technology lies in its ability to support participation, understanding, and accessibility while remaining integrated within the spatial experience.

The study found that visitors do not seek technology for its own sake. Rather, they value experiences that are intuitive, engaging, inclusive, and connected to the overall exhibition journey. When technology dominates the environment, it risks becoming a distraction; when thoughtfully integrated, it becomes a powerful tool for communication, interaction, and interpretation.

From an interior architecture perspective, these findings reinforce the idea that technology could and should be considered a spatial design tool rather than a standalone feature. Its success depends on how effectively it works with movements, narratives, sensorial conditions, and user needs to create meaningful experiences for diverse audiences.

However, the future of exhibition design lies not in creating more technological environments, but in creating better human experiences through technologies. By prioritizing participation, inclusivity, and spatial integration, exhibition designers can develop environments that are immersive without being overwhelming, interactive without being complicated, and innovative without losing sight of the visitor.

Acknowledgements: This research paper is an outcome of the final research achievement of our studio work. We would like to express our sincere gratitude to the visitors to Osaka Museum whose generous support enabled the research to be carried out.

Contributions of the Authors: All the others conceptualized the research as a part of a course of studies in Interior Architecture program at the University of Bahrain, Bahrain. Dr. Hawraa Alshaik supervised the research while Noor Alsafi, Sabah Ebrahim & Layla Ebrahim collected information during their vacation and wrote the paper.

Conflict of Interest: The authors declare that there are no conflicts of interest regarding the research and publication of this paper.

Ethical Research Practice: This study strictly follows standard ethical research guidelines.

Availability of Data:

This paper presents only some of the data produced through this research. However, most of the data generated through this research is available for scrutiny and can be provided upon request.

References

- He, Q. and Kosenko, D.Y. (2025) 'Digital technologies in exhibition spaces: transforming artistry and visitor experience', *Theory and Practice of Design*, (35). Available at: <https://doi.org/10.32782/2415-8151.2025.35.46>
- Qi, Y. and Wang, Y. (2025) 'A framework for designing, developing, and evaluating immersive and collaborative interactive exhibitions in cultural heritage', *Cognitive Science & Interactive Art Systems*, 1(1). Available at: <https://doi.org/10.37420/j.csias.2025.002>
- Zhong, Z. and Kluensuwan, P. (2024) 'Understanding the sociocultural impact of intelligent interactive exhibition design on visitor experience', *Pakistan Journal of Life and Social Sciences*, 22(1), pp. 2416–2432. Available at: <https://doi.org/10.57239/PJLSS-202422.1.00180>