# Augmenting Heritage: Youth-Driven AR Innovation in Museum Spaces

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**Abstract**

This study explores explores the potential for expanding museum exhibition practices by integrating technically sophisticated and narratively immersive Augmented Reality (AR) content into outdoor museum spaces. Focusing on a case study conducted at the Cheongju National Museum, the project involved the development and implementation of a character-driven, narrative-based AR experience titled *Seokshin Road*, designed to resonate with the cultural sensibilities and immersive preferences of visitors in their teens and twenties. The content utilizes Visual Positioning System (VPS) technology and a web-based AR platform to enhance spatial accuracy and accessibility. Through emotionally engaging character design and mission-based spatial navigation, the experience fosters active visitor participation. The system also includes an administrative interface that enables real-time feedback collection and user data analysis, supporting sustainable content management. As an example of transforming the museum environment into a narrative interface, this study empirically demonstrates how AR technology can deepen emotional engagement and interactivity in cultural heritage experiences. It further provides practical insights into visitor experience design and digital content strategies for cultural institutions.

## 1. Introduction

Contemporary museums are undergoing a significant transformation, shifting from traditional display-oriented exhibitions to interactive experiences that foster active visitor participation and emotional engagement. Among emerging technologies, Augmented Reality (AR) has garnered increasing attention for its capacity to enrich visitor interaction by superimposing digital content onto physical artifacts, thereby deepening understanding and enhancing experiential immersion. Despite its potential, the majority of museum exhibitions still rely heavily on static visual presentations, limiting opportunities for meaningful, participatory engagement.

This study addresses this gap by designing and implementing a participatory AR experience titled *Seokshin Road (‘Seokshin’ means ‘a deity made of stone’)*, situated in the outdoor stone artifact garden of the Cheongju National Museum. The project aims to revitalize museum engagement and reinterpret cultural heritage through immersive, interactive storytelling. A particular focus is placed on involving younger generations by integrating their cultural sensibilities and media preferences into the content development process. Through direct participation in planning and design, this study proposes a novel model of exhibition-making that resonates with the expectations of digital-native audiences and reflects the evolving role of museums in the 21st century.

## 2. Literature Review

Traditional museums primarily employed a unidirectional approach to education, transmitting knowledge passively from the institution to visitors. Contemporary museums, however, increasingly adopt a participatory model in which visitors actively create, share, and connect with museum content. Nina Simon's (2010) theory of the participatory museum underscores the necessity for museums to become platforms that accommodate visitors’ opinions and experiences, emphasizing co-creation rather than one-way dissemination of information.

According to Hein(2000)'s constructivist theory, knowledge emerges from individuals actively interpreting, understanding, and attributing meaning to their experiences within specific contexts. Learning, therefore, is not merely about acquiring objective knowledge, but involves constructing contextualized and situated knowledge through dialogue and collaboration among individuals. Consequently, education should move beyond neutral and value-free presentations, instead opening multiple perspectives and enabling learners to view the world through diverse viewpoints. Museums, through the exhibition of numerous artifacts, inherently present diversified historical and cultural narratives. Thus, adopting a dialogue-centered participatory educational approach informed by constructivist perspectives is likely to enhance museums' educational efficacy.

Augmented Reality (AR) is a graphical technique that overlays virtual 3D objects or diverse 2D informational elements onto real-world environments, creating the illusion that virtual information exists alongside physical reality. AR is characterized by five key attributes: interactivity, realism, immersion, engagement, and comprehensibility (Azuma et al., 2022). The application of AR in museum exhibitions extends beyond simple visual information delivery, evolving toward integrative approaches that combine storytelling with spatial interaction to facilitate a contextual understanding of cultural heritage. For example, the National Museum of Korean Contemporary History employed AR technology as a means to address identified problems in permanent exhibitions by analyzing exhibits, media, interpretive services, and experiential elements. Focusing on the experiential nature of AR, the museum aimed to foster interactive communication between visitors and exhibits (Lee, Jong Ki, 2016). Additionally, a case study on the Suwon Museum of Art’s digital convergence content, "Digital Walking Art Forest," proposed space-based storytelling and media interaction strategies to induce

immersive spatial experiences for visitors. This study explored the educational and artistic potential of digital exhibitions by integrating narrative structures with the physical environment, visitor pathways, and VR/AR interface design (Byun, Min Ju, 2021). Further, research has also explored AR applications designed to enable visually impaired visitors to understand and enjoy cultural heritage. For instance, one study introduced a learning system integrating AR technology by employing 3D-printed royal paintings and adapting web-based AR instructional methods for visually impaired and blind learners (Won Hae-yeon & Yu Jung-min, 2020).

Previous domestic and international studies affirm that AR-based museum content positively influences museum visitation by enhancing immersion and understanding of exhibitions. Moreover, AR fosters multifaceted museum experiences, encouraging visitors to explore cultural heritage and the museum environment interactively. However, there remains limited empirical exploration of content explicitly planned around youth participation in actual museum settings. Therefore, the current study examines the practical feasibility and potential outcomes of youth-centered participatory AR content development.

## 3. Research Methods and Design

### 3.1 Rethinking the Site Through Participation

The focus of this study is the newly established Outdoor Stone Artifact Garden at the Cheongju National Museum, which opened to the public in July 2023. This garden features approximately 210 stone relics dating from the Joseon Dynasty to the modern era, many of which were donated as part of the "Lee Kun-hee Collection" by the late chairman of Samsung and his family. After undergoing registration and conservation treatment, these artifacts were displayed in a naturalistic outdoor setting designed to encourage new modes of visitor engagement.

The garden includes various symbolic and functional stone sculptures such as muninseok (scholar statues), dongjaseok (child statues), jangseung (village guardian totems), and stone lanterns. These artifacts vary widely in material—granite, marble, basalt—and in size, from towering 3.5-meter statues to figures less than a meter tall. Spanning approximately 66,115 square meters, the garden is ten times the size of the museum’s original exhibition space, thereby functioning as an expansive open-air museum.[1]

Figure 1. Outdoor Stone Sculpture Garden

By integrating the artifacts into a natural landscape, the museum sought to move beyond traditional, static indoor exhibitions and promote an exploratory and autonomous form of visitor engagement in an outdoor context. However, initial observations revealed that many visitors treated the space as a casual walking path, failing to recognize the cultural significance of the artifacts, despite the presence of signage and interpretive panels. In some cases, uneven terrain further hindered access and disrupted visitors’ spatial immersion.

These findings underscored the need for new interpretive content that would not merely convey information but also facilitate emotional resonance and active participation. In particular, digital, experience-driven content emerged as a promising solution, especially for younger audiences who are adept with mobile devices and highly responsive to visual culture and character-based storytelling.

Accordingly, this project targeted audiences in their teens and twenties—groups typically underrepresented in museum attendance but crucial to future audience development. The museum collaborated with nine undergraduate students from the Department of Archaeology and Art History at Chungbuk National University to co-design the content. The students drew inspiration from the original spiritual functions of the stone relics—many of which were guardians placed at tombs or village entrances—and reimagined them as contemporary “guardian spirits” (*seokshin*) that align with the emotional sensibilities of today’s youth.

In recent Korean youth culture, character-based *bujeok* (talisman charms) featuring messages of encouragement, hope, and healing have gained popularity. These items are aesthetically appealing and resonate with emotions such as cuteness, warmth, and personal aspiration. By linking these contemporary motifs with historical artifacts, the student collaborators established a conceptual framework that blends heritage interpretation with emotionally engaging visual language.[2]

The key design values that emerged from the planning workshops included “cool,” “fun,” “authenticity,” “personalization,” and “healing.” These values guided the development of AR experiences that emphasized emotional immersion and user agency. By recontextualizing heritage objects from the visitor’s perspective, the project exemplifies a shift from expert-led interpretation toward user-centered experience design. It also demonstrates the potential for museums to evolve into participatory interpretive spaces that integrate cultural empathy and digital interaction.(Hooper-Greenhill, E., 2000)

| Keyword | Description |
|---|---|
| Cool<br>Fun<br>Authenticity<br>Personalization<br>Healing | · To facilitate meaningful engagement through direct, hands-on interaction<br>· To enhance immersion via AR-based interactive experiences<br>· To provide emotionally restorative content integrated with natural outdoor environments<br>· To encourage visitor co-creation by positioning them as active agents in the experience<br>· To incorporate personalization through matching visitors with contextually relevant guardian figures |

[1] *JoongAng Ilbo*, 2023. ‘Tenfold Expansion of Cheongju Museum: Outdoor Stone Garden Transformed by Lee Kun-hee’s Donation’. https://www.joongang.co.kr/article/25183581.

[2] Civic News, 2023. ‘Young Generation Falls for ‘Charm Characters’ Filled with Encouragement and Empathy’, http://www.civicnews.com/news/articleView.html?idxno=35373

| | |
|---|---|
| | · To employ collectible merchandise as a strategy for extended engagement and promotion |

Table. 1. Ideation and Concept Development with Chungbuk National University Students

### 3.2 Designing a Mission-Based, Experiential Journey

A central component of the project’s conceptual framework was the design of a mission-based experiential journey that shifted the role of visitors from passive observers to active participants within the museum space. Rather than presenting information through static displays, *Seokshin Road* adopted an interactive model in which audiences physically navigated the museum’s outdoor stone garden, uncovering spatial narratives, solving missions, and engaging directly with augmented content. This approach aimed not only to enhance engagement but also to stimulate cognitive and emotional interaction with cultural artifacts.

The AR journey commenced at the entrance of the exhibition garden, where visitors encountered an introductory information panel and scanned a QR code to initiate the experience. Upon scanning, they were introduced to a digital character who served as a virtual guide throughout the space. The narrative was organized around four emotionally resonant themes—“Greeting,” “Playing Together,” “Receiving Comfort,” and “Resting Together”—each intentionally crafted to correspond with universal emotional experiences. These themes provided a conceptual scaffold through which the historical stone relics could be reinterpreted not simply as artifacts of the past, but as emotionally expressive mediators between heritage and the contemporary visitor.

Eight AR “experience spots” were strategically installed across the garden landscape, encouraging visitors to wander freely and engage with content in a non-linear, exploratory manner. Each location presented a distinct narrative and participatory task, including: (1) Memory Awakening, (2) Stone Fit, (3) Cosmic Journey, (4) Hide-and-Seek, (5) Blooming Garden, (6) Memories in Droplets, (7) Remembering Today, and (8) Stone Deco *(Seok-kku)*. These activities blended spatial storytelling with interactivity, reinforcing visitors’ sensory and cognitive engagement with the space.

Prior to beginning the journey, visitors completed a brief personality quiz designed to identify their emotional dispositions. Based on their results, each participant was matched with a personalized “guardian spirit” character, which served as a symbolic companion throughout the AR journey. This emotional alignment determined the user’s course, consisting of five to eight tailored experience spots. At each stop, visitors accessed content via QR code, completed short interactive missions, and earned digital stamps. Upon collecting all assigned stamps, participants were rewarded with a physical AR card, available at the museum’s main lobby information desk.

The entire design of the journey was grounded in narrative coherence and personalized interactivity. By layering digital storytelling over the physical museum environment and incorporating gamification techniques—such as task-based progression, affective messaging, and tangible incentives—the program fostered sustained attention, curiosity, and immersion. The reward card, beyond functioning as a commemorative token, served as a material bridge linking the digital experience with the museum’s spatial and institutional framework, reinforcing the interpretive impact of the exhibition.

Ultimately, the project succeeded in transforming the outdoor exhibition space into an emotionally rich, narrative-driven environment, where movement, decision-making, and interaction were integral to meaning-making. This reconfiguration of spatial engagement enabled visitors to construct personal interpretations of cultural heritage through embodied experience. Furthermore, the project's structural elements—modular storytelling, adaptive pathways, and hybrid physical-digital artifacts—offer replicable strategies for other cultural institutions aiming to enrich visitor experience through immersive AR design.

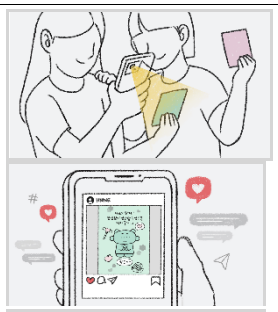
| | |
|---|---|
| **1. Content Awareness and Engagement**<br>Recognition of AR content via entrance signage and informational displays at the museum | **2. Experiencing AR Content**<br>Engagement with AR experiences introduced through the narrative on the entrance panel |
|  |  |
| **3. Reward Distribution**<br>Stamp collection through AR interaction and receipt of a physical AR card as a completion reward | **4. Online and Offline Dissemination**<br>Sharing digital content on social media and promoting offline engagement through the exchange of physical AR cards |
|  |  |

Table 2. AR Experience "*Seokshin Road*" Journey

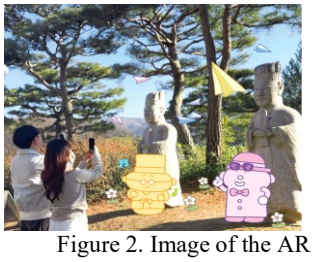



Figure 2. Image of the AR Experience '*Seokshin Road*'

### 3.3 Character Developmnet as Emotional Mediators

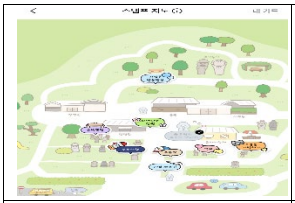
One of the core elements of the *Seokshin Road* AR content was the development of emotionally resonant characters that served as intermediaries between the audience and the stone artifacts. This strategy aimed to soften the traditionally solemn and distant image of stone relics, thereby enhancing accessibility and emotional engagement, particularly among younger audiences.

To achieve this, the project collaborated with a professional illustrator, “RomRom,” whose work is well-aligned with the sensibilities and aesthetic preferences of visitors in their twenties. Each character was carefully designed to reflect the symbolic meanings and formal features of specific stone artifacts. These characters were not mere visual representations; rather, they were reimagined through a contemporary lens, endowed with emotional narratives such as protection, encouragement, and healing—resonant with the broader “guardian spirit” concept that underpinned the content.

The character designs maintained visual and thematic consistency across the experience, while being tailored to the specific themes and locations of individual AR spots. This approach transformed each character into a narrative agent, contributing to a coherent and emotionally immersive storytelling environment throughout the museum garden.

Furthermore, the characters were implemented as AR elements within the mobile interface. They responded dynamically to user movement and offered simple interactive experiences, creating a bidirectional mode of engagement. As such, they functioned not merely as decorative visuals, but as essential narrative tools that facilitated user immersion, interaction, and emotional resonance.

By combining cultural heritage interpretation with contemporary visual culture and personalized emotional themes, the character development process substantially enriched the participatory experience. It contributed to the overall narrative cohesion and deepened the affective dimensions of museum engagement, particularly for digital-native audiences.



AR Experience Master Map

Characters Co-Developed with an Illustrator

### 3.4 Extending the Experience through Offline Integration

The *Seokshin Road* project aimed to transcend the boundaries of a purely digital experience by incorporating a reward-based system that linked online participation with offline engagement. This hybrid model was designed to enhance continuity in user experience and strengthen motivational factors for participation.

Visitors who completed the AR missions at designated “God Spots” collected digital stamps via the mobile web interface. Upon completing all tasks, they were eligible to receive a physical AR card as a reward, which could be claimed at the museum’s information desk located in the main lobby. This physical card functioned as a tangible representation of the visitor’s accomplishment, while simultaneously acting as a marketing tool to encourage further interest in museum content.

By directing participants to collect their reward at the information desk in the permanent exhibition area, the spatial design naturally guided them to engage with additional museum exhibits, thereby reinforcing the connection between digital interaction and traditional display formats.

The issuance of a physical AR card was also intended to ensure the sustainability of the program beyond the immediate visit. These cards extended the digital experience into the physical realm, enabling users to revisit their engagement through tangible keepsakes. Far from being mere souvenirs, the cards carried emotional and collectible value, deepening the user’s attachment to the content and institution.

Additionally, by encouraging visitors to share their digital outcomes—such as AR images and videos—on social media, the project facilitated organic online dissemination of museum content. This dual-channel approach expanded the public reach of the exhibition and promoted the museum’s role as a participatory cultural platform.

Through the integration of narrative, emotional design, and reward-based interactivity, *Seokshin Road* demonstrated a new model for extending museum engagement, one that bridges digital immersion with physical presence and personal memory.

Figure 3. AR Cards Image

### 3.5 Technical Implementation and Risk Mitigation

The technical infrastructure of *Seokshin Road* was designed to enable seamless AR experiences through a mobile web-based platform, eliminating the need for users to install additional applications. To enhance spatial precision between users and the stone artifacts, the system employed Visual Positioning System (VPS) technology. This allowed for high-accuracy mapping between physical space and digital content, thereby improving immersion and interaction fidelity within the museum’s outdoor setting.

To accommodate the varying performance levels of mobile devices, lightweight 3D assets and an optimized rendering environment were developed. A masking solution was also applied to each stone artifact to ensure accurate content alignment. These considerations enabled a consistent and responsive experience across a wide range of devices, including low-spec smartphones.

From an operational standpoint, an administrative dashboard was developed to collect and analyze real-time user data. This enabled museum staff to monitor visitor flow, measure

engagement levels at each AR checkpoint, and identify popular interaction zones. These insights were used not only to maintain system stability, but also to facilitate timely responses to user needs and to inform future content updates.

By combining robust technical design with responsive operational infrastructure, the project established a sustainable AR experience model. It also laid the groundwork for iterative improvements through user-driven analytics and real-time service monitoring, enhancing both the longevity and adaptability of the program.

Figure 4. Enhanced Recognition Accuracy through VPS Technology

## 4. Results and Discussion

This study presents an empirical case in which augmented reality (AR) technology was applied to an outdoor museum space to encourage voluntary visitor participation and emotional engagement. Through the development of immersive, narrative-driven content, the research examines the potential of digital technologies to enhance the interpretation and experiential value of cultural heritage.

By engaging young adults in the co-creation of the AR content *Seokshin Road*, the project highlights a shift from expert-driven to user-centered approaches in museum interpretation. The reimagining of traditional stone artifacts as guardian spirit characters—blending their original ritualistic functions with themes of emotional support and healing—demonstrates how reinterpretation can broaden the scope of meaning and deepen audience connection.

*Seokshin Road*, developed for the outdoor stone garden of the Cheongju National Museum, provided not only informational content but also an emotionally resonant, interactive experience. Its web-based AR platform, combined with VPS (Visual Positioning System) technology, enhanced both accessibility and spatial accuracy. The inclusion of user-friendly interfaces and gamified elements successfully increased visitor engagement and sustained attention throughout the museum visit. In particular, the physical AR reward cards distributed upon completion of all mission checkpoints extended the digital experience into the offline realm, supporting long-term recall and promotional diffusion.

Following its pilot on December 13, 2023, the *Seokshin Road* program was fully launched and operated throughout 2024, attracting 7,072 participants. Considering that the total number of educational program participants at the museum for the same year was 9,043, the program significantly contributed to increasing visitor participation. The project was particularly effective in transforming museum visits for teenagers and young adults into active cultural experiences, thereby underscoring the role of digital technologies—especially AR—in facilitating intergenerational engagement and expanding the museum’s public value.

The excellence of the project’s design and emotional engagement strategy was externally validated when *Seokshin Road* received the 2024 Red Dot Design Award in the Brand & Communication category. This recognition underscores the program’s creative integration of storytelling, spatial design, and digital interactivity, affirming its potential as a benchmark for experiential museum content.[3]

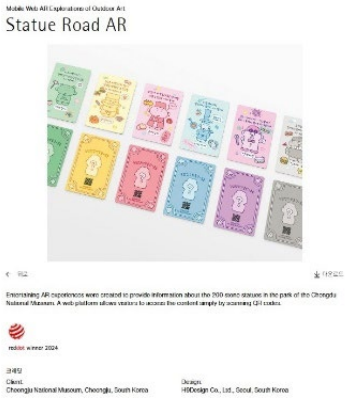



Figure 5. red dot winner 2024

However, several technical and operational limitations were also observed. Outdoor AR experiences are susceptible to environmental variables such as weather conditions and device specifications, which may affect consistency and quality. Moreover, if artifacts are relocated or rearranged, reprogramming of spatial coordinates is required, presenting challenges for long-term maintenance.

To address these issues, the study recommends establishing a sustainable content management system that includes continuous updates and feedback-driven customization. Additionally, incorporating real-time adaptive interfaces and visitor data analytics will further support responsiveness and content relevancy.

Ultimately, this study illustrates the potential of museums to evolve beyond static exhibition spaces into dynamic environments of interpretation and experience through digital technologies. The participatory AR content co-created with the younger generation affirms the museum’s role as a site of dialogue with the community and highlights a strategic model for enhancing both educational function and cultural inclusivity. This approach can serve as a valuable reference for museums seeking to redefine their exhibition paradigms in the digital age.

## 5. Conclusion

This study examined the design and implementation of *Seokshin Road,* an AR-based cultural heritage experience that blends spatial storytelling, emotional character design, and participatory interaction within an outdoor museum context. The project demonstrated how digital technologies can shift museum interpretation toward immersive, user-centered formats that resonate with younger audiences.

By involving young adults in content development and reinterpreting traditional artifacts through a contemporary lens,

[3] Red Dot Design Award
https://www.red-dot.org/ko/project/statue-road-ar-73273

the project redefined the visitor experience as both emotionally engaging and culturally informative. Technologically, the use of a mobile web platform, location-based VPS, and optimized 3D assets ensured broad accessibility and technical stability. The inclusion of physical AR cards helped extend the experience beyond the digital realm, enriching the museum's outreach.

Despite its successes, the project revealed operational limitations in maintaining outdoor AR content, particularly regarding environmental factors and the need for spatial recalibration. Addressing these challenges requires long-term strategic planning, infrastructure for maintenance, and adaptive content systems.

In conclusion, *Seokshin Road* offers a replicable model for integrating AR technology into cultural heritage interpretation. It highlights how museums can leverage digital tools to foster meaningful engagement, particularly among younger generations. This approach sets a precedent for inclusive, narrative-driven, and emotionally rich museum experiences that align with evolving public expectations in the digital era.

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